Making responsibility matter

MAKING RESPONSIBILITY MATTER

The Emergence of Responsible Innovation as an Intellectual Movement

Danielle Shanley

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Dissertation

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List of Acronyms and Abbreviations

4S – Society for Social Studies of Science
AAAS – American Association for the Advancement of Science
ACM – Association for Computing Machinery
ADS – Alternative Development Strategies
AI – Artificial Intelligence
AID – Agency for International Development
ANT – Actor Network Theory
AT – Appropriate Technology
ATI – Appropriate Technology International
BOP – Bottom of the Pyramid
BSSRS – British Society for Social Responsibility in Science
CARE – Committee for American Relief Everywhere
CAT – Center for Appropriate Technology
CDS – Conventional Development Strategies
CICAT – Center for International Cooperation and Appropriate
COSPEP – Committee on Public Engineering Policy
COSPUP – Committee on Science and Public Policy
CTA – Constructive Technology Assessment
EC – European Commission
ELSA – Ethical, Legal, and Social Aspects
ELSI – Ethical, Legal, and Social Implications
EPTA – European Parliamentary Technology Assessment Network
ERC – European Research Council
GE – General Electric Company
GMO – Genetically Modified Organism
GWU – George Washington University
IBM – International Business Machines Corporation
IIASA – International Institute for Applied Systems Analysis
IMAT – International Mechanism for Appropriate Technology
IRRPOS – Interdisciplinary Research Relevant to Problems of Our Society
ISTA – International Society of Technology Assessment
ITDG – Intermediate Technology Development Group
JRI – Journal of Responsible Innovation
LRS – Legislative Reference Service
LSE – London School of Economics
MASE – Mohawk Association of Science and Engineers
MIT – Massachusetts Institute of Technology
MOOC – Massive Open Online Course
NAS – National Academy of Sciences
NASA – National Aeronautics and Space Council
NATO – North Atlantic Treaty Organization
NCAT – National Center for Appropriate Technology
NCB – National Coal Board
NGO – Non-governmental Organization

NPSS – New Political Sociology of Science
NRA – National Rifle Association
NSF – National Science Foundation
OAT – Office of Appropriate Technology
OECD – Organization for Economic Cooperation and Development
OTA – Office of Technology Assessment
PSAC – President's Science Advisory Committee
R&D – Research and Development
R(R)I – Responsible (Research) and Innovation
RANN – Research Applied to National Needs
RI – Responsible Innovation
RRI – Responsible Research and Innovation
S.NET – Society for New and Emerging Technologies
SATIS – Socially Appropriate Technology Information System
SCOT – Social Construction of Technology
SHOT – Society for the History of Technology
SIM – Scientific/Intellectual Movement
SISCON – Campaign for Science in a Social Context
SPRD – Science Policy Research Division
SPRU – Science Policy Research Unit
SSK – Sociology of Scientific Knowledge
SSS – Journal for the Social Studies of Science
STS – Science and Technology Studies
SUV – Sport Utility Vehicle
T&SC – Technology and Social Change
TA – Technology Assessment
TOOL – Technische Ontwikkeling Ontwikkenlings Landen (Technical Development for Developing Countries)
TRANET – Transnational Network
TUB – Technical University of Berlin
U.S. – United States of America
UAV – Unmanned Aerial Vehicle
UK – United Kingdom
UN – United Nations
UNESCO – United Nations Educational, Science, and Cultural Organizations
VITA – Volunteers in Technical Assistance
VT – Video Tape

Chapter 1

Responsibility, Research, and Innovation

There's a classic example that's often used to engage students with the question as to whether or not technology has values. I remember discussing it when I was a student, and I've since discussed it with students of mine. It's a simple slogan and we've all heard it: "Guns don't kill people, people kill people". Initially popularized by the National Rifle Association (NRA) of the United States (U.S.), this maxim has been remarkably successful in framing the gun control debate, capturing the widely held belief that technology itself is value-neutral. Its persuasiveness lies in its commonsensical view of technology. Yet, as any good student will hopefully tell you, it is hardly a well-formulated argument. Like many technologies, guns change our relation to the world around us. They also have a specific materiality, in that they were designed with a specific purpose in mind—they therefore embody behavior-shaping values. And while it might be true that a gun could be used for purposes other than firing bullets; the shape, weight, and feel of a gun constrains which of those options it is possible to pursue. In this sense, the gun plays a role in the action we are likely to take by changing the way we relate to the environment. When I hold a gun, certain aspects of my experience are "amplified", while others are "reduced".[1]

As I was thinking about how I would write this introduction, I stumbled across a YouTube video, which repurposed the NRA's famous

[1] See Peter-Paul Verbeek, *Moralizing Technology* (Chicago: University of Chicago Press, 2011).

slogan.[2] The man on the stage started out in the familiar way: "They used to say guns don't kill people, people do". But then he continued, "Well, people don't. They get emotional, disobey orders, aim high. Let's watch the weapons make the decisions". A split-screen VT then appears on a large screen showing an underground parking garage from four different angles. Four men all dressed in black and seemingly unarmed, run towards a black SUV, two of them carrying large black duffle bags. Within seconds, the screen's hue turns red and we are shown from the drone's eye view that each of the four individuals has been identified as a target. Moments later, all of the men are dead. The man on the stage speaks over this final scene, "Now trust me, these were all bad guys," he tells a captivated audience reassuringly.

Fortunately, the seven-minute video that contains these scenes is not footage from a real product launch, but instead an arms-control advocacy video set in a dystopian future, with the slick production and quality of an episode of Black Mirror. The Slaughterbots video was originally released to coincide with the United Nations (UN) meeting on autonomous weapons in 2017. Perhaps unsurprisingly, the video caught the attention of the world's media and has since had around 75 million views. While there is much that can and has been said about the video, what struck me was the use of that slogan; that slogan which I had first heard unpacked as an undergraduate in a lecture hall. It made me think about how technological change, in this case the advent of artificial intelligence (AI), or more specifically, unmanned aerial vehicles (UAVs) or drones, often triggers us to reevaluate how we think about technology and social change. Whereas the success of the NRA's slogan relied on the assumption that only the human agent was capable of decision making—meaning that only people could be held responsible for killing people—the advent of AI means that now, we can potentially "watch the weapons makes the decisions".

In a world where weapons can make decisions, new questions arise about accountability and responsibility. Of course, new technologies often shape society in unexpected and unpredictable ways. Technological change refers to the wide range of effects which technology can have on society. As Benoît Godin writes, the vocabulary used to discuss technological change

[2] "Slaughterbots," Future Life Institute, accessed 6 April, 2022, https://www.youtube.com/watch?v=HipTO_7mUOw

therefore includes things like "social impacts, social implications and social consequences".[3] Today, for example, there is a great deal of speculation and discussion surrounding the potential impacts, implications, and consequences of AI. This means that talking about technological change often implies talking about what it means to develop technology *responsibly*. For example, when watching the Slaughterbots video, we are shown these small devices soaring over buildings and flying high up in the sky, bringing to mind the image of Icarus. In an effort to avoid the same fate, we typically try to anticipate or predict what sorts of impacts new technologies might have; we do so in the hope that providing *early warnings* might help mitigate against any potential costs or risks. We also try to imagine the potential impacts of new technologies. For example, one *unintended consequence* of the Slaughterbots becomes evident in a later scene in the video where we are shown a world within which the devices have become widely available and are being used to carry out acts of terrorism, just as easily as they were previously used in order to kill "the bad guys". Finally, new and emerging technologies also often require new forms of governance and *control*. So in the case of Slaughterbots, for example, if the weapons are now the decision-making agents, does that mean they should be granted legal personhood?

In his 2021 BBC Reith Lectures, Stuart Russell—also a member of the team behind the creation of Slaughterbots—suggested that AI might be "the biggest event in human history".[4] According to an Ipsos survey for the World Economic Forum published in January 2022, around 60% of adults agree that in the next 3-5 years, AI will profoundly change the way that they live their lives.[5] The survey unveiled a broad mix of positive feelings and concerns about AI's potential impact, demonstrating the ways in which technological change often polarizes opinion.

But as Melanie Mitchell rightly points out "overconfident predictions about AI are as old as the field itself".[6] Consider, for example, an exchange

[3] Benoît Godin, *The Invention of Technological Innovation: Languages, Discourses and Ideology in Historical Perspective* (Cheltenham: Elgar, 2019), 74.
[4] Stuart Russell, "The Biggest Event in Human History," BBC Reith Lectures, December 2021, accessed 6 April, 2022, https://www.bbc.co.uk/programmes/m001216j
[5] Joe Myers, "5 Charts that Show what People around the World Think about AI," *WeForum*, 5 January, 2022, accessed 6 April 2022, https://www.weforum.org/agenda/2022/01/artificial-intelligence-ai-technology-trust-survey/
[6] Melanie, Mitchell, "Why AI is Harder than we Think," *arXiv preprint* (2021): 2.

between Herbert Simon, Allen Newell, and Richard Bellman that illustrates the pervasiveness of projected impacts that circulate widely. At an address at the banquet of the twelfth national meeting of the Operations Research Society of America in November 1957, Simon presented a paper co-written with Newell within which they predicted that within ten years computers would, among other things, discover important mathematical theorems and write worthwhile music. They suggested that "intuition, insight, and learning" were no longer the "exclusive possession of humans" and that "any large high-speed computer" could be programmed to exhibit them just as well.[7] They concluded that their ability to do these things would continue to increase rapidly "until in a visible future the range of problems they can handle will be coextensive with the range to which the human mind has been applied".[8]

In response, Richard Bellman wrote that suggesting that machines could think, learn, and create "without a careful statement as to what is meant by these terms in connection with machines" was "irresponsible".[9] In Bellman's view their statements were "sensationalized" and contributed to the "mystification" of topics which were "too important to be obscured" in such a way.[10] But whereas Bellman saw their approach as cavalier, Simon and Newell argued that it was not *irresponsibility*, but instead "a sense of responsibility for alerting a broader scientific public to the social implications of research developments" that led them to make their predictions in the form that they did.[11] They refused to apologize for discharging what seemed to them "an important professional responsibility".[12]

It is worth pointing out at this stage that this is not a book about guns, drones or AI. In fact, it is not really about any specific technology at all. It is instead about how technological change triggers us to reevaluate what it means to develop new technologies *responsibly*. As Russell asks throughout his Reith Lectures on AI, "how can we get our relationship with it right?"[13] The

[7] Herbert A. Simon and Allen Newell, "Heuristic Problem Solving: The Next Advance in Operations Research," *Operations Research* 6, no. 1 (1958): 7.
[8] Ibid, 8.
[9] Richard Bellman, "On "Heuristic Problem Solving," by Simon and Newell," *Operations Research* 6, no. 3 (1958): 448.
[10] Ibid.
[11] Ibid.
[12] Ibid, 449.
[13] Russell, "Biggest Event in Human History."

exchange outlined above gives a good indication as to the historical depth of discussions and debates concerning responsibility in relation to technological change. Yet around the turn of the millennium, as responsibility became an increasingly important concept in relation to research and innovation within both policy and academic discourse, responsibility was largely framed as a new and emerging matter of concern.

What the Simon, Newell, Bellman exchange illustrates is the extent to which responsibility has meant different things to different people for a very long time. This would seem to suggest that contemporary ideas surrounding responsibility within research and innovation did not emerge out of nowhere; rather, they are part of a long history within which different ways of understanding responsibility have been *made* to matter. For example, early warnings, unintended consequences, and control are just some of the ways in which responsibility matters when it comes to talking about research and innovation—or more broadly, technological change. The question I am interested in is therefore within discourses surrounding research and innovation, *how have different ideas about responsibility been made to matter*?

Thinking about how and why responsibility matters may seem rather straightforward. As Heather Douglas wrote, "There are two general bases for moral responsibilities in modern life: there are the general moral responsibilities that each of us holds as humans/full moral agents and there are the role responsibilities that arise from our taking on particular positions in society".[14] So for example, as a moral agent, I might have a range of general responsibilities such as to be a good person, a good friend, or a good daughter. As a scholar, I then have specific role responsibilities, regarding how I conduct research or how I engage with my students. In what follows however, what I want to try to understand is how different responsibilities have been *made to matter* when it comes to thinking about research and innovation. This means looking at moments, interactions, or performances, *through* which the process of making responsibility matter—or *matter-ing*—has taken place.

Prompted by Karen Barad's notion that "The world is an ongoing open process of mattering", John Law helpfully unpacks the processes

[14] Heather E. Douglas, "The Moral Responsibilities of Scientists (Tensions between Autonomy and Responsibility)," *American Philosophical Quarterly* 40, no. 1 (2003): 60.

through which matter-ing takes place.[15] First, Law suggests, matter-ing collapses the distinction between facts and values—that separates off "matters of fact" from "matters of concern" and "matters of care".[16] Instead of seeing these as solid, pre-existing categories along which labor and resources, for example, might be divided, thinking about matter-ing merges these domains and asks how it is that differences between them are *made* to matter. Second, matter-ing marks a shift away from stability towards "things in process", where instead of seeing categories like "meaning" and "matter" as separable, the emphasis is placed upon processes in and through which divisions are *made*. Third, thinking about matter-ing as a process means thinking about how things are made to matter in practice. As Law points out, Karen Barad, Bruno Latour, and Annemarie Mol are amongst a number of writers who have emphasized the extent to which the world is in a constant state of being enacted. Focusing on enactment draws attention to the conditions within which "choices" become visible and to the ways in which decisions are made. As Law writes, "Making facts is making values is making arrangements that are in one way or another political".[17] All of this is to say that whatever may seem readily apparent, natural, or as a matter of fact, has in one way or another *been made to matter*—and how we think about responsibility in relation to research and innovation is no exception.

I used the example of AI to demonstrate how technological change can trigger us to reevaluate how and in what ways responsibility matters. Crucially, technological change can be used to refer both to the *process* leading to a technological change—including both research *and* innovation—as well as the range of *societal impacts* which technological change generates. Of course, understandings of technological change as a sequential process that begins with "basic" or "pure" research and results in the commercialization of inventions are not natural or self-evident either; yet they have been influential, and widely natural-ized, since at least the 1940s. Godin has traced,

[15] Karen Barad, "Posthumanist Performativity: Toward an Understanding of how Matter comes to Matter," *Signs: Journal of women in culture and society* 28, no. 3 (2003): 817.
[16] On "matters of concern" see Bruno Latour, "Why has Critique Run out of Steam? From Matters of Fact to Matters of Concern." *Critical inquiry* 30, no. 2 (2004): 225-248; and on "matters of care" see Maria Puig de La Bellacasa, *Matters of Care: Speculative Ethics in more than Human Worlds* (Minneapolis: University of Minnesota Press, 2017).
[17] John Law, "Matter-ing: Or How Might STS Contribute?" *Centre for Science Studies, Lancaster University, June, 2004, 2, accessed 6 April, 2022, http://www. heterogeneities. net/publications/Law2009TheGreer-BushTest. pdf*

for example, the roots of the so-called "linear model of innovation" to the ideas of Rupert Maclaurin, whose involvement is evident in Vannevar Bush's famous 1945 report *Science: The Endless Frontier*.[18]

In the 1950s and 1960s, building on the work of economists like Maclaurin, sociologists started thinking seriously about technological change; in particular, about whether and to what extent technology could be forecasted, planned or controlled. Their focus was not on what caused a specific technology to change, but rather in how social changes were produced by particular technologies.[19] As I will discuss in the following chapters, by the late 1960s, approaches such as technology assessment (TA) emerged as a means to evaluate the potential impacts of technological change and new academic programs, such as the Harvard program on 'Technology and Society', explored the role of values in guiding technological choices. As a result, through the course of the 1960s and 1970s 'technology and social change' and 'technology and society' rapidly rose "from academic obscurity to command broad public attention".[20]

Today, we think about how responsibility matters with regards to both the *processes* and *societal impacts* of technological change. Within the research system, codes of conduct and ethics committees have become commonplace.[21] So too have a number of research funding criteria: for example, researchers are regularly required to include an interdisciplinary perspective in their problem framing; to demonstrate the anticipated impact of their research; to engage with and include diverse stakeholders throughout the research and development (R&D) process; and to attain some form of ethical clearance. Research funding is also often organized around particular themes or focus areas, such as the UN's sustainable development goals. Today, all of these efforts are broadly captured under the banner of *responsible innovation*.

[18] Benoît Godin, "The Linear Model of Innovation: The Historical Construction of an Analytical Framework," *Science, Technology, & Human Values* 31, no. 6 (2006): 639-667.
[19] Benoît Godin, "In the Shadow of Schumpeter: W. Rupert Maclaurin and the Study of Technological Innovation," *Minerva* 46, no. 3 (2008): 343-360.
[20] Eric Schatzberg, *Technology: Critical History of a Concept* (Chicago: University of Chicago Press, 2018), 215.
[21] See e.g. Noortje Jacobs excellent PhD thesis which examines the rise of ethics committees in the Netherlands. Noortje Jacobs, Ethics by Committee: Governing Human Experimentation in the Netherlands 1945-2000, *Maastricht University*, 2018, https://cris.maastrichtuniversity.nl/en/publications/ethics-by-committee-governing-human-experimentation-in-the-nether

Introducing R(R)I

Since around 2010, "Responsible Innovation" (RI) and "Responsible Research and Innovation" (RRI) have become popular ways of framing responsibility-related issues for academics and policy-makers alike.[22] Internationally, these discourses have gained considerable traction over the last decade. For example, Research Councils in the Netherlands, the UK, and Norway implemented or expanded their own RI programs and policies. In the U.S., the National Science Foundation (NSF) provided funding for a global, Virtual Institute for RI that was established in 2013 and in 2014, a new *Journal in Responsible Innovation* was launched.[23] As a result, a plethora of meetings, research groups, projects and networks have addressed the conceptualization and institutionalization of RI/RRI.

While the terms RI and RRI emerged in parallel, they are nonetheless considered to be different things.[24] Whereas RI typically refers to an academic discourse which attempts to "open up technovisionary science and innovation, creating spaces for discussion, analysis, debate… aiming to provide a measure of 'social agency in technological choices"', RRI represents a specific policy artefact with its roots in the Science in Society program at the European Commission (EC).[25] Not intending to undermine the

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[22] For authoritative introductions and broad overviews of the discourse see: Jonny Hankins, *A Handbook of Responsible Innovation* (Giannino Bassetti Foundation: 2012); Richard Owen, John R. Bessant, and Maggy Heintz, eds. *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society* (Chichester: John Wiley & Sons, 2013); Jeroen van den Hoven, Neelke Doorn, Tsjalling Swierstra, Bert-Jaap Koops, Henny Romijn, eds. *Responsible Innovation 1: Innovative Solutions for Global Issues* (Dordrecht: Springer, 2014); Bert-Jaap Koops, Ilse Oosterlaken, Henny Romijn, Tsjalling Swierstra, Jeroen van den Hoven, eds. *Responsible Innovation 2: Concepts, Approaches, and Applications* (Dordrecht: Springer, 2015); Robert Gianni, *Responsibility and Freedom: The Ethical Realm of RRI* (Chichester: John Wiley & Sons, 2016); Konstantinos Iatridis and Doris Schroeder, *Responsible Research and Innovation in Industry*: *The Case for Corporate Responsibility Tools* (Dordrecht: Springer 2016); Lotte Asveld, Rietje van Dam-Mieras, Tsjalling Swierstra, Saskia Lavrijssen, Kees Linse, Jeroen van den Hoven, eds. *Responsible Innovation 3: A European Agenda? (*Dordrecht: Springer, 2017); and René Von Schomberg and Jonathan Hankins, eds. *International Handbook on Responsible Innovation: A Global Resource* (Cheltenham: Elgar, 2019).

[23] For a recent overview of these developments see: Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey? Reflections on a Decade of Responsible Research and Innovation," *Journal of Responsible Innovation* 8, no. 2 (2021): 217-233.

[24] Richard Owen and Mario Pansera, "Responsible Innovation and Responsible Research and Innovation," in *Handbook on Science and Public Policy*, eds. Dagmar Simon, Stefan Kuhlmann, Julia Stamm, Weert Canzler (Cheltenham: Elgar, 2019), 26-49.

[25] Richard Owen and Mario Pansera, "Responsible Innovation: Process and Politics," in *International Handbook on Responsible Innovation*, eds. René von Schomberg and Jonathan Hankins (Cheltenham: Elgar, 2019), 39. For an overview of the emergence of RRI within the EC context, see: Stevienna de Saille,

importance or weight of this distinction, I follow Mareike Smolka by referring to the two together using the acronym R(R)I.[26] This is so as to highlight the somewhat porous boundary that exists between them in terms of the ideas, people, institutions and resources which have formed the basis of an international network in recent years. While recognizing that differences do exist, I think few would deny that the significant amount of funding provided by the EC's support of R(R)I in Horizon2020—its flagship research funding program—helped to catalyze the creation of a community of scholars who today straddle the boundary between RI and RRI.

With regards to R(R)I's intellectual underpinnings as an academic discourse, scholars from a variety of disciplines, such as economics, philosophy, sociology, and media studies, to name but a few, have contributed to its development over the years. Arguably, the greatest contribution may have come from science and technology studies (STS) scholars, or at least scholars who would at least partially identify with the field. The motivations of R(R)I intersect with a number of key concerns within STS, such as understanding the complex trajectories and societal dimensions of technologies, examining and anticipating the potential impacts of emerging technologies, promoting the importance of interdisciplinary collaboration, and prioritizing the inclusion of and engagement with diverse stakeholders throughout the process of research and innovation. As a result, the relationship between STS and R(R)I will be an ongoing theme throughout this book.

René von Schomberg suggests that RRI should be related to two issues, namely: "Can we define the right outcomes and impacts of research and innovation?" and "Can we subsequently be successful in directing innovation toward these outcomes if we would agree upon them?"[27] He then provides the following much-cited definition

"Innovating Innovation Policy: the Emergence of 'Responsible Research and Innovation'," *Journal of Responsible Innovation* 2, no. 2 (2015): 152-168.

[26] Mareike Smolka, "Generative Critique in Interdisciplinary Collaborations: From Critique in and of the Neurosciences to Socio-Technical Integration Research as a Practice of Critique in R(R)I," *Nanoethics* 14, no. 1 (2020): 1-19.

[27] René von Schomberg, "A Vision of Responsible Innovation," in *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, eds. Richard Owen, Maggy Heintz, and John R. Bessant (Chichester: John Wiley & Sons), 51-71.

> Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).[28]

Note that here R(R)I is both *process* oriented and focused upon the realization of desirable *societal outcomes*. Similarly, Jack Stilgoe, Richard Owen, and Phil Macnaghten suggest, "Responsible innovation means taking care of the future through collective stewardship of science and innovation in the present".[29] They go on to outline four "dimensions of R(R)I": "anticipation", "reflexivity", "inclusion" and "responsiveness".[30] Based on these definitions it is clear that R(R)I broadly reflects valuable and worthy ambitions which are difficult to be against—as some have rightly asked, who could possibly be for *irresponsible* innovation?[31] Yet at the same time, these ambitions also reflect a particular set of concerns.

As suggested earlier, since the early 2000s, R(R)I has been framed as a novel approach, despite occasional gestures to its "foundations and heuristics" extending back many decades.[32] In the first editorial of the *Journal of Responsible Innovation* (JRI), for example, R(R)I was described as an "heir to earlier endeavors", such as "technology assessment, the economic productivity of research, research ethics, engineering ethics, and the ethical, legal, and social implication of research".[33] Across the literature, other notable predecessors include risk assessment, environment and sustainability assessment, constructive and real-time technology assessment, bioethics, anticipatory governance, upstream public engagement, and social

[28] Ibid, 19.
[29] Jack Stilgoe, Richard Owen, and Phil Macnaghten, "Developing a Framework for Responsible Innovation," *Research Policy* 42, no. 9 (2013): 1570.
[30] Ibid, 1571-1572.
[31] See e.g. René von Schomberg, "A Vision of Responsible Innovation."
[32] Richard Owen and Mario Pansera, "Responsible Innovation: Process and Politics," 37-39.
[33] David H. Guston, Erik Fisher, Armin Grunwald, Richard Owen, Tsjalling Swierstra, and Simone Van der Burg, "Responsible Innovation: Motivations for a New Journal," *Journal of Responsible Innovation* 1, no. 1 (2014): 2.

innovation.[34] Given its long and heterogeneous history some have asked, somewhat provocatively, whether R(R)I is simply "new wine in old bottles".[35]

Such critiques notwithstanding, today, R(R)I is one of the most prominent frameworks for describing and prescribing the relationship between society and technology.[36] As the Simon, Newell, Bellman exchange makes clear however, responsibility has long been a matter of concern when it comes to thinking about new and emerging technologies; as well as the individual responsibility of scientists towards society. Indeed, much like R(R)I, previous approaches and methods were also historically rooted in "visions of how science and society (ought to) relate", and thus the web of evolving influence extends back into distant history.[37] Yet, surprisingly, the ways in which *specific* earlier debates – as opposed to generic references to earlier movements – potentially shaped R(R)I have been largely overlooked.

It is important to recognize that as a way of envisioning responsibility, R(R)I was not always already a matter of concern for academics and policy-makers. Rather, R(R)I came into being in a historically specific process that was shaped by multiple forebears, including but not limited to those mentioned above. As a result, there is not one single origin story of R(R)I. Instead, its history is a collection of the people, places, and practices, through which ideas about responsibility have been enacted over time. Paying attention to how different visions of responsibility have been made to matter, at different times, in different places reminds us that R(R)I *could have been otherwise*. History is therefore an important lens through which we can try to understand how and why particular visions of responsibility have come in and out of focus over time.

So far, I have suggested that the treatment of R(R)I's historical antecedents has been minimal. At the same time, I have highlighted several

[34] See e.g. Barbara E. Ribeiro, Robert DJ Smith, and Kate Millar, "A Mobilising Concept? Unpacking Academic Representations of Responsible Research and Innovation," *Science and Engineering Ethics* 23, no. 1 (2017): 81-103.

[35] See e.g. Robert Frodeman, "International Handbook on Responsible Innovation. A Global Resource," *Journal of Responsible Innovation* 6, no. 2 (2019, 255-257.

[36] Job Timmermans, "Mapping the RRI Landscape: An Overview of Organisations, Projects, Persons, Areas and Topics," in *Responsible Innovation 3*, edited by Lotte Asveld, Rietje van Dam-Mieras, Tsjalling Swierstra, Saskia Lavrijssen, Kees Linse, Jeroen van den Hoven (Dordrecht: Springer, 2017), 21-47.

[37] David H. Guston, Erik Fisher, Armin Grunwald, Richard Owen, Tsjalling Swierstra, and Simone Van der Burg, "Responsible Innovation: Motivations," 2.

intellectual frameworks and policy programs with which R(R)I is considered to have a shared heritage. An important question is therefore: *which histories have been made to matter within the discourse of R(R)I, and how*? One very straightforward answer to that question might be not many—at least, not to any great extent. As I have written about elsewhere, despite R(R)I holding up reflexivity as a key pillar which provides "a mirror to one's own activities, commitments and assumptions", there has been little reflexivity to date about how actors in the field *arrived* at those commitments and assumptions—which is a necessary step in fulfilling the reflexivity requirement.[38] As Cyrus Mody has suggested, it is for this reason that R(R)I appears to have "an impoverished sense of its own history".[39] For while many do acknowledge that R(R)I's history stretches beyond the turn of the millennium, brief and potted histories of the field have become commonplace. As Mody notes, though these accounts are "correct as far as they go", they typically ignore "several decades of moves toward *and away from* something like responsible R&D".[40] Instead, these potted histories help to support a particular version of R(R)I's development, one that is decidedly linear and at least moderately triumphalist; in other words, a "folk history" of R(R)I.

R(R)I's Folk History

Inspired by Arie Rip's notion of "folk theories"—which describes the ways in which scientists sometimes mobilize unexamined, uncritically accepted, or superficially plausible ideas in order to explain or promote new ideas—I mean to suggest that folk histories similarly rely on existing narratives, which are rarely checked for historical accuracy, instead being taken up and appropriated until they are accepted and no longer thought to be in need of questioning.[41] These historical narratives then evolve into repertoires which

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[38] Jack Stilgoe, Richard Owen, and Phil Macnaghten, "Developing a Framework for Responsible Innovation," 1571, cited in Danielle Shanley, "Imagining the Future through Revisiting the Past: the Value of History in Thinking about R(R)I's Possible Future(s)," *Journal of Responsible Innovation* 8, no. 2 (2021): 235.
[39] Cyrus Mody, *The Squares: US Physical and Engineering Scientists in the Long 1970s* (Cambridge: MIT Press, 2022), 318.
[40] Ibid.
[41] Arie Rip, "Folk Theories of Nanotechnologists," *Science as Culture* 15, no. 4 (2006): 349-365.

can be adapted and developed depending upon how and when they are used and by whom.

I first became aware of R(R)I's folk histories at the start of my PhD, while conducting what Pnina Abir-Am refers to as "historical ethnography".[42] During the first stage of my research, I immersed myself in the R(R)I community, paying particular attention to moments of historical construction, be they in handbooks and journal entries, or at workshops and conferences. My goal was to get an understanding of how people made use of history within the context of R(R)I. What I noticed was that depending on the context and audience, specific controversies relating to technological change (e.g. the anti-nuclear movement; the human genome project; mad cow disease; or nanotechnology), or specific scientific/intellectual developments (e.g. science and technology studies; technology assessment; or ethical, legal, and social implications research) were emphasized for having brought to light how, why, and in what way(s) different ideas about responsibility mattered. In this sense, the purpose of R(R)I's folk histories appears to have been largely to help legitimize the need for R(R)I, while also facilitating community building around common historical anchor points.

A common starting point for R(R)I's folk history is the creation of the Office of Technology Assessment (OTA) in the U.S. in 1972. Technology assessment (TA)—as practiced at the OTA—is typically considered to have been the first systematic attempt to influence policy decisions by assessing the potential impacts of new technologies. Through the course of the 1980s, a number of approaches, such as constructive technology assessment (CTA), broadened the approach of so-called "classical" TA to try to address societal issues within the design process itself. Subsequent discourses considered relevant to the evolution of R(R)I are often traced in relation to a number of emerging technologies, such as "genetically modified organisms [GMOs] and synthetic biology, information and communication technology, robotics and geoengineering".[43] For example, research into the ethical, legal, and social

[42] Pnina Abir-Am, "A Historical Ethnography of a Scientific Anniversary in Molecular Biology: The First Protein X-ray Photograph (1984, 1934)," *Social Epistemology: A Journal of Knowledge, Culture and Policy* 6, no. 4 (1992): 323-354. See also Barbara Frankel & Pnina Abir-Am, "Historical Ethnography as a Way of Knowing (with Response)," *Social Epistemology: A Journal of Knowledge, Culture and Policy* 6, no. 4 (1992): 355-364.

[43] David H. Guston, Erik Fisher, Armin Grunwald, Richard Owen, Tsjalling Swierstra, and Simone Van der Burg, "Responsible Innovation: Motivations for a New Journal," 2.

implications (ELSI) or aspects (ELSA) of genetics was originally developed in the context of the Human Genome Project in the U.S. in 1990—from where it was subsequently taken up across much of Europe. The "Elsification" of research soon referred to the integration of societal research within large-scale techno-science programs.[44]

According to Owen, von Schomberg, and Macnaghten, through the course of the 1990s and early 2000s, various experiments built on the CTA/ELSI/ELSA legacy, demonstrating the desire to democratize research and innovation through different forms of public engagement. The social sciences also started to play an increasing role in technological governance, as privacy and autonomy came to be seen as important values within technological design and development. With regards to R(R)I specifically, the emergence of nanoscience and nanotechnology played a particularly critical role in the shift towards a language of responsibility, in that several national programs explicitly used the language of "responsible development".[45] The EC also introduced a "Code of Conduct for Responsible Nanosciences and Nanotechnologies Research" through which responsibility began to explicitly "permeate the science and society policy lexicon".[46]

A workshop in Brussels in 2011 marked the evolution from responsible development to R(R)I. Though few of the delegates (most of whom were academics and science policy officials) were aware of the term at the start, by the workshop's end they asserted that R(R)I was "a moral imperative: environmentally protective, answering social needs, demonstrating shared

[44] See in particular Hub Zwart, Laurens Landeweerd, and Arjan Van Rooij, "Adapt or Perish? Assessing the Recent Shift in the European Research Funding Arena from 'ELSA' to 'RRI'," *Life Sciences, Society and Policy* 10, no. 1 (2014): 1-19; and Hub Zwart and Annemiek Nelis, "What is ELSA Genomics?" *EMBO reports* 10, no. 6 (2009): 540-544. For the full debate on the relationship between ELSI/ELSA and R(R)I see ELSA and RRI of Life Sciences, Society and Policy, 2015: Ellen-Marie Forsberg, "ELSA and RRI – Editorial," *Life Sciences, Society and Policy* 11, no. 2 (2015), 1-3.

[45] For an overview of the development of R(R)I in relation to nanoscience and nanotechnology see Clare Shelley-Egan, Diana M. Bowman, and Douglas K. Robinson, "Devices of Responsibility: Over a Decade of Responsible Research and Innovation Initiatives for Nanotechnologies," *Science and Engineering Ethics* 24, no. 6 (2018): 1719-1746; and Sally Randles, Jan Youtie, David H. Guston, Barbara Hawthorn, Chris Newfield, Philip Shapira, Fern Wickson, Arie Rip, René von Schomberg, and Nicholas Frank Pidgeon, "A Trans-Atlantic Conversation on Responsible Innovation and Responsible Governance," in *Little by Little: Expansions of Nanoscience and Emerging Technologies*, edited by Harro Van Lente, Christopher Coenen, Torsten Fleischer, Kornelia Konrad, Lotte Krabbenborg, Colin Milburn, François Thoreau, and Torben B. Zülsdorf (Amsterdam: IOS Press, 2012): 169-180.

[46] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey," 7.

European values and beneficial to the widest range of actors".[47] Within a couple of years, R(R)I as an idea was on the move; being bolstered by a €462 million budget for the Science with and for Society unit (SWafS) of the EC, which funded some 150 R(R)I projects by 2020.[48] Certainly when I started this research towards the end of 2017, R(R)I's momentum showed little sign of slowing down.

Yet despite the relatively quick uptake, it wasn't long before there was a sense that R(R)I's initial ambitious vision was being lost. Within the EC, R(R)I was operationalized through a set of 6 keys, which many saw as a way of interpreting R(R)I as a means through which to improve upon "business as usual".[49] There was a sense that the drive towards reframing and reconfiguring innovation and innovation systems "in mutually responsive, inclusive and ethically sensitive ways towards societal challenges" may have been "a bridge too far".[50] In the EC's next framework program, Horizon Europe, SWafS was dismantled and along with it R(R)I lost the cross-cutting position it previously held. The "golden age of RRI" appeared to be over.[51] As we entered the 2020s, a series of seminars, workshops, and a special issue of JRI, asked what R(R)I's possible future(s) might hold in store.

What I have provided here in a few short paragraphs is a version of R(R)I's folk history as it is often re-told; and while as suggested by Mody, this narrative is correct in as far as it goes, it implies an "evolutionary characteristic" to R(R)I, which suggests that each successive development improved upon what went before. Folk histories—like this one—chart a selection of key developments and provide some sort of context and justification for R(R)I's emergence, yet they are typically non-reflexive and overtly simplified. Admittedly, any history of R(R)I will necessarily be partial and selective; yet crucially, these sorts of accounts fail to provide any critical reflection on how R(R)I could have potentially been otherwise. As Melvin Kranzberg explains, historians interested in the development of science and

[47] de Saille, "Innovating Innovation Policy," 157.
[48] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey," 7.
[49] de Saille, "Innovating Innovation Policy," 157.
[50] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey," 7.
[51] Erik Fisher, "RRI Futures: Ends and Beginnings," *Journal of Responsible Innovation* 8, no. 2 (2021): 135.

technology need to begin with the question, "How did things get to be the way they are?"[52]

In the case of R(R)I, in order to try and provide some sort of answer to this question, I follow Law in thinking about matter-ing as a dynamic and active process. I will ask *how* responsibility has been *made* to matter at different times and in different places. I'll also ask how the ways in which responsibility mattered in one place potentially shaped how it mattered in another place and, how different ideas about responsibility travelled and were taken up (or not) in different contexts. Before I dive in, however, I will first use the remainder of this introductory chapter to reflect on the what, why, and how questions, that is: what is the history of R(R)I a history of? Why do we need a history of R(R)I? And, how to do a history of R(R)I? I will also provide a brief overview of the chapters of this book, answering the when, where, and who questions that remain.

What is a History of R(R)I a History of?

R(R)I has been called an umbrella term, a body of thought, a sub-field, a boundary object, a bubble, a community, a paradigm, a normative project, and a bandwagon. All of which raises the question, what kind of history am I actually doing here? Applying any one of these labels would result in a potentially different history being told. But like any research, doing historical research means making choices, in the knowledge that these choices will have practical ramifications for the ways in which histories get researched and written.

Based on my ethnographic experiences in and around R(R)I, I define R(R)I as a scientific/intellectual movement (SIM). In line with Miles Brundage and David Guston's findings, I too found that "many of the hallmarks of a SIM can be seen in the communities invoking, theorizing and

[52] And then, as educators, Kranzberg continues, we ask a second question: "What do we intend to do about it? Melvin Kranzberg, "The Uses of History in Studies of Science, Technology & Society," *Bulletin of Science, Technology & Society* 10, no. 1 (1990): 6.

enacting RI".[53] Scott Frickel and Neil Gross outline a number of commonalities among diverse and disparate SIMs. They suggest that SIMs typically have some sort of coherent intellectual program; reflect a degree of contention; are inherently political; require collective action; are episodic; and can range in intellectual scope from ambitious to modest, progressive to reactionary.[54] In that Frickel and Gross largely concentrate on how movements emerge, consolidate, and develop, treating R(R)I as an intellectual movement allows me to zoom in on antecedent movements, tracing some of the factors which allowed them to "emerge, gain prestige, and achieve some level of institutional stability".[55] These factors include the actions of movement intellectuals; the existence of appropriate structural conditions; the creation of micro-mobilization contexts; as well as the framing of movement ideas.

According to the editors of JRI, R(R)I represented a new intellectual program. Insofar as that program was inherently normative, it was undoubtedly also both contentious and political. R(R)I also involved the reconfiguration of positions—demonstrable through the career paths of movement intellectuals; as well as competition for scarce resources—as in both the national and European funding programs outlined above. The growth and development of R(R)I required spatial, temporal, and social coordination, which was made possible through the establishment of journals, centers, conferences, and networks. That R(R)I was supported and nurtured within the context of Horizon2020, before being somewhat left out in the cold within Horizon Europe, also suggests that R(R)I may have been somewhat episodic. As Frickel and Gross note, the "birth of a SIM often is marked by the announcement of a bold new intellectual program, and its death either by the effective disappearance of the movement from the intellectual scene or by its transformation into a more stable institutionalized form such as a school of thought, subfield, or discipline".[56]

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[53] Miles Brundage and David H. Guston, "Understanding the Movement (s) for Responsible Innovation," in *International Handbook on Responsible Innovation*, eds. René von Schomberg and Jonathan Hankins (Cheltenham: Elgar, 2019), 118.
[54] Scott Frickel and Neil Gross, "A General Theory of Scientific/Intellectual Movements," *American Sociological Review* 70, no. 2 (2005): 204-232.
[55] Ibid, 204.
[56] Ibid, 208.

In relation to my overarching question, regarding how different conceptions of responsibility have been made to matter, I am not only interested in how R(R)I's antecedents emerged and developed, but also in their impacts or effects over time—that is, to what extent can we say that they transformed into more stable institutionalized forms? According to social movement theorists, there are four kinds of external impacts a social movement can have: *procedural* (changes to rules, laws, or policies), *substantive* (changes to the material environment), *structural* (changes in institutional structures), and *sensitizing* (changes to the political agenda and/or public attitudes).[57] However, these impacts are tied to an understanding of social movements as dependent on traditional repertories of action (e.g. street protests, demonstrations, boycotts etc.).

As we will see, because intellectual movements are typically deeply embedded within institutions right from the start, they rarely involve contentious tactics such as protests or boycotts. Whereas much social movement research centers on "overt" movements, understanding the dynamics of intellectual movements, like R(R)I, involves looking at "less obvious and in your face forms of mobilization".[58] In this sense, R(R)I—and its antecedents—are more akin to "covert" movements, which as Mayer Zald and Michael Lounsbury point out, are "more likely to germinate in communities of expertise that shroud change efforts in discourses of technique and formal rationality".[59] As movements that arise within institutions, intellectual movements can also mobilize both insiders and outsiders, drawing upon a variety of institutional actors "using established networks and resources to diffuse alternative practices, and drawing effectively on existing institutional elements and models to craft new systems".[60]

[57] See Marco Giugni, "Outcomes of New Social Movements," in *New Social Movements in Western Europe,* eds. Hanspeter Kriesi, Ruud Koopmans, Jan Willem Duyvendak, and Marco Giugni (Minneapolis: University of Minnesota Press, 2019); and Hein-Anton Van der Heijden, "Environmental Movements, Ecological Modernisation and Political Opportunity Structures," *Environmental Politics* 8, no. 1 (1999): 199-221.
[58] Mayer N. Zald and Michael Lounsbury, "The Wizards of Oz: Towards an Institutional Approach to Elites, Expertise and Command Posts," *Organization Studies* 31, no. 7 (2010): 982.
[59] Ibid.
[60] Marc Schneiberg and Michael Lounsbury, "Social Movements and the Dynamics of Institutions and Organizations," in *The Sage Handbook of Organizational Institutionalism,* ed. Royston Greenwood, Christine Oliver, Thomas B. Lawrence & Renate E. Meyer (London: Sage Publications, 2017): 288.

In order to think about the outcomes and consequences of intellectual movements, I will therefore draw upon the ideas of institutional scholars who have focused on how "new organizations gain legitimacy, persuade field-level audiences to offer their endorsement, and or/encourage other organizations to adopt the change, yet without open conflict".[61] I will explore the extent to which intellectual movements might play a role in the production of unintended trajectories of change, through "reconfiguration, recombination or layering".[62] Given that all movements leave legacies and evidence of paths not taken, it is important to consider how legacies of previous intellectual movements may serve as resources and infrastructures for intellectual movements in the future, particularly in my case, from the perspective of R(R)I today.

In this section, I have established that the histories which I have traced are histories of R(R)I as an intellectual movement and I've made clear that what I'll be looking at is the emergence, development, outcomes and consequences of antecedent movements on ideas that are today encapsulated under the banner of R(R)I. In the next section, I'll turn to the important question as to why R(R)I actors, or anyone else for that matter, should be interested in histories of R(R)I at all; essentially, why *should* history matter to R(R)I?

Why Do We Need Histories of R(R)I?

Law explains three "modes of matter-ing" which are particularly familiar to scholars in STS: critique, puzzle-solving, and balance. Each of these, he suggests, speaks to an absence—"the absence of good values for critique; the absence of just the right piece needed to solve the problem in the case of technical puzzle-solving; or the absence of an overall view in the case of balance".[63] While Law admits that this list is only partial and somewhat arbitrary, I would add that another crucial mode of matter-ing within STS, in addition to making critiques; solving puzzles; or playing at balancing; is *providing context*. Situating knowledge practices in specific times and places,

[61] Evelyn Micelotta, Michael Lounsbury, and Royston Greenwood, "Pathways of Institutional Change: An Integrative Review and Research Agenda," *Journal of Management* 43, no. 6 (2017): 1892.
[62] Ibid.
[63] John Law, "Matter-ing," 5.

drawing attention to the contingent nature of knowledge production is a crucial part of thinking and doing in STS; and when providing context: *history matters*.

Numerous books and articles have made the case for why history matters far more extensively than I intend to.[64] What I will make the case for here, is why history matters for R(R)I. First of all, as we have seen, R(R)I's folk histories typically have a somewhat whiggish character—presenting the emergence of R(R)I as the logical outcome of prior developments. Within the literature, history is often used to support programmatic overviews of R(R)I, providing a neat frame of reference for how things came to be in the present. From this point of view, R(R)I is seen as an inevitable product of the past which is built upon the ground laid by inherently inferior antecedents. However, this sort of triumphalism ignores that history is nonlinear and that R(R)I *could have been otherwise*. Whereas, R(R)I's linear folk histories give the impression that the wheels of history move only in one direction—toward R(R)I; careful historical analysis can help temper such accounts. Nonlinear narratives demonstrate the extent to which people have found visions of responsibility unconvincing—or at least only temporarily convincing over the years. Nonlinear narratives also help us to question dominant folk histories, revealing whose interests selective interpretations might serve.

Examining what we might call "alternative" or "forgotten" histories of R(R)I also draws attention to how history can be used as a valuable resource for (re)imagining the future. As many before me have pointed out, because approaches like R(R)I are forward looking, practicing anticipation through scenario building and foresight exercises, historical perspectives often tend to take a back seat.[65] James Wilsdon attributes this to a particular hierarchy of knowledge in terms of what is considered important, relevant, or valid. He argues that despite the growing appreciation of the value of multi- and inter-disciplinary perspectives, history is often "left out in the cold".[66] Even when

[64] See e.g. John Tosh, *Why History Matters* (London: Macmillan International Higher Education, 2019); and Donald Bloxham, *Why History? A History* (Oxford: Oxford University Press, 2020).
[65] See Eda Kranakis, "Technology Assessment and the Study of History," *Science, Technology, & Human Values* 13, no. 3-4 (1988): 290-307; Alfred Nordmann, "Responsible Innovation, the Art and Craft of Anticipation," *Journal of Responsible Innovation* 1, no. 1 (2014): 87-98; James Wilsdon, "From Foresight to Hindsight: The Promise of History in Responsible Innovation." *Journal of Responsible Innovation* 1, no. 1 (2014): 109-112; Silke Zimmer-Merkle and Torsten Fleischer, "Eclectic, Random, Intuitive? Technology Assessment, RRI, and their use of History," *Journal of Responsible Innovation* 4, no. 2 (2017): 217-233.
[66] James Wilsdon, "From Foresight to Hindsight," 109.

historians are included—in policy-making for example—Wilsdon suggests that their role tends to be somewhat "totemic" as their message is often misunderstood or simply mobilized for strategic purposes. In the case of R(R)I, I'll argue that critical historical reflection not only adds nuance and depth when thinking about the imagined trajectories of technoscientific developments, but also provides important insights for thinking about the possible future(s) of R(R)I itself.[67]

Of course, in addition to helping us to think about the future, insights from the past can also provide us with guidance in the present. For while the present is never the same as the past, we can still learn important lessons from how things went before; or, as the old adage goes, history doesn't repeat, but it might sometimes rhyme. Understanding the successes and failures of antecedent movements could potentially inform and shape how we talk about and practice R(R)I today. For example, Eda Kranakis uses the analogy of an automatic camera, which uses "archetypes" in order to select shutter speed and exposure in any given setting.[68] She suggests historical analyses might serve a similar function; not only by looking at the trajectories of particular techno-scientific developments, but also by looking at how their trajectories were anticipated, interpreted, and assessed. Kranakis argues that we shouldn't only look at how the archetypes themselves were produced (e.g. looking at the development of past technologies in order to inform the assessment of technologies in the present); but also look at what those archetypes enabled the production of, in terms of different types of approaches and methods (e.g. how successful or not was the assessment of a particular technology, and how can analyzing its success/failure potentially inform current assessments?). Crucially, as Kranakis points out, both successful and unsuccessful archetypes are equally important as "'negative' historical archetypes" can also "provide a means to learn from past mistakes".[69]

Finally, historical analysis also has intrinsic worth; R(R)I's history is simply a history worth remembering. But it is also important to consider who

[67] See Danielle Shanley, ""Imagining the Future through Revisiting the Past," and Cyrus C.M. Mody, "Responsible Innovation: The 1970s, Today, and the Implications for Equitable Growth," *Center for Equitable Growth*, 2016. https://equitablegrowth.org/research-paper/responsible-innovation/?longform=true

[68] Eda Kranakis, "Technology Assessment and the Study of History," 298.

[69] Ibid, 299.

it is who is doing the remembering. Historical reflection on R(R)I, when it has taken place, has tended to come from insiders speaking from their own first-hand experiences. Such accounts are valuable and informative, yet at the same time, it is important to distinguish between a "practical past" and a "historical past".[70] Silke Zimmer-Merkle and Torsten Fleischer reflect on this distinction, highlighting how the two are often conflated in practice. Whereas practical pasts are largely based on individual experience and used as a means for people to make sense of their own lived experience in order to convey it to others; historical pasts are the result of "critical enquiry".[71] So we might say that while everyone engages in the creation of practical pasts, historical pasts tend to be the focus of academic historians and their interlocutors. The problem with practical pasts is that they often (re)produce archetypal narratives, which perpetuate particular folk histories. Building on Kranakis' camera analogy, once a specific archetype has been programmed into a camera, the amateur no longer needs to adjust all the different settings—that entails learning what they all are and how they work together. Instead, the automatic program provides a shortcut. Archetypes and folk histories serve a similar function—instead of needing to look critically at the history of R(R)I, for example, we simply begin to rely on existing accounts of "practical pasts". Of course historical pasts, like practical pasts, are still only partial, but by making the choices taken in their (re)construction explicit, they hopefully will not only provide an account that is recognizable to those who were there in the past, but also facilitate more critical reflection on how and why things came to be the way they are in the present.

How To Do a History of R(R)I?

In that I am interested in the ways in which responsibility has been made to matter in and through R(R)I's antecedent intellectual movements—practically, discursively, and symbolically—my approach is inspired with work in the "new political sociology of science" (NPSS). As Scott Frickel and Kelly Moore suggest, NPSS puts into sharper focus "the political and institutional

[70] Michael Oakeshott, "Present, Future and Past," in *On History and Other Essays*, edited by Michael Oakeshott (Indianapolis: Liberty Fund), 1-48.
[71] Silke Zimmer-Merkle and Torsten Fleischer, "Eclectic, Random, Intuitive?" 224.

dynamics that shape the funding, administration, and practice of science, doing so in a way that is engaged with broader social change processes as well as central elements of cultural science studies—particularly in its emphasis on meaning and networks".[72] The NPSS project therefore centers upon the analysis of *power*—as a "a dynamic and social condition whose character can be described empirically by the forms it takes, its distribution across societies, the mechanisms through which it is expressed, and the scope and intensity of its effects"; *institutions*—as "durable sets of practices and ideas that are organized around social activities and that in various ways shape the contour and experience of daily life", thereby embodying "routinized 'ways of going on' that, even when largely taken for granted by individual members of society, nevertheless continuously shape or channel social choices, constraining certain courses of action and enabling others"; and *networks*—which "are dynamic configurations of relationships among individual and organizational actors" that can "operate within settings described entirely within a particular institutional setting," or play a role "in bridging or linking institutional domains".[73] As Frickel and Moore explain, NPSS essentially "seeks new answers to an old question: what's political about science?"[74]

My approach builds upon work in NPSS but focuses specifically on how different challenges associated with technological change have been responded to through the language of responsibility. I will look at how resources were distributed and mobilized and by whom; how organizational networks emerged and combined so as to either alter existing institutional arrangements or as a way of preventing or resisting emerging arrangements; as well as the outcomes and consequences of particular collective efforts geared towards making research and innovation more responsible.[75] As Frickel and Moore make clear, NPSS is rooted in a number of shifts, which took place through the course of the 20th century, resulting in the ever-increasing complexity of engagements surrounding the use and production of scientific knowledge. My aim in this book closely aligns with the goals of NPSS in that I will try to highlight how R(R)I "might become better

[72] Scott Frickel and Kelly Moore, eds. *The New Political Sociology of Science: Institutions, Networks, and Power* (Madison: University of Wisconsin Press, 2006), vii.
[73] Ibid, 8
[74] Ibid, 3.
[75] Ibid, 25.

equipped to understand these broad historical changes and their sociopolitical implications".[76]

In order to understand R(R)I's longer pre-history and get a sense of how previous efforts at making research and innovation more responsible have fared, what I will propose is essentially an alternative historiography of R(R)I. To that end, my approach has also been inspired by the notions of "ANTi-history" and "micro history". First theorized by Albert Mills and Gabrielle Durepos, ANTi-History builds upon theoretical insights from the sociology of knowledge and actor network theory (ANT), in order to look at "how history as *knowledge of the past* is produced". As such, ANTi-history "is interested in how human and non-human actors come to perform, and in the process, produce histories".[77] As Mills and Durepos explain, the approach is *ANT*i-history in that while drawing upon the ways in which ANT can inform history methodologically, it "goes beyond ANT" as it "critiques ANT's lack of explicit attention to history".[78] It is at the same time '*ante* history', in that by focusing on how history is written or performed by actors, it draws attention to the time before a given history was produced.[79] In a sense, ANTi-history closely aligns with the motivations of R(R)I in that it offers a "hyper reflexive" and "hyper transparent" approach to history, encouraging "writing in, as part of the narrative itself, the social and political tactics of respective actors to describe not only *what* is the narrative, but also *how* that narrative came to be".[80]

As Frickel and Moore point out, methodological considerations are central to studies within NPSS. Particularly with regards to establishing the "appropriate level of analysis in studies that draw conclusions about the intersection of human action and larger-scale structures".[81] According to Frickel and Moore, what is most important is developing a nuanced understanding of "how social life is meaningfully organized on different scales" as well as how to "usefully work across those scalar differences".[82] So

[76] Ibid, 16.
[77] Gabrielle Durepos and Albert J. Mills, "ANTi-History: An Alternative Approach to History," in *The SAGE Handbook of Qualitative Business and Management Research Methods,* eds. Ann L. Cunliffe, Catherine Cassell, and Gina Grandy (London: Sage Publications, 2018), 431.
[78] Ibid, 432.
[79] Ibid, 431.
[80] Ibid, 432.
[81] Scott Frickel and Kelly Moore, eds. *The New Political Sociology of Science,* 13.
[82] Ibid, 13.

while ANTi-history helps draw attention to the social context within which established histories were produced; I also draw upon "microhistory" which is defined by one of its founding fathers as "the intensive historical investigation of a relatively well-defined smaller object, most often a single event".[83] In my case, combining ANTi-history and microhistory allows me to zoom in and out of particular episodes, in order to highlight how intellectual movements both shaped and were shaped by the broader sociopolitical contexts within which they emerged and grew.

First developed by Italian historians in the 1970s as a way of experimenting with different scales of historical analysis, microhistory has been widely taken up as an innovative way of researching and writing history.[84] Like most histories, microhistorical analysis begins from a broad research question, but then reduces the scale of analysis, zooming in on an individual, a community or a unique event. Often confused with the case study, microhistorical methods therefore "set up an investigation around singular, unique objects, not patterns or 'cases'," .[85] So rather than serving as an illustrative example that is indicative of a broader phenomenon or pattern, microhistories isolate particular episodes enabling us to ask, "What can the singular teach us?"[86] As outlined by Duke University's MicroWorlds Lab, interpretive microhistorical practices might include exploring historical actors' first-hand experiences; tracing hidden connections through multiple sources; reconstructing webs of social networks; and scaling the analysis up and down in order to highlight specific historical contexts and perspectives.[87] Microhistory therefore closely aligns with ethnographic approaches and other methodologies widely used within disciplines such as anthropology and STS. A microhistorical analysis also nicely complements my ambition to develop an ANTi-history of R(R)I as microhistories often serve as correctives to grand historical narratives, or in this case, well established and taken for granted folk histories.

[83] Carlo Ginzburg, *The Cheese and the Worms: The Cosmos of a Sixteenth-Century Miller* (Baltimore: The Johns Hopkins University Press, 1980), cited in: Sigurður Gylfi Magnússon and István M. Szijártó, *What is Microhistory? Theory and Practice* (New York: Routledge, 2013), 4.
[84] See Sigurður Gylfi Magnússon and István M. Szijártó, *What is Microhistory?*
[85] The MicroWorlds Lab, "What is Microhistory?" *Duke University*, accessed 6 April, 2022, https://sites.duke.edu/microworldslab/what-is-microhistory/
[86] Ibid.
[87] Ibid.

In order to identify the individuals, communities, or events that could help me understand how different conceptions of responsibility had been made to matter, I started the research by conducting a "historical ethnography". Some of the activities I undertook during this period included becoming a participant observer at conferences in Brussels and Amsterdam; attending workshops at the BrisSynBio conference in Bristol; joining the NewHoRRIzon project and attending 3 social labs in Vienna, Ljubljana, and Bonn; following an open science train-the-trainer course in Barcelona; helping to organize the Society for New and Emerging Technologies (S.NET) conference in Maastricht; as well as following a massive open online course (MOOC) on the subject of R(R)I. Along the way I attended numerous other project meetings, lectures, and seminars primarily in the UK, the Netherlands, and online. Once I had begun to get a sense of the ways in which R(R)I's history was typically (re)presented, both by members of the community in practice, as well as across the rapidly growing body of literature, I conducted qualitative interviews with 19 leading figures in the R(R)I community from the UK, the US, the Netherlands, Germany, Norway, and Spain.[88] The purpose of this "historical ethnography", was to inquire, identify, test, and further explore the ways in which R(R)I's history was being understood and mobilized by members of the R(R)I community.

Tracing R(R)I's antecedent intellectual movements took me on a three month visit to the U.S. in 2019 where I visited 8 archives between Boston and Washington D.C. Unfortunately, any plans for further archival trips were disrupted by the COVID-19 pandemic, but I was able to attain access to reports, meeting minutes, and other documents through a number of digital archives. In conjunction with the archival work, I also conducted a further 12 interviews, this time methodologically more akin to oral histories than qualitative interviews.[89] Moving iteratively between data collection and analysis, I identified the relationship between technology and social change; the potential implications of technological change; and the role of social agency in technological choice, as core themes which connected

[88] Interviews typically lasted between 45 and 90 minutes and were transcribed and coded manually by the author.

[89] See Joanna Bornat, "Oral History," in *Qualitative Research Practice*, eds. Clive Seale, David Silverman, Jaber F. Gubrium, and Giampietro Gobo (London: Sage Publications, 2003): 34-47. Once again, interviews varied in length between 45 and 90 minutes and discussions were transcribed and coded by the author.

contemporary R(R)I with intellectual movements which emerged in the long 1960s. I then traced the emergence of three prominent intellectual movements that sought to help society make informed choices about technology.

Responsibility, Ambivalence, and Technological Change

Both Dorothy Nelkin and Carl Mitcham have described the 1960s and 1970s as a period within which ideas about responsibility in relation to research and innovation expanded. At the risk of oversimplifying, Mitcham suggests that from the mid-1940s onwards discussions concerning social responsibility evolved in two stages. During the first period (from roughly 1945 to 1970), scientists recognized "the potentially adverse implications of some of their work and desire to help society adjust accordingly". In the second (from the 1970s onwards), scientists aspired "to transform the inner character of science itself".[90] In the first stage, it has been well documented that after the war, atomic scientists used "the press and the podium" in order to challenge policies concerning military technology, in forums such as The Bulletin of the Atomic Scientists (1945 to the present), The World Federation of Scientific Workers (1946 to the present) and the International Pugwash Conferences (1957 to the present). However, as Nelkin points out, while activists in the 1940s "fought to isolate research from political control", by the 1970s, their counterparts wanted to "increase political interaction", as "whistle-blowing", "demystification", "accountability" and "participation" became "the rhetoric of social responsibility in the 1970s".[91]

Nelkin suggests that debates about social responsibility during the 1970s came to reflect a number of different dimensions. "The most difficult and nebulous dimension of social responsibility", she states, was "the obligation of scientists to use their special expertise to call public attention to the dangers of new technologies and, indeed, to the potential use and consequences of their own research".[92] She continues, "This aspect of

[90] Carl Mitcham, "Responsibility and Technology: The Expanding Relationship," in *Technology and Responsibility*, ed. Paul T. Durbin, (Dordrecht: Reidel Publishing Company, 1987), 10.
[91] Dorothy Nelkin, "The Social Responsibility of Scientists," *Annals of the New York Academy of Sciences* 334, no. 1 (1979): 177-180.
[92] Ibid, 177.

responsibility, with its implications of political activism and public dispute, is the greatest source of ambivalence; for political activism also carries implications for the autonomy of science from external control".[93] As Kelly Moore has shown, during the 1970s, scientists became increasingly politically mobilized, "using their expertise to challenge the government's and industry's uses of science and to call for the redirection of research towards 'socially responsible ends' ends".[94] In her analyses of organizations such as Science for the People and the Union of Concerned Scientists, Moore's work focuses on the way in which scientists as "a relatively privileged group of people… used the tactics and techniques of social movements so often used by more disenfranchised people".[95] Though Moore's work has been an important source of inspiration for the histories I will tell, in the case of R(R)I's antecedent intellectual movements, I am interested in those whose views were perhaps less pronounced—in those that found responsibility in the context of technological change to be a considerable source of ambivalence.

Ambivalent actors tend to be overlooked or forgotten because, as Mody suggests, "most histories of science—maybe even most histories full stop—revolve around figures with pronounced views".[96] Indeed, as the journalist Ian Leslie writes, "because it goes largely unmeasured and undetected" ambivalence is generally "undervalued".[97] Yet, ambivalence is widely considered as an inevitable, inescapable and therefore intrinsic part of the human experience.[98] While in everyday language we sometimes use ambivalence to refer to someone who is indifferent, or non-committal,

[93] Ibid.
[94] Scott Frickel and Kelly Moore, eds. *The New Political Sociology of Science,* 4.
[95] Britt Kennerly in conversation with Kelly Moore, "'Disrupting Science' Tackles 'Relevant and Rich' Research Area," *McMicken College of Arts and Sciences*, 2007, accessed 6 April, 2022, https://www.uc.edu/profiles/profile.asp?id=7299
[96] Mody, *The Squares,* 309.
[97] Ian Leslie, "Ambivalence is Awesome," *Slate Magazine*, June 13, 2013, accessed 6 April, 2022, https://slate.com/technology/2013/06/ambivalence-conflicted-feelings-cause-discomfort-and-creativity.html
[98] The term ambivalence was initially coined by the Swiss psychiatrist Eugen Bleuler in the early 1900s. See Richard B. Corradi, "Ambivalence: Its Development, Mastery, and Role in Psychopathology," *Bulletin of the Menninger Clinic* 77, no. 1 (2013): 41-69; for a recent overview see Berit Brogaard and Dimitria Electra Gatzia, eds. *The Philosophy and Psychology of Ambivalence: Being of Two Minds* (New York: Routledge, 2021); For general philosophical introductions see Kenneth Weisbrode, *On Ambivalence: the Problems and Pleasures of having it Both Ways* (Cambridge: MIT Press, 2012); and Hili Razinsky, *Ambivalence: A Philosophical Exploration* (London: Rowman & Littlefield, 2016); and on sociological ambivalence see Robert K. Merton *Sociological Ambivalence and Other Essays* (London: Simon and Schuster, 1976).

ambivalence actually refers to the state of experiencing conflicting beliefs or feelings simultaneously. The prefix *ambo or ambi* meaning *both* and the suffix valere or *valence* deriving from the Latin for *vigor*, which refers to active bodily, or mental strength or force. Someone can feel a positive or a negative valence; or both. Traditionally, the predominant view seems to have been that ambivalence is a temporary or pathological condition which describes a divided entity, and as such something that needs to be *resolved*.

Yet according to psychologists Marina Assis Pinheiro and Gessivânia de Moura Batista ambivalence can instead be conceived as “a condition inherent to human experiences”; it can appear in ordinary situations that involve “the transposition of boundaries”, or whenever individuals have to make specific “distinctions and choices”.[99] In contrast to the notion that ambivalence is something that needs to be resolved, I will argue that ambivalent attitudes can actually open up opportunities for different courses of action to enfold (chapter 1); be used strategically in order to enroll supporters and win over critics (chapter 2); or finally, contribute to a certain sort of amnesia within historical narratives, resulting in ambivalence being interpreted as irrelevance (chapter 3).

According to Andrew Weigert and David Franks, ambivalence often becomes prevalent in times of rapid social change or uncertainty, they write, “change is the soil for ambivalence because it can simultaneously create excitement of novelty and growth, yet threaten old attachments and familiar ease that will now be lost. The person can yearn for what the future will bring and yet mourn for the past that the future will destroy”.[100] As we will see in the coming pages, technological change—and the discourses surrounding it—have often been both a source *and* consequence of ambivalence. From the perspective of R(R)I specifically then, ambivalence provides an interesting lens. For as Rosalind Williams suggests, it can be difficult to identify and distinguish particular ideals and ideologies in practice, both “within the social order or even within an individual’s mind”.[101] She argues that this is because

[99] Marina Assis Pinheiro and Gessivânia de Moura Batista, “Ambiguity and Ambivalence: an Issue for the Subjective Dynamics in the Relation between Language and Affection,” *Integrative Psychological and Behavioral Science* 55, no. 3 (2021): 474.

[100] Andrew Weigert and David D. Franks, “Ambivalence: A Touchstone of the Modern Temper,” in *The Sociology of Emotions: Original Essays and Research Papers,* eds. David D. Franks, E. Doyle McCarthy (Atlanta: JAI Press, 1989), 206.

[101] Rosalind Williams, *Retooling: A Historian Confronts Technological Change* (Cambridge: MIT Press, 2003), 16.

the "change resister" and "the change agent" can often be found within the same person.[102]

There is a clear tendency to categorize appraisals of the impact and meaning of technology as simply optimistic or pessimistic.[103] However, in practice, such clear-cut distinctions rarely hold for very long. Matthew Wisnioski has argued that in order to find "new means for explaining the cultural and intellectual changes of 1960s America", for example, it is necessary to traverse the "boundaries between modernity's assumed critics (typically leftist intellectuals) and its proselytizers (businesspeople, scientists, and engineers)".[104] In this vein, Wisnioski points to the work of Langdon Winner—who as a scholar in the 1970s was someone with a stake in moving the discussion beyond what he considered the "vacuous distinction" between optimists and pessimists.[105] Winner thought it was inconsequential whether particular individuals were appropriately labelled as a "prophet of hope" or a "prophet of doom".[106] Instead, he contrasted those who exhibited an "ideology" of technological change, which reflected a "utilitarian-pluralist model", centered upon the notions of "choice", "consequence", and "control"; with those who engaged with a "theory" of technological politics, a "set of pathologies" which foregrounded "reform" through "transformation", and "adaption".[107]

Wisnioski argues that an ideology of technological change was dominant among professional elites by the late 1960s, becoming a "normative philosophy" through which it was possible to recognize and deal with "technology's ills".[108] Having been crafted by a relatively heterogeneous network of academics, journalists, and engineers, this approach was highly dependent upon "flexible concepts", which rendered "the past and present understandable and the future manipulable through expertise".[109] According

[102] Ibid, 16-19.
[103] See Robert A. Wauzzinski *Discerning Prometheus: The Cry for Wisdom in our Technological Society* (Vancouver: Fairleigh Dickinson University Press, 2001).
[104] Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge: MIT Press, 2012), 8.
[105] Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge: MIT Press, 1978), 52.
[106] Ibid.
[107] Ibid, 319-324.
[108] Matthew Wisnioski, *Engineers for Change, 12.*
[109] Ibid.

to Winner, studies of technology and society in the 1960s and 1970s were exponents of this ideology, as were "the ecology movement, Naderism, technology assessment, and public-interest science", each of which while having "somewhat different substantive concerns" shared "notions of politics and rational control" that all fit within the same broad frame.[110] Winner suggests that while these approaches were "sufficiently young to offer spark to tired arguments" and "sufficiently critical of the status quo to seem almost Risqué", ultimately, in that they accepted "the major premises and disposition of traditional liberal politics", they were, in the end "entirely safe", merely providing a "bright future" for academics and policy analysts alike.[111]

As Wisnioski writes, in that Winner was an advocate for "technological politics as a viable moral philosophy" it is important to point out that his analysis was somewhat "asymmetrical".[112] For example, Winner describes approaches that exhibit a "theory of technological politics" as "highly specific, solution oriented, and pragmatic".[113] Yet these examples consisted of an eclectic range of activities, including

> The school of humanist psychology, writers and activists of the counterculture, utopian and communal living experiment, the free schools, proponents of encounter groups and sensual reawaking, the hip catalogers, the peace movement, pioneers of radical software and new media, the founders and designers of alternative institutions, alternative architecture, and 'appropriate' or 'intermediate' technology.[114]

Winner saw these sorts of efforts as attempts to build "human-centered and responsible institutions", while at the same time "restoring the element of responsibility to situations that have tended to exclude responsible conduct".[115] Whereas for proponents of an ideology of technological change, technology was considered problematic and in urgent need of legislation, from the perspective of technological politics, ("disjointed and feeble though it may be"), according to Winner, its foundations lay in the position that technology "in a true sense *is*

[110] Langdon Winner, *Autonomous Technology,* 319.
[111] Ibid.
[112] Matthew Wisnioski, *Engineers for Change,* 45.
[113] Langdon Winner, *Autonomous Technology,* 321.
[114] Ibid.
[115] Ibid, 322.

legislation".[116] The fundamental difference between the two, as far as Winner was concerned, was "a difference in insight and commitment".[117]

As I will try to demonstrate, looking at concrete exchanges between individuals, rather than highly publicized polemics demonstrates that Winner's divide is just as problematic as the one between optimists and pessimists. Indeed, within R(R)I, for example, I would argue that both an ideology of technological change and a theory of technological politics are often at play *at the same time*. While folk histories of R(R)I tend to emphasize developments more typically associated with the former, the ideals and visions of R(R)I tend to share more in common with the latter. This speaks to a deep tension wherein many working within R(R)I seek to transform the system of research and innovation, while at the same time seemingly struggling to present any serious challenge to the status quo, perhaps in some ways, even reinforcing it. I will argue that attempts to reconcile these seemingly contradictory discourses have, regardless of their success or failure at the time, been instrumental to the emergence of ideas about R(R)I. The extent to which they are reconcilable remains to be seen, however, looking at how they have intersected and diverged at various points in the past, foregrounding the conflicting ideals and buried assumptions upon which the discourse has been built is a way of checking in and reflecting upon where visions of R(R)I could, or dare I say it *should*, be headed.

(A Brief) Outline

In deciding upon the organization of this book, I decided to follow the set-up of Al Teich's "near-classic anthology" *Technology and the Future,* first published in 1972.[118] In the third volume, published in 1981, Teich organizes several canonical readings from the 1960s and 1970s—many of which will feature throughout—in 3 parts: Part 1, "Thinking about Technology"; part 2 "Forecasting, Assessing, and Controlling Technology", and part 3 "Reshaping Technology".[119] Though I will identify specific intellectual movements as having belonged to each of these three categorizations separately, what we will see is that convergences between them seem to have

[116] Ibid, 323.
[117] Ibid.
[118] Stephen H. Cutcliffe, "Albert H. Teich, ed., 'Technology and the Future', (Book Review)," *Technology and Culture* 35, no. 4 (1994): 904.
[119] Albert H. Teich, *Technology and Man's Future* (New York: St. Martin's Press, 1981).

been facilitated by a network of people who frequently and more or less fluidly criss-crossed between them.

From the vantage point of today, it looks as though the people behind these efforts had quite distinct views on the relationship of technology and politics, and put those ideas into practice in very different ways. This view is very much in keeping with the historiography on science and technology in the 1970s, which has focused on individuals and groups with pronounced views, whether liberals, conservatives, or "groovy" adherents of the California ideology.[120] But by adopting a microhistorical lens and zooming in on the early days, circa 1970 and before, what we will see is that the intersections between these groups were made possible by the catalyzing presence of individuals with deeply ambivalent views. As I will return to in the final chapter, it would seem that because these individuals occupied a middle ground that was unstable at the time, their contributions to making responsibility matter within research and innovation appears to have largely disappeared from view ever since.

Following Teich's lead, in chapter 2, I will trace the emergence of an intellectual movement concerned with "thinking about technology", looking at proto-STS programs in the 1960s—particularly the Columbia Seminar on Technology and Social Change (T&SC)—asking: *what sorts of issues did proto-STS programs help to put on the agenda?* In, chapter 3, I will turn my attention to the emergence of TA as an intellectual movement concerned with "forecasting, assessing, and controlling technology"; in this case, I will focus in particular on the decade leading up to the creation of the OTA (1962-1972) and the sorts of discussions and debates that took place regarding what TA could, or should be. The main question in this chapter is therefore: *what was TA before the OTA?* Finally, in chapter 4, I will focus on the "appropriate technology" (AT) movement as an intellectual movement dedicated to "reshaping technology", examining how different approaches were adopted by different groups within the movement. I'll show that where some sought to provide minor reforms through providing international technical aid to

[120] See e.g. Wisnioski, *Engineers for Change*; Kelly Moore, *Disrupting Science* (New Jersey: Princeton University Press, 2009); Fred Turner, *From Counterculture to Cyberculture* (Chicago: University of Chicago Press, 2010); David Kaiser, *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (New York: WW Norton & Company, 2011); David Kaiser and W. Patrick McCray, eds. *Groovy Science: Knowledge, Innovation, and American Counterculture* (Chicago: University of Chicago Press, 2016).

those in need of assistance, others saw AT as a way through which technological change could be reimagined in ways that prioritized societal needs and human values. Given that of the three AT is the only one that has yet to really feature within R(R)I's folk histories, in this chapter I'll ask *what can we learn from looking at AT from a perspective that extends forward and backward from the usual endpoints of the movement that most observers work with*?

The next 3 chapters all follow a similar narrative arc. I'll begin by setting the scene and posing the specific research question relative to STS, TA, and AT respectively. I will then briefly engage with the historiography of each development, before zooming in on particular individuals, communities, and events in order to show how responsibility was made to matter in different ways, in different places. I end each chapter by scaling back up, following how what mattered in one place potentially shaped what mattered in another place and, how what mattered travelled and was taken up (or not) in different contexts. In the final chapter, I'll revisit the main research question, and reflect on what R(R)I's antecedent intellectual movements tell us about the trajectories of intellectual movements. I'll also make the case for ambivalence as a conceptual tool, methodological heuristic, and intellectual virtue.

Chapter 2

Science, Technology, and Society: Building Ivory Bridges

On March 8th 1944, while the world was at war, a memorandum was sent to Frank Fackenthal, then Provost of Columbia University, outlining a charter for a new type of university seminar. "The time was ripe," recalled long-time seminar leader Margaret Mead some years later, "the academic air rumbled with a low thunder of complaints against the isolation of academic life, the separation of men in universities from men of affairs, and the separation of different departments of universities from one another".[121] Within the memo a small group of professors, led by Frank Tannenbaum, professor of Latin American history, expressed their concerns to Fackenthal that the increasing fragmentation of knowledge within the university reflected neither the world, nor their knowledge of it. The memo was signed by nineteen professors and outlined the organization of a limited number of seminars which would "obliterate the departmental lines", shifting the emphasis from a particular disciplinary subject onto a "matter of going concern".[122] Tannenbaum sought, as he once stated, to "resemble specialists so that they can see the whole again".[123]

[121] Ronald Gross, "Creating a 'Community of Scholars'," *Change* 14, no. 2 (March 1982): 43.
[122] Frank Tannenbaum et al., "Appendix 1," in *A Community of Scholars,* ed. Frank Tannenbaum (Frederick A. Praeger: New York, 1965), 145.
[123] Tannenbaum cited in Paul Hond, "Meeting of the Minds," *Columbia Magazine*, Winter 2020-21, 22.

What the Columbia professors proposed was an attempt to overcome the particularization of academic disciplines divided into strict departments and faculties. The seminars would instead focus the collective brainpower of the university toward “perennial problems”, reuniting specialists from both inside and outside of its walls.[124] Tannenbaum described the university as an “ancient establishment with its own rules and traditions”, whose organization had always been dedicated to “the accumulation, preservation, and transmission of knowledge”.[125] He noted how as an institution it had long remained resistant to reform. The role of the seminars, as he saw it, was to add another dimension to those basic functions. “It can now accumulate, preserve, transmit, and *focus* knowledge upon some specific issue”, he wrote, adding, “This new function brings the university into the ‘practical’ world and brings the practical world into the university”.[126] To borrow Gerhart Sonnert’s turn of phrase, what Tannenbaum was interested in was building “ivory bridges”.[127]

The notion of an ivory bridge effectively describes what is today referred to as the “third mission” of the university. Whereas teaching and research have long been considered as the two core aims of the university, discussions around the so-called “third mission” have gained ground in recent decades. Perhaps best referred to as the “transfer” mission, the third mission of the university is now used to reflect the way in which the university is expected to actively contribute to society.[128] The transfer mission is an important part of theoretical models of innovation, where within “triple helix” relations and “mode 2 knowledge production”, the discourses of “relevance” and “impact” have come to play a central role in the distribution of resources.[129] It is fair to say that a shared mandate of today’s “innovation

[124] Frank Tannenbaum, “Origin, Growth, and Theory of the University Seminar Movement,” in *A Community of Scholars*, ed. Frank Tannenbaum (Frederick A. Praeger: New York, 1965).
[125] Ibid, 6.
[126] Ibid.
[127] Sonnert focuses on the contributions of “science-administrators” and “citizen-scientists” in attempting to “bridge the gap between the ivory tower and real life”. See Gerhart Sonnert, *Ivory Bridges: Connecting Science and Society,* (Cambridge: MIT Press, 2002), 9.
[128] Arend Zomer and Paul Benneworth, “The Rise of the University’s Third Mission,” in *Reform of Higher Education in Europe*, ed. Enders, Jürgen, Harry De Boer, Jon File, Ben Jongbloed, and Don Westerheijden. (Leiden: Brill Sense, 2011), 81-101.
[129] Loet Leydesdorff and Henry Etzkowitz, “The Triple Helix as a Model for Innovation Studies,” *Science and Public Policy* 25, no. 3 (1998): 195-203.; Nowotny, Helga, Peter Scott, and Michael Gibbons. “Introduction: 'Mode 2' Revisited: The New Production of Knowledge,” *Minerva* 41, no. 3 (2003): 179-194.

hubs", "technology transfer offices", "valorization centers", and "impact units" is to bring the university into the practical world and the practical world into the university.

The growing institutionalization of third mission activities reflects an ongoing shift in the relationship between science and society, which in recent years has become increasingly global.[130] In some places however, such discussions are far from new. In the 1970s, for example, the Netherlands was one of the frontrunners in emphasizing the importance of societal relevance to academic research where in two science policy white papers, published by the Ministry of Education in 1975 and 1980, it was explained that Dutch Science should be driven by societal problems be they economic, technological or cultural.[131] According to Eleanora Belfiore, through the course of the '80s and '90s, the "utilitarian emphasis on socio-economic usefulness" in the U.S. and across much of Europe, represented a "change in legitimation narrative".[132] In the UK, for example, "impact" was increasingly used as a proxy for "value" within what was an increasingly "neoliberal monoculture".[133] By the mid-2000s, the European Commission was consistently funding streams of research on the societal impact of new and emerging technologies through a series of programs dedicated to the relationship between science and society.[134] As outlined in the previous chapter, these efforts were later codified by the European Commission's Directorate-General for Research and Innovation into a policy framework for Responsible Research and Innovation (RRI).[135]

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[130] Henry Etzkowitz, Andrew Webster, Christiane Gebhardt, and Branca Regina Cantisano Terra, "The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm," *Research Policy* 29, no. 2 (2000): 313-330.

[131] See Paul Benneworth, "Thirty Years of Crisis? The Disputed Public Value Humanities Research in the Netherlands 1982-2012," *HERAVALUE (Measuring the Value of Arts & Humanities Research) Country Report* (Enschede: Center for Higher Education Policy Studies, 2014).

[132] Eleonora Belfiore, "'Impact', 'Value' and 'Bad Economics': Making Sense of the Problem of Value in the Arts and Humanities," *Arts and Humanities in Higher Education* 14, no. 1 (2015): 106.

[133] Ibid.

[134] The discursive shift from deficit to engagement can also be seen in the renaming of programs at the European level from 'Science and Society' to 'Science *in* Society'. See Andy Stirling, "Precaution, Foresight and Sustainability. Reflection and Reflexivity in the Governance of Science and Technology," in *Reflexive Governance for Sustainable Development,* ed. Jan-Peter Voß, Dierk Bauknecht, René Kemp (Cheltenham: Elgar, 2006), 225-272.

[135] Stevienna de Saille, "Innovating Innovation policy: The Emergence of 'Responsible Research and Innovation'," *Journal of Responsible Innovation* 2, no. 2 (2015): 152-168.

Of course, the third mission discourse is but a recent chapter in a much longer history regarding the relationship between science and society—which is also a history of the division of moral labor.[136] Where once this relationship was predicated upon a "republic of science" model—where science was thought to inhabit a neutral space and be entirely separate from questions of a political, social, or ethical nature—ideas about this relationship have increasingly shifted towards a more constructivist model—where science and scientists are understood to be deeply embedded in the world around them. The rise of science and technology studies (STS) since the early 1970s can therefore be seen as both (partial) cause and consequence of this shift.

Studying the ways in which the boundaries between science and politics are subject to constant negotiation and re-imagining is the bread and butter of STS scholars who typically research and analyze "the development and dynamics of science and technology, including their relationship to politics, society and culture".[137] Since the emergence of STS, it has not been uncommon for the ethical, legal, and societal aspects of technological change to be outsourced to STS scholars. As suggested in the previous chapter, many of R(R)I's acknowledged antecedents (such as anticipatory governance, ELSI/ELSA, and technology assessment) emerged from—or in close collaboration with—STS.[138] R(R)I therefore builds upon decades of discussions and debates within the field concerning the complex evolution, social dimensions, and potential impacts of technologies as well as the importance of interdisciplinary collaborations both inside and outside of the academy.[139]

One of the Columbia seminars that resulted from Tannenbaum's letter—indeed, the seminar that Tannenbaum and other leaders of the

[136] See Arie Rip, "Division of Moral Labour as an Element in the Governance of Emerging Technologies," in *Embedding New Technologies into Society: A Regulatory, Ethical, and Societal Perspective*, eds. Diana M. Bowman, Elen Stokes and Arie Rip (Singapore: Pan Stanford Publishing, 2017), 115-131; and Arie Rip, "Technology and Evolving and Contested Division of Moral Labour," in *Technology, Anthropology, and Dimensions of Responsibility*, eds. Birgit Beck and Michael Kühler (Stuttgart: JB Metzler, 2020), 23-32.
[137] See the description of STS given on the homepage of the journal Science, Technology, and Human Values, accessed March 1, 2022, https://journals-sagepub-com.mu.idm.oclc.org/home/sth
[138] Richard Owen and Mario Pansera, "Responsible Innovation: Process and Politics," in *International Handbook on Responsible Innovation*, ed. by René von Schomberg and Jonathan Hankins, (Cheltenham: Elgar, 2019), 35-48
[139] Barbara E. Ribeiro, Robert DJ Smith, and Kate Millar, "A Mobilising Concept? Unpacking Academic Representations of Responsible Research and Innovation," *Science and Engineering Ethics* 23, no. 1 (2017): 81-103.

movement saw as most exemplifying their aims—was the seminar on Technology and Social Change (T&SC). This seminar not only prefigured the emergence of STS, but also directly inspired several of the individuals and institutions widely recognized as foundational for STS. The T&SC seminar created a space within which "the 'practical people'" were considered "as important as the economist, political scientist, sociologist, and educator".[140] This sort of interdisciplinary collaboration was essential for Tannenbaum; as he wrote

> Unless we can bring the practitioner and the theorist face to face so that they may live together long enough to become aware of the limits within which each one operates and of the essential interdependence of all of their activities neither can really make headway against the growing complexities of our time.[141]

Created in 1962, the T&SC seminar provided a forum within which a heterogeneous group of experts, including scientists, engineers, and industrialists; philosophers, historians, and policy makers—many of whom would go on to play active roles in the creation of STS-related programs, policy studies, and social movements—could come together to discuss the relationship between technology and society. Yet despite clear parallels between Tannenbaum's vision for a more interdisciplinary, engaged and outward-looking academy (and with efforts in STS, R(R)I, and related discourses today), to date, Tannenbaum's seminar project—the T&SC seminar in particular—has been largely overlooked within histories of STS. This chapter is therefore organized around the question: *what issues did proto-STS initiatives—like the T&SC seminar—help put on the agenda*? As we will see, the T&SC theme provided topics and problems that necessitated broad-based discussions, requiring a wide range of expertise. The result was that the seminar became an exemplar of what Tannenbaum had hoped the university seminars would be.[142]

It is worth highlighting that the Columbia seminars were undoubtedly a product of both time and place. For example, their success depended on

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[140] Tannenbaum, *Community of Scholars*, 19.
[141] Tannenbaum, *Community of Scholars*, 19.
[142] The T&SC seminar was far more interdisciplinary than earlier seminars, where typically the social sciences and humanities—as the disciplines where the University Seminars movement originated—were the most heavily represented.

participants having the availability to commit to ongoing meetings that fell outside of their day-to-day duties and responsibilities. An easy to reach location, with good transport links was a bonus. Tannenbaum wrote that the seminars "could probably only have originated at Columbia, a great university with a traditionally decentralized administration, located in a metropolis within easy reach of many other institutions of higher learning".[143]

Through the course of the 1960s, the total number of seminars on offer at Columbia grew to 39, and the total membership swelled to over 1,000, around half of whom were "outsiders", and almost a third of whom had no academic affiliation at all.[144] In 1965, *A Community of Scholars* was published as a *Festschrift*, containing memoirs and analyses as well as a detailed overview from Tannenbaum on the 'Origin, Growth, and Theory of The University Seminar Movement'—within which the T&SC seminar was one of the few to which he referred at any great length.[145] In their respective contributions, Mead summarized the seminars as a "new institution" that would likely "survive in its own right"; Robert Theobald called it "a paradigm of the future"; and Daniel Bell hailed it as "a force that can combat dehumanization within the humanities"; Leslie C. Dunn praised the "cross-fertilization between faculties" and "the exchange and expansion of ideas the Seminars have made possible".[146] Paul Goodman also suggested there were signs that the seminars was becoming a "world-wide movement".[147] Scattered across Tannenbaum's desk he described having seen

143 Alice Newton, "Introduction: Engaged Learning," in A Community of Scholars: 75 Years of the University Seminars at Columbia, ed. Thomas Vinciguerra (Columbia: Columbia University Press, 2020), xv.
144 Tannenbaum, *Community of Scholars*.
145 Describing the T&SC seminar, Tannenbaum detailed how it dealt with the following "broadly based" and "urgent" questions: "How can the community be made aware of the many issues pending in the newly developing technology? How can the scientist, the politician, the voter, the sociologist, the corporate manager, and the government official learn to look with the same eyes at the increasingly complex and difficult national issues resulting from the impact of rapid changes in production methods, the prospect of increasing unemployment, and the expanding size of the unit? More insistently, how can the leadership in our modern, industrial society—political, scientific, managerial, labor, and academic—learn to speak a common language descriptive of these increasingly complicated matters? How can it do so with sufficient speed to keep abreast of the changes that are occurring? For this common language among the leaders of our society is a prerequisite for a desirable policy in what seems too many as an approaching crisis of great magnitude. The University Seminar seemed the only available instrumentality that could assemble the relevant knowledge and experience scattered in dozens of sciences, skills, professions, and occupations". Tannenbaum, *Community of Scholars*, 36.
146 From insert inside Tannenbaum, *Community of Scholars*.
147 Ibid.

> A letter from the U.N. about setting up seminars in Tokyo; another from the Weizmann institute in Israel; another from the Academy of Arts and Science, the publishers of Daedalus, about seminars in connection with Boston University; another from the Organization of American States; another from the Australian University at Canberra.[148]

It is also important to point out at this stage, that while the word "seminar" may rouse images of a circle of students and a professor, the University Seminars were an altogether "different beast".[149] For example, Goodman described them as an "irregular" and "unorthodox" institution, for they were "at variance with the way American institutions were supposed to succeed", that is "without money, publicity, or organization, and following a course pretty uncompromisingly irrelevant to the needs of the front office".[150] Most seminars lasted around 90 minutes and convened not in classrooms, but in the meeting rooms and dining rooms of Faculty House. Presentations were routinely followed by the energetic questioning typical of a postgraduate seminar, though the seminars stood out for having "a keen practical edge".[151]

Yet as Ronald Gross explains, not one seminar could be taken as representative, "since each one sets its own agenda, selects its own new members, and determines its own process and products".[152] In general, however, they were a low-cost, "do-it-yourself" operation with minimal overhead, "relying on the voluntary energies of the participants".[153] For example, the total expenses for 1962-1963 came to just $27,000 covering some 450 meetings of 31 groups—Tannenbaum did occasionally managed to scrounge additional money for the odd train fare.[154] The chief expense was secretaries at $11,500—most of whom were graduate students who would operate the tape recordings and take the minutes.[155] Other costs included printing and room rental—members paid for their own dinners.

The organization of the seminars was intended to break down hierarchies, "informal as well as institutional" that existed within and between

[148] Paul Goodman, "An Example of Spontaneous Administration," in *A Community of Scholars*, edited by Frank Tannenbaum (New York: Frederick A. Praeger, 1965), 87.
[149] Paul Hond, "Meeting of the Minds", 21.
[150] Paul Goodman, "Columbia's Unorthodox Seminars," *Harper's Magazine*, 1 January, 1964, 72.
[151] Ronald Gross, "Creating a 'Community of Scholars'," 44.
[152] Ibid.
[153] Ibid.
[154] Paul Goodman, "Columbia's Unorthodox Seminars," 74.
[155] Ibid.

disciplines.[156] Tannenbaum made clear that the rigid hierarchy of the academy was not welcome in the meetings where age, experience, and status were irrelevant. The seminars were therefore deliberately designed to create an opportunity for "community, fellowship, and mutual intellectual appreciation, no matter your official role".[157] According to Tannenbaum, "The group must feel completely free to follow its own bent, it must be responsible only to its own academic conscience, and it must be untrammelled in organization, method, and membership".[158]

The format of the Columbia seminars certainly appeared to allow space for ambiguous views to be aired and ambivalent positions to be adopted. Reviews of the T&SC seminar, for example, praised the wealth of experience and insight that participants brought to the table, as well as the diversity of viewpoints. [159] But while the philosopher of science Jerome Ravetz described the proceedings of the T&SC seminar as a "most interesting record of the degree of understanding on the subject among the best qualified people at the time", he was somewhat critical of the apparent absence of any clear problem framing.[160] He wrote, "If an understanding of this phenomenon is still fragmented, it is as well to know that this is the case and also to be able to identify the fragments".[161] It is fair to say that discussions at the T&SC seminar were wide-ranging, but in that the participants were trying to navigate relatively new territory without any real sense of direction, the discussions were also far from straight-forward or consistent. As we will see, as the discussions from the seminar started to evolve beyond Morningside Drive and 117th Street, this plurality of framings gave shape to a diverse array of activities, many of which can be associated with the emergence of STS.

The history of R(R)I is inextricably bound up with the history of STS, and STS scholars continue to make up a significant proportion of the R(R)I community.[162] From the unpacking of techno-scientific processes as dynamic

[156] Alice Newton, "Introduction: Engaged Learning," xv.
[157] Ibid.
[158] Tannenbaum, *Community of Scholars*, 20.
[159] Ravetz, "Review," 255-257. See also Cecil O. Smith, "Review of *Technological Innovation and Society*, by Dean Morse and Aaron W. Warner eds.," *Technology and Culture* 10, no. 3 (1969): 470-473.
[160] Ravetz, "Review," 256.
[161] Ibid.
[162] Job Timmermans, "Mapping the RRI Landscape: An Overview of Organisations, Projects, Persons, Areas and Topics," in *Responsible Innovation 3*, ed. Lotte Asveld, Rietje van Dam-Mieras, Tsjalling Swierstra, Saskia Lavrijssen, Kees Linse, Jeroen van den Hoven (New York: Springer, 2017) 21-47.

social practices, to the anticipation of unintended or undesirable consequences, STS scholars have, arguably, tried to make responsibility matter within research and innovation for roughly fifty years. My interest in the seminar is therefore threefold. First, the seminar is an early and as yet overlooked part of the history of STS. It is an example of an interdisciplinary, problem-oriented forum which sought to enable dialogue and interaction on the relationship between technology and social change—all of which remain crucial features of contemporary R(R)I. In the process, it brought together several high-status actors—or *movement intellectuals*—who would go on to set-up, or contribute to, new programs and courses that helped lay the foundations for the emergence of STS.

Second, in contrast to origin stories of STS and R(R)I which often present their development as a somewhat radical departure from existing positions and practices, the network that the T&SC seminar helped create provides a window onto an overlooked counter-narrative of STS and R(R)I. Attention to the T&SC seminar foregrounds the role of more ambivalent actors—or *bridge builders*—who either stepped away from, or were forced out of STS as it became an increasingly professionalized academic field. As we will see, these figures often pursued change while at the same time emphasizing continuity. They were often conflicted by their desire to engage with societally relevant research and development, while simultaneously trying to maintain a value-free, politically neutral image of science and technology. The seminar therefore helps to shed light on the stakes involved in attempting to build bridges, and the different meanings and practices associated with making responsibility matter.

Finally, looking at the T&SC seminar as an intellectual movement draws attention to it as an example of a collective effort that successfully put technology and society relations on the agenda in the U.S. in the 1960s—making responsibility matter in ways that would be taken up internationally by STS programs through the course of the 1970s and 1980s. This is important, for despite STS being a diverse field whose history can be told in many different ways, STS narratives tend to dismiss attitudes towards technological change pre-1970 for having been dominated by the linear model of innovation or unabashed displays of technological determinism. As the seminar took place long before STS scholars developed theoretical approaches to technological change— such as the Social Construction of

Technology (SCOT) or Actor Network Theory (ANT)—, the discussions it fostered did of course lack the nuance or theoretical clarity of subsequent approaches. Nevertheless, they illustrate that during the 1960s, a relatively heterogeneous group of actors debated and discussed both the *process* of technological change, as well as its *societal impacts*. New research programs were created as a result, providing important institutional footholds upon which subsequent developments in STS could be built.

While I will zoom in on exchanges at the T&SC seminar for the most part of this chapter, this will be bookended by a brief survey of more standard historical narratives of STS and other proto-STS efforts both within and beyond the U.S. context. As I will argue, by paying attention to some of the issues discussed during the T&SC seminar and following some of the actors involved as they moved beyond discussions on Morningside Drive, we will see that the T&SC seminar actually played a fairly significant role in getting proto-STS activities off the ground.

The Emergence of "STS"

The early to mid-1970s is considered an important landmark within histories of STS, in that during that time a number of developments served to consolidate activities taking place on both sides of the Atlantic. For example, in 1971, the sociologist David Edge and his colleagues at Edinburgh established the *Journal for the Social Studies of Science* (SSS).[163] Shortly thereafter, in 1975, a special issue of *The Sociologist of Science*, published by Cornell University's Department of Sociology, announced the imminent formation of the Society for Social Studies of Science (4S) which held its first annual meeting in November 1976.[164] Reflecting on the emergence of the field,

[163] In his opening editorial Edge stated that "there is beginning to emerge a new, vigorous, searching system of social and professional inquiry, awakened by the impulse of the sweeping transformations made in modern civilization by the ill-understood processes of science and technology". He continues "The vigor of intellectual debate and awakening is not to be restricted to disciplinary lines of battle". David Edge, "Editorial," *Social Studies of Science* 1, no. 1 (January 1971): 1.

[164] Within the issue, the society's proposed Charter outlined its purpose, "to promote research, learning and understanding in the systematic social analysis of science". The organization committee hoped that the new society would attract "a broad spectrum of scientists, historians, philosophers and others". The society soon created its own newsletter, the second of which announced that its first annual meeting would take place at Cornell in October, 1976—owing to a delay in funding, the first meeting was later

several former 4S presidents have described the importance of that first meeting in bringing together different activities that were then captured under the broad banner of "STS".[165]

In the *Oxford handbook of Interdisciplinarity*, former 4S president Sheila Jasanoff wrote that "at the risk of oversimplification and of flattening cross-cultural differences", contemporary STS can be seen as having effectively merged two broad streams of scholarship which first emerged in the 1970s; one focused its energy on understanding the "nature and practice" of science and technology, the other on its "impacts and control".[166] Godin notes that given this focus on both the *process* of technological change and its *societal impacts*, it is surprising that as "a term and research tradition", technological change has largely faded from historical narratives of STS.[167]

Historically speaking, these two "strands" of STS reflect quite different vantage points with different orientations. As Jasanoff puts it, the location of the ampersand with regards to Science *&* Technology Studies, or Science, Technology *&* Society, often signals important intellectual distinctions within the field.[168]According to Stephen Cutcliffe, Juan Ilerbaig provided the first systematic overview of the field in terms of two "subcultures" in 1992.[169] As many have done since, Ilerbaig's account presented the history of STS in terms of a split between more disciplinary, theory-oriented scholars, often led by European sociologists of science to whom he ascribed a descriptive, science focus, and more interdisciplinary, issue-centered educators, commonly led by philosophers of technology and engineering ethicists whose

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postponed until November. SASS/Department of Sociology, "Special Issue," *The Sociologist of Science* (June 1975): 1-4.

165 For example, Harry Collins (1992-1993) explained that having organized a conference in Edinburgh in 1975, which had successfully brought together historians, philosophers, and sociologists of science in the UK for the first time, the 4S meeting "got us hand shaking, or more personal flesh touching, as it were", with the broader international community. See "Presidential Interviews" accessed March 1, 2022, https://www.4sonline.org/what-is-4s/4s-history/presidential-interviews/

166 Sheila Jasanoff, "A Field of Its Own: The Emergence of Science and Technology Studies," in *The Oxford Handbook of Interdisciplinarity*, eds. Robert Frodeman, Julie Thompson Klein, and Roberto Carlos Dos Santos Pacheco (Oxford: Oxford University Press, 2017), 173-187.

167 Benoît Godin, *The Invention of Technological Innovation: Languages, Discourses and Ideology in Historical Perspective* (Cheltenham: Elgar) 2019: 74.

168 Sheila Jasanoff, "The Floating Ampersand: STS Past and STS to Come," *Engaging Science, Technology, and Society* 2 (2016): 227-237.

169 Juan Ilerbaig, "The Two STS Subcultures and the Sociological Revolution," *Science, Technology & Society Curriculum Newsletter of the Lehigh University STS Program & Technology Studies Resource Center* 90, (1992): 1-6.

focus was more prescriptive, and technology oriented.[170] Responding to Ilerbaig, in a highly visible exchange published in Lehigh University's Science, Technology & Society Newsletter, Steve Fuller designated these two camps as the "High Church" and the "Low Church" of STS.[171] While High Church "relativist scholars" conducted detailed case studies, deliberately steering clear of prescriptive judgements, members of the more "activist" Low Church were "strident in expressing their views regarding the strengths and weaknesses of contemporary technoscience".[172] As David Hess has pointed out, it is important to note that the activities across this divide were undoubtedly contextually contingent.[173]

Over the years, scholars sought to fashion the "unruly territory" which characterized STS in the 1970s, into a unified and recognizable academic field. Histories of the High Church have since been well documented, typically describing the rise of the sociology of scientific knowledge (SSK) in the UK in the mid-1970s, particularly in Bath and Edinburgh, as well in pockets across Europe.[174] Today, the development of High Church STS is often conceptualized as a series of successive waves.[175] The first wave stressed the social nature of scientific knowledge making; the second advocated a symmetrical approach, by extending constructivist explanations to error and truth as types of the same sort of social agreement; and the third questioned the implications of wave two insofar as it illustrated that science is not neutral and invariably reflects and reinforces existing power structures in society.[176] Despite its heuristic value, critics suggest that this reading of STS's

[170] See Stephen Cutcliffe, *Ideas, Machines, and Values: An introduction to Science, Technology, and Society Studies* (Oxford: Rowman & Littlefield, 2000), 80; Steve Breyman, Nancy Campbell, Virginia Eubanks, and Abby Kinchy, "STS and Social Movements: Pasts and Futures," in *The Handbook of Science and Technology Studies, Fourth Edition,* ed. Ulrike Felt, Rayvon Fouche, Clark A. Miller, Laurel Smith-Doerr (Cambridge: MIT Press, 2016), 292-293; Arie Rip, "STS in Europe," *Science, Technology and Society* 4, no. 1 (1999): 73-80.
[171] See Leonard J. Waks, "STS as an Academic Field and a Social Movement," *Technology in Society* 15, no. 4 (1993): 399-408.
[172] Cutcliffe, *Ideas*, 100
[173] See David J. Hess, "If You're Thinking of Living in STS....A Guide for the Perplexed," in Cyborgs and Citadels: Anthropological Interventions in Emerging Sciences and Technologies, ed. Gary Downey and Joe Dumit (Santa Fe: SAR Press, 1997), 148.
[174] Jasanoff, "Floating Ampersand", 231; Jasanoff, "A Field of its Own", 193
[175] One of the more prominent examples of this is Harry M. Collins and Robert Evans, "The Third Wave of Science Studies: Studies of Expertise and Experience," *Social Studies of Science* 32, no. 2 (2002): 235-296.
[176] Collins & Evans, Studies of Expertise and Experience: A Sociological Perspective on Expertise, in The Oxford Handbook of Expertise, edited by Paul Ward, Jan Maarten Schraagen, Julie Gore and Emilie M. Roth

history is reductionist and demonstrates a misunderstanding of the broader science studies corpus.[177]

While not uncommon, the wave metaphor disguises what is washed away with successive developments—especially those whose attitudes were more ambivalent; instead portraying a somewhat triumphalist narrative. In many cases, new developments do build on and add to what went before, but at the same time, they can and do entail substantial costs. For example, in the case of STS, Jasanoff suggests that the costs of the shift from the first to the second wave included: the loss of communication with scientific and engineering communities; the loss of "distinguished scientists with an interest in science policy" who found themselves a "second career in STS"; and the loss of exchanges between academic STS and the "practicalities of public policymaking".[178] She highlights how the growing professionalism of the field potentially isolated practitioners, resulting in scientists and other professionals feeling increasingly "excluded, even patronized, by a disciplinary discourse that strikes them as unnecessarily opaque and distant from their lived experience".[179]

By the early 1990s, a number of critical voices began taking issue with how the origins of STS were typically represented. Alternative histories have since become increasingly common, particularly those which foreground the role of radicals and outsiders.[180] Chapters in the third and fourth editions of the STS handbook (2008 and 2016, respectively) emphasize that social movements can and do take place both inside and outside the intellectual arena, tracing the influence of Low Church developments and diverse reform

[177] See Sheila Jasanoff, "Breaking the Waves in Science Studies: Comment on HM Collins and Robert Evans: The Third Wave of Science Studies'." *Social Studies of Science* 33, no. 3 (2003): 389-400; and Brian Wynne, "Seasick on the Third Wave? Subverting the Hegemony of Propositionalism: Response to Collins & Evans," *Social Studies of Science* 33, no. 3 (2003): 401-417.

[178] Sheila Jasanoff, "Coming of Age in Science and Technology Studies," *Science Communication* 20, no. 1 (1998): 93

[179] Ibid.

[180] For example, Brian Martin took the citation practices of SSK scholars to task in 1993. He criticized how SSK's "usual suspects" (including Collins, Harvey, Knorr-Cetlna, Latour and Woolgar, Pickering, Pinch, Shapin and Schaffer, and Travis) were repeatedly referred to, proposing instead a counter-narrative which foregrounded the role of radical social movements such as environmentalism, feminism and civil rights. Brian Martin, "The Critique of Science Becomes Academic," *Science, Technology, & Human Values* 18, no. 2 (1993): 247-259. See also David J. Hess, "If You're Thinking of Living in STS."; on the field's debt to the Cold War, see e.g. Elena Aronova and Simone Turchetti. *Science Studies during the Cold War and Beyond* (Palgrave Macmillan, 2016); and on how STS has potentially obscured its origins and predecessors in the Global South see e.g. Kavita Philip, Lilly Irani, and Paul Dourish, "Postcolonial Computing: A Tactical Survey," *Science, Technology, & Human Values* 37, no. 1 (2012): 3-29.

movements on STS, including the role of activists, thinkers, and writers who "sought to link scholarship to partisan and activist goals".[181] In the European context, for example, Low Church developments in the UK might include the British Society for Social Responsibility in Science (BSSRS) and the campaign for Science in a Social Context (SISCON), both of which built on the momentum of earlier movements, such as the movement of concerned scientists.[182] In the early 1970s, SISCON provided courses that included topics with wide political ramifications including the role of government and industry in science, and the commercial application of scientific findings.[183] The group produced a series of teaching and learning booklets amongst which were 'Society and Food', Technology and Survival' and 'Research and Technology as Economic Activities'.[184]

In the Netherlands, as Arie Rip and Erbert Boeker have documented, the transition within Dutch universities from "an emphasis on autonomy to an emphasis on social awareness" took place gradually in the years following the Second World War, becoming most publicly visible in the student movements in 1968 and 1969.[185] Then, throughout the 1970s, came growing concerns about the depletion of finite resources; increased calls for the democratization of the university; and demands for scientific research which could clearly demonstrate its relevance for society. Combining these concerns with a focus on issues surrounding the risks of nuclear energy and environmental degradation, the science-technology-society movement tried to enrich educational programs through the creation of courses that often became a formal part of degree requirements. At the same time, these concerns also contributed to the creation of new participatory mechanisms aimed at democratizing science and contributing to social change. For

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181 David Hess, Steve Breyman, Nancy Campbell, and Brian Martin, "Science, Technology, and Social Movements," in *The Handbook of Science and Technology Studies, Third Edition*, ed. Edward J. Hackett, Olga Amsterdamska, Michael Lynch, Judy Wajcman (Cambridge: MIT Press, 2008) 473.

182 On BSSRS see Jon Agar, "What Happened in the Sixties?" *The British Journal for the History of Science* 41, no. 4 (2008); and Alice Bell, "The scientific revolution that wasn't: The British Society for Social Responsibility in Science," *Radical History Review* 2017, no. 127 (2017): 149-172.

183 Beginning in 1973, SISCON started as a cooperative effort between eight universities and one polytechnic, funded by grants from the Nuffield Foundation and Leverhulme Trust. See Eric Ashby, "Science in a Social Context," *New Scientist*, 74, no. 1049, April 28, 1977, 207-208; Anon, "Public Participates in Technological Paralysis," *New Scientist*, 79, no. 1117, August 24, 1978, 531.

184 Ashby "Science", 208.

185 Arie Rip and Egbert Boeker, "Scientists and Social Responsibility in the Netherlands," *Social Studies of Science* 5, no. 4 (1975): 468.

example, in the Netherlands "science shops" were established at universities in order to try to make scientific knowledge more widely accessible.[186]

While the UK and the Netherlands were both crucial incubators of STS (and for that matter, R(R)I), I am interested in Low Church developments in the 1960s in the U.S. for two reasons. First, despite alternative histories becoming more common within STS in recent years, the emergence of proto-STS programs in the U.S. in the 1960s has still been largely overlooked. Second, these programs provided important institutional footholds upon which proto-R(R)I approaches, like technology assessment, were established. As I will argue in the following sections, the T&SC seminar at Columbia played an important role in creating the social conditions for a nascent STS movement to gain adherents and win intellectual prestige—both of which are important requirements for the formation of intellectual movements. As Scott Frickel and Neil Gross explain, the history of almost every field of study is

> [A] history of new scientific or intellectual movements that rose up to challenge established patterns of inquiry, became the subject of controversy, won or failed to win a large number of adherents, and either became institutionalized for a time, until the next movement came along, or faded into oblivion.[187]

While it is true that the T&SC seminar and its progeny only managed to carve out a small amount of institutional stability for a relatively short period, neither did they *fade into oblivion*. Instead, the ambivalent attitudes of key actors meant that proto-STS programs could go in multiple different directions, while remaining primarily oriented towards the impacts and control of technological change. As we will see throughout this chapter, and indeed throughout this book, not only did these ambivalent actors give shape to proto-STS programs throughout the 1960s, but they also began making responsibility matter in ways that have since been taken up within discourses like R(R)I.

[186] See Joseph Wachelder, "Democratizing Science: Various Routes and Visions of Dutch Science Shops," *Science, Technology, & Human Values* 28, no. 2 (2003): 244-273.
[187] Frickel and Gross, "Scientific/Intellectual Movements," 204.

Meetings in Manhattan

> The Manhattan skyline shimmered in the imaginations of all the nations, and people everywhere cherished the ambition, however unattainable, of landing one day upon that legendary foreshore, where the sirens always hooted, the bright lights perpetually shone, and black lace panties dangled emblematically from portholes… The flash and merriment of it was like a tonic, to the fancy of a debilitated world… Seen in magazine photographs, in propaganda letters, or in the backgrounds of Hollywood musicals, Manhattan looked all panache, all rhythm, all good-natured dazzle, all Frank Sinatra and Betty Grable. It was the present tantalizingly sublimated. It was the future about to occur.[188]

This was New York in 1945: 'Manhattan's Golden Age', or the time 'When the Big Apple Blossomed'.[189] The above excerpt is taken from the travel writer Jan Morris' *Manhattan '45* where she takes us back "to witness all sorts of beginnings and endings, to collect the myth of Manhattan".[190] Morris paints a portrait of the city as it was on June 25, 1945 when 14,000 American servicemen and women sailed into New York aboard the British liner, the Queen Mary. It was a time of "unbridled self-confidence" during which New York was riding a "wave of triumph".[191] According to Morris, few cities in the history of the world could have "stood so consciously at a moment of fulfilment, looking into a future that seemed so full of reward".[192] The crowded island of Manhattan was "the head, the brain, the essence of America, and the idea of America was omnipotent then".[193]

Perhaps better known to Tannenbaum and his colleagues however, was another New York. Largely thanks to the support of several Rockefeller-funded programs, this New York saw the assimilation of émigré intellectuals such as Roman Jakobson and Claude Levi-Strauss into an "interdisciplinary scientific apparatus"—one which they were expected to "perpetuate and

[188] Jan Morris, *Manhattan '45* (London: Faber & Faber ltd., 1987), 8.
[189] See Jonathan Yardley, "Manhattan's Golden Age," *The Washington Post*, March 25, 1987, C2; and Roger Starr, "When the Big Apple Blossomed: Manhattan '45 by Jan Morris," *The New York Times*, April 19, 1987, BR8.
[190] Jerome Charyn, "Manhattan '45 by Jan Morris," *Los Angeles Times*, April 26, 1987, 2.
[191] Sam Roberts "New York 1945; The War Was Ending. Times Square Exploded. Change Was Coming," *New York Times*, July 30, 1995, 13.
[192] Morris, *Manhattan '45*, 11.
[193] Morris, *Manhattan '45*, 7.

expand in their home countries after the war".[194] As Bernard Geoghegan explains, as the Second World War receded, the Rockefeller Foundation relied on its network of exiled scientists to try to create a "world-wide fraternity of scientists".[195] According to Geoghegan, support for Jakobson in particular, "was part of a broader program to overhaul funding priorities in favor of useful research modeled on the tools and techniques of experimental science".[196]

Whether buoyed by the feeling that Manhattan's future seemed to be one full of reward, or encouraged by the interdisciplinary arrangements being funded by the Rockefeller Foundation, Tannenbaum's proposed charter immediately struck a chord with Fackenthal who described it as "tremendously important" and something which demanded serious consideration "at once".[197] On Fackenthal's recommendation, President Nicholas Butler approved an appropriation of $7,500 in order to get the University Seminars off the ground—it's worth noting here that a few years earlier Butler himself had put together a (failed) program committee with the mandate "to ask the University to get conscious".[198] With Butler's approval, the seminars announced for the academic year 1945-1946 included: The State; The Problem of Peace; Studies in Religion; The Renaissance; and Rural Life.[199]

By the 1950s, the program had taken off. Columbia faculty continually developed new seminars. If faculty members became interested in an issue, they would consult associates in that area to establish interest before

[194] Bernard Dionysius Geoghegan, "From Information Theory to French Theory: Jakobson, Levi-Strauss, and the Cybernetic Apparatus," *Critical Inquiry* 38, no. 1 (2011): 104.
[195] Ibid, 109.
[196] Ibid, 111.
[197] Tannenbaum, *Community of Scholars,* 9.
[198] Dean Miller, from mimeographed report, "The University Seminars for 1950," cited in Tannenbaum, *A Community of Scholars*, 5. It helped that the Columbia administration was ready for just this sort of development, having tried (and failed) since the early 1940s to "add a new function" wherein the knowledge and expertise of individual scholars could be focused on problems that would transcend "any one department, or discipline, or any one conceivably wise man". Butler remarked that while it was clear that the seminars themselves would not bring in much money, they "would compensate the university in other ways". Ibid, 10.
[199] Tannenbaum recalls a conversation with Professor Oscar J Campbell regarding the creation of a seminar on The Renaissance: "He asked 'Why can't we have a seminar on the Renaissance?' 'The Renaissance,' I replied 'is not a going concern.' 'Ain't it now!' came the half-mocking, half-serious reply. 'Look, here at Columbia we teach the Renaissance in the Departments of English, French, Italian, German, History, Philosophy, Art, Music, Architecture etc., etc.; we do not know each other and have sat down at the same table.' Clearly, scholars could making a 'going concern' out of a historical period. A seminar on the Renaissance was, therefore established as one of the initial five". Ibid.

arranging a luncheon with the Director of the University Seminars in order to discuss the proposal's feasibility. There was only one basic proviso: "the question must lie beyond the province of any one department, discipline, school, or perhaps even beyond any one faculty".[200] The initiating group would then find individuals to invite to the newly formed seminar. According to Tannenbaum, the process was akin to making a new appointment to a department; there was the same sort of need for "competence, interest, useful involvement, originality".[201]

Participation in the seminars was voluntary, no one received an honorarium for attending gatherings, serving on committees or writing papers—the whole enterprise was run on a shoestring. Members were invited as individuals, not as delegates of the institution to which they belonged. The intention was that once a seminar was established it should take on "a life of its own" and become entirely "self-governing.[202] Members would then congregate bi-weekly or monthly in Columbia's neo-Renaissance Faculty House (formerly the Men's Faculty Club). The seminars were semiprivate affairs; attendance was by invitation only, though most groups welcomed guest speakers and visitors. A great deal of emphasis was placed upon the importance of providing opportunities for informal exchanges, such as eating and drinking together. One session of the Nature of Man seminar (1968)—chaired by Mead—featured "a rollicking, erudite address by [W. H.] Auden, who riffed on Darwinism, Carnival, and the hippies while dropping Latin phrases and pouring himself glass after glass of wine".[203] Meetings were typically attended by about twenty-five to thirty people, on average. Initially, seminar-meeting participants were—for the most part—exclusively male, while the secretaries were almost exclusively female—all barring one. Over time, the participation of women increased, and by the mid-1950s, women were counted among the members of the majority of seminars.[204]

While the first decade of the University Seminars were set against the backdrop of New York's golden age, by the early 1960s, a gradual economic

[200] Ibid, 12.
[201] Ibid, 14.
[202] Gross, "Creating a 'Community of Scholars'," 43.
[203] Paul Hond, "Meeting of the Minds," 22.
[204] Newton, "Engaged Learning", xvi-xvii. According to Newton women now participate actively in all of the current Seminars. They make up approximately half of the Advisory Board, and the acting director is a woman.

and social decline was beginning to set in: poverty, crime, and racism, while far from being new problems within the city, were becoming a more visceral part of the daily lived experience of the average New Yorker. At the same time, further afield, the space race was well underway, the contraceptive pill was hitting the mass market, and Rachel Carson's *exposé* on the long-term effects of pesticides was all over the front pages. Between 1960 and 1965, the promises and perils associated with technological change could hardly be ignored, making the topic a prime candidate for a University Seminar.

A Seminar of Some Importance

In contrast to standard practice, it was actually a group of employees working just up the road from Columbia, at the International Business Machines Corporation (IBM), who first approached Tannenbaum in 1962 with a view to creating a seminar on T&SC.[205] According to Robert Theobald, these IBM staffers "felt it was necessary to create a dialogue between those developing new technological systems—the computer scientists and the systems engineers—and those responsible for helping man to live in a new machine-created environment—the social scientists".[206] In effect, their underlying motivations seemed to align perfectly with Tannenbaum's philosophy for the university seminars as a whole.[207] In a *Community of Scholars*, Tannenbaum wrote that when it came to the topic of T&SC, "The University Seminar seemed the only available instrumentality that could assemble the relevant knowledge and experience scattered in dozens of sciences, skills, professions, and occupations".[208]

A press release announcing the seminar's creation suggested that rarely had there been "a central issue about which so many divergent views have been expressed".[209] The problem was considered "so large" and "opinion so

[205] This was two years before IBM moved its corporate headquarters to Armonk.
[206] Robert Theobald, "The Potential of the University Seminar Model," in *A Community of Scholars*, ed. Frank Tannenbaum (New York: Frederick A. Praeger, 1965), 138.
[207] The organizing committee included: William O. Baker, Melvin Kranzberg, Robert Lekachman, Donald Michael, Emmanual Piore, Ormsbee Robinson, Mario Salvadori, David Sidorsky, Robert Theobald, Henry Villard, Charles Walker, Kirby Warren, Aaron Warner, Seymour Wolfbein and Christopher Wright (among others).
[208] Tannenbaum, *Community of Scholars*, 36.
[209] Anon, "Statement on the University Seminar on Technology and Social Change," Review of Seminar Proceedings, Technology and Social change, seminar 461, 1962-1963.

varied', that it was proposed that the seminar not only focus on the "new machines" associated with the "narrower subject" of automation—which as the seminar's co-founders, economists Eli Ginzberg and Aaron Warner, suggested was "merely one manifestation of a much larger problem"—but on the broader implications of technological change throughout society.[210] The purpose of the seminar was described by its first chair, Warner, as providing a forum for sifting issues and exchanging views on the widespread ramifications of technological change. This was completely in keeping with Tannenbaum's ambition, which as the philosopher Sidney Morgenbesser wrote, was to "let participants combine what they worry about as members of the academy, with what they worry about when they read the morning paper".[211] Perhaps this helps to explain why Tannenbaum came to see the T&SC seminar as so emblematic of the entire University Seminars enterprise.

In order to identify the areas deemed most worthy of the seminar's attention, the steering committee sent out a questionnaire to potential participants.[212] Respondents emphasized, first and foremost, the importance of a historical approach, "which would put recent technological innovations in historical perspective".[213] The survey also showed that there was interest in discussing the broad range of factors involved in bringing about change; the impacts of technology on social life; the effects of automation on work and consumption; and the responsibilities of "government and of leaders of industry to mitigate social costs inherent in the process of change".[214] The organizers were keen not to adopt too broad an approach, "which would invite confusion", but at the same time wanted to avoid narrowing down the subject too much from the start, "in order to allow scope for imaginative and creative formulations of the problems that were of prime importance".[215] The program was therefore designed to provide "vastly different orientations and vantage points," opening up a "Pandora's box of issues" for discussion and debate.[216]

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210 Eli Ginzberg, ed., *Technology and Social Change*, (Columbia: Columbia University Press, 1964), 3.
211 Gross, "Creating a 'Community of Scholars'," 43.
212 The steering committee included: Samuel Devons, Walter Goldstein, Norman Kaplan, Melvin Kranzberg, and Charles Weiner.
213 Ginzberg, *Technology and Social Change*, 3.
214 Ibid, 4.
215 Ibid.
216 Ibid, 7. According to Ginzberg, during the first year, the seminar frequently "see-sawed back and forth between extreme views". Ginzberg attributed this to the assumption of a loud minority that only

The T&SC seminars were well attended right from the start. The diversity of its membership increased steadily (in the second year it welcomed the first woman to join its ranks, Mary Alice Hilton of the Cybercultural Research Institute), as did the total number of members, climbing to sixty-three by the third year. From the outset, IBM's presence at the seminars was notable, in fact, often the only organization better represented was Columbia itself.[217]Among other notable participants were the historian Melvin Kranzberg, founder of the Society for the History of Technology (SHOT), and Columbia professor and Quaker peace activist Victor Paschkis, founder of the Society for Social Responsibility in Science (SSRS). Other lesser known regulars included Emmanuel Mesthene, a philosopher and RAND corporation analyst, who would go on to accept the role as Director of Harvard's Program on Technology and Society in 1964; Chris Wright, who would lead Columbia University's new Institute for the Study of Human Affairs when it was created in 1966; and Daniel Greenberg, who later became an editor at *Science* magazine where he gained the reputation as an unshakeable critic of the "cheerleaders" of science.

In addition to its focus on the broad ramifications of technological change, the T&SC seminar is also particularly interesting with regards to its organization and method of work. "Men of affairs" who had "specific but different experience mediating the interaction between science and technology" presented informal papers.[218] Each speaker considered the problem itself, be that "Technology and Social Change" or "The Impact of Science on Technology" broadly, meaning that equally broad discussions typically followed. During the second year, for example, across 7 seminars, discussions included around 200 questions and answers, comments and counter-comments, by an audience of about 60 people. The relative diversity of the audience—by then consisting of about one-half economists, political

economic referents could be "delineated and measured", all else was "shadowy and speculative". As Ginzberg wrote, "much of the methodological spinning reflected this cleavage between participants who wanted to limit the discussion to the economic consequences of technological change in the hope of pinpointing at least a few elements, and those who sought to roam farther afield even at the risk of getting lost and of pinning down nothing". Ibid, 140-150.

[217] In addition to DeCarlo, other members of the IBM contingent included Emmanuel Piore, Chief Scientist and Director of Research (he had also been a member of the President's Scientific Advisory Committee (PSAC) under the Eisenhower administration); Ormsbee Robinson, Director of University Relations Planning; and Charles Bowen, Manager of Education Program Development.

[218] Ginzberg, *Technology and Social Change*, 3.

scientists and sociologists; a quarter coming from business and industry; and a quarter from government—meant that a variety of implications of the main themes could be discussed. As a result, the seminar became an interdisciplinary forum for processing raw information on problems and ideas relating to science, technology, and society, facilitating dialogue about the responsibilities of practitioners and academics in the context of technological change. Within the published proceedings, an attempt was then made to frame these issues in such a way that would lay the basis for future discussions and studies.

It is important to point out that discussions in the early years of the seminar were not only a reflection of the times, but also of the patronage of a technology giant like IBM, where Thomas Watson Jr. had recently succeeded his father as chief executive officer.[219] In 1960, Watson had contributed a chapter on 'Technological Change'—, which he described as "a modern sounding term"—for the Commission on National Goals Report.[220] Perhaps unsurprisingly, his focus in the chapter was largely on the relationship between technological change, automation, and the problem of unemployment. Though Watson Jr. was undeniably a great believer in the power of technology, he also recognized the need to think carefully about the desirability of technological impacts and the responsibility of the industrial corporation. Speaking at the University of California, Berkeley, in the early 1970s he said

> The world can no longer put up with the kind of unbridled, unreasoning, unthinking advance that characterized Nineteenth-Century industrialists. If corporations do not police themselves in such things as preserving the ecology, telling the truth in advertising, considering the impact on people of new technological devices that they produce, government will be forced to do this policing for them. And it should.[221]

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[219] From this position, he would go on to oversee the company's transformation from a medium sized member of the US top 100 businesses, into one of the largest industrial corporations in the world. Fortune magazine would later refer to him as "the greatest capitalist who ever lived". Steve Lohr, "I.B.M.'s Computing Pioneer, Thomas Watson Jr., Dies at 79," *New York Times*, January 1, 1994, 1. On IBM's growth and development during this period see James W. Cortada, "Change and Continuity at IBM: Key Themes in Histories of IBM," *Business History Review* 92, no. 1 (2018).
[220] Benoît Godin, *The Invention of Technological Innovation,* 114.
[221] Given IBM's drastic growth from the 1950s onwards and Watson Jr.'s sensitivity towards the consequences of technological change, it is perhaps unsurprising that the year he became chairman of the board was the same year that the small group of IBM's upper management had got in contact with

With these sentiments, Watson Jr. broadly echoed the opening talk of the first T&SC seminar that had taken place over a decade earlier. The talk was entitled 'Perspectives on Technology' and was delivered by his Director of Education, and leading proponent of the T&SC seminar, Charles DeCarlo.

DeCarlo described his own role at IBM as that of an acceptable maverick and gadfly—perhaps explaining why he became something of a sought after figure at roundtable discussions and public events. Whereas in media appearances and in writing, DeCarlo was often interpreted as having a narrowly technocratic stance, in his talk at the T&SC seminar, DeCarlo was quick to criticize arguments about technological change that he considered too "alarmist" or too "enthusiastic". Instead, he pleaded for sensitivity towards viewpoints that may appear "at first blush" to exhibit "despairing pessimism".[222] Quoting Jacques Ellul at some length, he said that far greater attention needed to be paid to the "subjective world of feelings, values, and the many qualitative aspects of life not susceptible to measurement or mathematical manipulation".[223] He stressed repeatedly that in addition to being related to changes in the economy, technological change was also of a qualitative nature, and that extensive study was required in order to understand the various sorts of effects that such change implied. He stated that, "If there is an insistence upon the view that change effects only the material and technological, and that all past practices fit easily into the new and larger world, then indeed we are headed for trouble".[224]

As one of the driving forces behind its creation, DeCarlo's talk was undoubtedly intended to articulate a clear vision for the T&SC seminar. And in many ways, DeCarlo's ambivalence regarding the promises and perils of technological change did set the tone during first few years.[225] DeCarlo saw the seminar as a necessary forum through which new ways of thinking about technology and its societal impacts could be designed, emphasizing how at the basis of such designs lay concerns about *who* should be responsible for making decisions and according to *what* priorities those decisions should be

Tannenbaum with a view to creating the T&SC seminar. "Tom Watson, Jr. quoted," IBM, accessed October 8, 2021, https://www.ibm.com/ibm/history/exhibits/watsonjr/watsonjr_quoted.html

[222] Charles DeCarlo, "Perspectives on Technology," in *Technology and Social Change*, ed. Eli Ginzberg (Columbia: Columbia University Press, 1964), 21.

[223] Ibid, 11.

[224] Ibid, 29.

[225] According to the seminar's steering committee, DeCarlo's paper was intended to provide a "broad framework for the succeeding discussions". Ginzberg, *Technology and Social Change*, vi.

made. Several ideas which bear familial resemblances with contemporary R(R)I can therefore be identified throughout the talks and exchanges at the seminar. Questions that emerged in and through discussion included, for example: How to better direct science and technology towards the promotion of "human welfare"? How to maximize the "inherent" benefits of science and technology? How to ensure professional standards within and across the institution of science? And, how to forge "linkages or bridges… between pure scientists, engineers, social scientists and other specialists and non-specialists involved in social progress?"[226]

In the next section, I'll turn my attention to a particularly good example of a central theme which dominated discussion during the early years of the seminar—and subsequently became a central concern of proto-STS programs: the relationship between "basic" (or "pure") and "applied" research. Participants realized early on that in order to try and understand the relationship between T&SC—or between technology and its *societal impacts*, there first needed to be some clarity about the *process* of technological change, and in particular about the relationship between science and technology; or, research and innovation.[227]

From Resources to Responsibilities

At the time of the T&SC seminar, the question of the relationship between basic and applied science was also very much a question about the fit and utility of the linear model. According to Godin, the linear model of innovation emerged gradually from the beginning of the twentieth century onwards. While suggesting that "the precise source of the linear model remains nebulous", he traces its origins in the notion that a causal link existed between curiosity driven, "knowledge for its own sake"—basic research; and

[226] Warner cited in Isidor I. Rabi, "Seminar Minutes: The Interaction of Science and Technology," Columbia University Seminar on Technology and Social Change, October 10, 1963, 1. Accessed March 1, 2022 from The University Seminars Digital Archive.

[227] As Cyrus Mody has pointed out, despite ongoing debates regarding in how far people at the time genuinely believed research could be organized along a spectrum from basic to applied, these terms were undoubtedly in widespread use throughout the 1960s and 1970s. Cyrus CM Mody, *The Squares: US Physical and Engineering Scientists in the Long 1970s*, (Cambridge: MIT Press, 2022).

research aimed at solving real world, practical problems—applied research.[228] As Godin notes, though basic and applied research were often seen as in opposition based on motive, they were also considered to be in close cooperation: "basic research was the seed from which applied research grew".[229]

As Mody points out, it is clear that for analysts "basic" and "applied" are essentially constructed categories whose boundaries can be drawn differently at different times. However, as he suggests, many historical actors were actually also "fully away of that point: they keenly felt *both* the interpretive flexibility and the reality of the distinction".[230] According to Mody, when it comes to understanding the construction of the boundary between them, what often matters most is in how far it "underwrote an asymmetry in resource allocation that was more frequently contested from the later 1960s onward".[231] Certainly, at the seminar, resource allocation was an important concern; participants discussed how government support of science could best be organized in the post-war context. There was widely held agreement that the public had new and different expectations regarding the relationship between science and society and the role of the government in directing scientific priorities than had been the case before the war.[232] The extent to which spending should be directed towards particular priorities was, as Earl Johnson put it, "beginning to dawn on people… as a problem of morality".[233]

During the second year of the seminar, two talks were emblematic of the ways in which the boundary between basic and applied research were (re)constructed at the seminar. These talks—and the discussions that

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228 Godin suggests that the linear model of innovation was developed in three stages: "The first linked applied research to basic research, the second added experimental development, and the third added production and diffusion". Benoît Godin, "The Linear Model of Innovation: The Historical Construction of an Analytical Framework," *Science, Technology, & Human Values* 31, no. 6 (2006): 642.
229 Ibid, 647.
230 Mody, *The Squares*, 24.
231 Ibid.
232 The notion that spending on military and space research resulted in "spillover" or "fall out" that would benefit the civilian sector was seen by seminar participants as being highly questionable. The Assistant Secretary of Commerce for Science and Technology Herbert Hollomon commented that "to go to the moon" was "a hell of a way to get better Quaker Oats". Herbert Hollomon, "Science and Civilian Technology," in *The Impact of Science on Technology*, eds. Aaron W. Warner, Dean Morse, and Alfred Richner, (Columbia: Columbia University Press, 1965), 121-123.
233 Earl Johnson, "The Aerospace Industry," in *Technology and Social Change*, ed. Eli Ginzberg (Columbia: Columbia University Press, 1964), 79.

followed—also illustrate the ways in which different framings of this boundary enabled people to put different issues on the agenda. The speakers were two esteemed physicists: Isidor Rabi, a long-time supporter of the Columbia seminars; and Harvey Brooks, a central figure in discussions concerning technology and society relations throughout the '60s and '70s (as will become evident in subsequent chapters). During their respective talks, it was clear that both men shared a similar ideology of technological change insofar as they stressed the need to exploit opportunities for advancing the frontiers of knowledge. However, they had quite different ideas about the relationship between basic and applied research.[234] Rabi addressed the seminar first, in October 1963, with a talk entitled "The Interaction of Science and Technology". [235] Brooks followed in January 1964 with a paper on "The Relation between Science and its Applications".

Having been awarded the Nobel Prize for physics in 1944, by the 1950s Rabi had cemented his reputation as a statesmen of science.[236] According to John Rigden's biography, *Rabi: Scientist and Citizen*, advances in physics and their "consequences for modern culture", then became for Rabi, "an agenda for life".[237] Rigden explains how in the post-war period physicists found themselves "at the hub of potential with opportunity emanating in all directions".[238] At the same time however, there was widespread disagreement as to how government support of basic science should be organized. "What

[234] This is echoed in the titles given to their respective papers published in the seminar's proceedings (which differ from the original titles of their talks). Rabi's paper was titled 'The interaction of science and Technology' and Brooks' 'The Interaction of Science and Technology: Another view'.
[235] Soon after his talk, in 1964, Rabi became the first full University Professor at Columbia. He had previously worked on the Manhattan project during the war, as well as working on radar at the Radiation Laboratory (RadLab) at the Massachusetts Institute of Technology (MIT). By the late 1940s, Rabi had become a "celebrity of physics with broad experiences and established powers" and he soon became a member of the Science Advisory Committee (SAC), of the Office of Defense Mobilization. As the sitting chair of the SAC in 1957, the year it was transformed into the President's Scientific Advisory Committee (PSAC), he took up the role as President Eisenhower's science advisor. See John Rigden, *Rabi: Scientist and Citizen* (New York: Basic Books, 1987), X.
[236] In his review of the T&SC seminar proceedings, Ravetz described Rabi as a "relic of 'little science'", who had been a "Grand Old Man" of science ever since he had ceased to be a "bright young thing". Jerome R. Ravetz, "review of *The Impact of Science on Technology,"* 255.
[237] Rigden, *Rabi: Scientist and Citizen*, ix.
[238] As Rigden writes, "There were jobs to choose from within a range of job sectors; there were clubs to address and banquets to attend; there were committees and commissions to be served. Physicists were sages, and their utterances were reckoned with". He cites a writer in Harper's Magazine who described the situation as follows: "Physical scientists are the vogue these days. No dinner party is a success without at least one physicist to explain… the nature of the new age in which we live". Cited in Rigden, *Rabi: Scientist and Citizen*, 180.

yardsticks should be used to measure significance: Society's needs? Defense needs? The needs of science itself?" [239]As far as Rabi was concerned, "If the science of physics lags, the inheritance of technology is soon spent". He suggested that "To set out a detailed program with practical goals for truly scientific research is like trying to make a map of a country no one has ever seen and the very existence of which is in grave doubt. Pure science cannot have any goal other than the appeasement of the human spirit of intellectual adventure".[240] Rabi covered similar ground in his talk at Columbia; after which, Daniel Bell questioned the huge outlays involved in funding basic research, suggesting that there had to be a specification of priorities somewhere—perhaps much earlier in the R&D process than Rabi's model permitted. Rabi agreed that while few people questioned the "great blessings of science", they often remained skeptical about the rate of return on investment. Yet, he maintained that the public should have faith that within the scientific community there was a sense "of what's right and what is important and what isn't".[241] Effectively Rabi's defense of scientific freedom closely resembled Michael Polyani's ideas about the importance of "tacit knowledge".[242]

The central thesis of Rabi's talk was that scientific research gets started when effort is poured into a certain field, "of a nature so wonderful and so original", that "interesting things do come out".[243] In making this point, he made clear that despite being of the "same breed", science and technology did not sit well together. He said, "It is a little bit like the race horse and the draught horse, being hitched together for practical purposes".[244]According to Rabi, you could easily chart the stages through which scientific knowledge was translated into technology and these neatly corresponded with the "different types of scientific imagination". This began with "the theoretician", moving to "the experimentalist" and then on to "the man involved in technique", who could "reduce an invention to some practical

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[239] Rigden, *Rabi: Scientist and Citizen*, 188.
[240] Rabi cited in Rigden, *Rabi: Scientist and Citizen*, 188.
[241] Isidor I. Rabi, "Seminar Minutes: The Interaction of Science and Technology," 11.
[242] Michael Polyani, *The Tacit Dimension* (London: Routledge, 1966).
[243] Ibid, 13.
[244] Ibid, 2. This metaphor was found by some to be somewhat problematic, as Melvin Kranzberg pointed out in the discussion, a racehorse is generally found to be "guided in some measure", Ibid, 17.

form.[245] Success in scientific endeavors was therefore primarily a matter of good organization. Leadership was essential; so too was teamwork. Rabi provided a number of examples from his own career, wherein excellent leaders had attracted excellent team-members. He then used these examples in order to argue that groups of scientists should be allowed to pursue their own curiosity, for creativity required autonomy. Despite clearly seeing applied science as an important end goal, Rabi insisted that sorts of activities were of an altogether different breed in order to defend the notion that "basic" research should be driven by intellectual opportunity alone.

For Rabi then, the government's support of science could be justified by the needs of science itself. For Harvey Brooks however, the picture looked somewhat different. Whereas Rabi felt that society needed to accept expenditure in science, and trust the scientists and their sense of what was important and what was not, Brooks argued that there was little question that in a democracy the responsibility for the allocation of funds should be shared between scientists, engineers, industrialists, public representatives, and citizens. In his own talk, Brooks challenged what he considered the "excessively comforting" notion that the relationship between science and technology was straightforwardly linear.

Speaking a few months after Rabi, in January 1964 on "The Relation between Science and its Applications", Brooks suggested that new technologies were often the product of industrial necessity and "mechanical ingenuity", referring to examples such as barbed wire, the typewriter and the sewing machine.[246] Brooks said

> When one thinks of the relationship between basic science and applied science, one is inclined to think of dramatic models, like the atomic bomb, or the transistor… and the analogy which comes to mind it the analogy of the seed and the plant; basic science is the seed and technology is the plant. The basic science idea is converted into a technology. This, however, is a misleading model… A better analogy, I am inclined to feel, is the analogy between the seed and the fertile field. The role of scientific knowledge and the role of science in the development

[245] Finally, there was also the "problem of production", but this required "another kind of engineer—with another kind of imagination". Rabi, "Seminar Minutes," 3.

[246]. Harvey Brooks, "Seminar Minutes: The Relation between Science and its Applications—with Particular Reference to Government," Columbia University Seminar on Technology and Social Change, January 9, 1964, 2. The University Seminars Digital Archive.

> of technology is to provide the environment in which technological ideas can be exploited, rather than in fact being itself the origin of a technological idea.[247]

Brooks explained that while it was generally assumed that the transistor was a product of solid-state physics, understanding its development and successful exploitation required looking at chemistry, metallurgy, and various kinds of techniques, some going back as far as the 1900s.

During the War, Brooks had worked on the development of "Fido", an acoustic homing torpedo, at the Harvard Underwater Sounds Laboratory and subsequently made the decision to join General Electric's Knolls Atomic Power Laboratory rather than Bell Laboratories—given the focus of the former on the "possibilities of civilian applications of fission physics".[248] After a decade of science-based engineering, Brooks returned to Harvard, as Gordon McKay Professor of Applied Physics. In the early 1960s, he was appointed to the President's Science Advisory Committee (PSAC) under President Kennedy. During his 50 years at Harvard he cemented his reputation as a pioneer in incorporating science in to public policy. In a tribute to Brooks, published by the National Academy of Engineering, John Holdren wrote that "For at least the last 40 years of his life, he was the best known, best read, and most respected scholar in the world in the field of science and technology policy—the acknowledged chief architect and dean of the discipline".[249] Holdren suggests that much of Brooks' career was shaped by his fascination in "bridging the gap" between theoretical and applied science, he writes

> He was fascinated from the earliest stages of his career with interactions across boundaries: the interaction of fundamental with applied science, the interaction of science with technology, and the interactions across the still more complex and fractious boundary of science and technology with the public-policy process. This

[247] Brooks, "Seminar Minutes," 2-3.

[248] Returning to Harvard a decade later, Brooks received an invitation from the Atomic Energy Commission (AEC) to join the Advisory Commission on Reactor Safeguards (ACRS), whose task it was to review plans for civilian reactors from the standpoint of public safety. According to Lewis Branscombe, during these experiences Brooks cultivated a "deep concern" for conflicts that were predicated upon technology and social values, becoming "particularly interested in the strengths and limitations of alternative institutional arrangements for mediating strongly held differences of views". See Lewis M. Branscomb, "Biographical Memoirs: Harvey Brooks, 1915-2004," *National Academy of Sciences*, 2014: 5.

[249] John Holdren, "Memorial Tributes: Harvey Brooks," 2004, p. 4. Accessed March 1, 2022, https://www.belfercenter.org/publication/tribute-harvey-brooks

> fascination with boundaries shaped a professional life in which Harvey, in turn, reshaped the understanding of all of us about the intersections of science and technology with each other and with society.[250]

It is clear that during their talks at the T&SC seminar, both Rabi and Brooks engaged in "boundary work"—using rhetorical strategies to articulate what should be considered *real* science and as such, in possession of a legitimate claim for financial support and autonomy.[251] Rabi constructed boundaries around different types of scientific imagination, where only the technician should really be concerned with the societal impact of science in its applied form. For Brooks, on the other hand, the fruits of technology were not always the application of science "per se", but instead the result of a far less linear, more dynamic process. Rabi suggested that science and technology were like a "symphony orchestra", where each (separate) section should work in harmony—despite their use of different instruments and techniques, whereas Brooks stressed their "symbiotic" nature, claiming that scientists and engineers often shared the same qualities of mind.[252] Ultimately, while Rabi sought to reinforce the boundary between basic and applied research, suggesting technological work was quite different from, and also potentially destructive of, real science, Brooks tried to obscure or dissolve the boundary, by recognizing and identifying some of the complexities involved in the interaction between them.

Brooks suggested that the more relevant and interesting tension existed between opportunity and need (or autonomy and responsiveness). Along one dimension, Brooks placed the priority of "social goals", and along the other, the priority of "intellectual opportunities", stressing that too much emphasis in either direction would inevitably lead to "trouble".[253] Brooks' idea was that, "spending on intellectual opportunity would be tempered by what is socially needed; at the same time, spending on what is socially needed would

250 Ibid.

251 See Thomas F Gieryn, "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists," *American Sociological Review* (1983): 781-795.

252 Rabi, "Seminar Minutes," 9-10; and Brooks, "Seminar Minutes".

253 Harvey Brooks, "The Interaction of Science and Technology: Another View," in *The Impact of Science on Technology*, eds. Aaron W. Warner, Dean Morse, and Alfred Richner, (Columbia: Columbia University Press, 1965).

be tempered by the state of the art".[254] In the discussion that followed, participants were largely receptive to Brooks' framing. He also received a number of questions related to the importance of the marketplace and other social and cultural factors in shaping R&D trajectories. Brooks acknowledged that numerous qualitative factors undoubtedly played a critical role in shaping technological change (both in terms of *process* and *societal impacts*) and that extensive inquiry into these sorts of questions was required.

Overall, as a number of seminar participants pointed out during the discussion, what Brooks' talk seemed to be getting at was that it was undesirable and increasingly untenable to draw a sharp distinction between basic and applied research. Consequently, through the course of subsequent exchanges at the T&SC seminar, questions about resource allocation were less about reinforcing a boundary between basic and applied research and more about priority setting; codes of conduct; societal impacts; and citizen engagement. All of which were themes that would figure prominently in the early years of (proto-)STS and that contributed to the matter-ing of responsibility in research and innovation.

An Intellectual Movement on the Move

As a result of the sorts of issues raised in talks and discussions like the two discussed above, seminar participants broadly agreed that when it came to understanding the relationship between T&SC, new areas of study were needed that would cut across departmental or disciplinary lines. Rabi suggested that the T&SC seminar was a good sign that the tides were turning in this direction.[255] Alvin Weinberg, a nuclear physicist at the Oak Ridge National Laboratory (ORNL), agreed stressing that the discussions at

[254] Aaron W. Warner, "Summation," in *The Impact of Science on Technology*, eds. Aaron W. Warner, Dean Morse, and Alfred Richner, (Columbia: Columbia University Press, 1965), 213.

[255] Rabi believed that new forms of organization, such as "schools of advanced studies", could be organized along interdepartmental lines, in order to counter the increasing specialization of academic training. These schools would be places where emerging fields of study, like the history of science, for example, could find a home, allowing them to develop into self-sustaining disciplines. They could also provide courses for scientists who might want to retrain in economics or sociology—which he envisaged would be an increasingly valuable skill-set in both government and private industry. Isidor Rabi, "The Interaction of Science and Technology," in *The Impact of Science on Technology*, eds. Aaron W. Warner, Dean Morse, and Alfred Richner, (Columbia: Columbia University Press, 1965), 34-35.

Columbia had set an important precedent for issues surrounding social responsibility to be taken seriously.[256] He said

> There has been an implicit intellectual choice of the scientific and university community to abrogate their responsibility for the changes which are taking place in social institutions. I think these are the problems that the seminar must deal with. This is where you really need the philosopher, because you are dealing with choice, you need the economist because you are dealing with the flow of human activity, and you need the sociologist because you are dealing with the effect on the ways people live.[257]

Indeed despite some participants remaining skeptical of inter- or multi-disciplinary approaches, the majority accepted that thinking critically about T&SC would, "require much creativity on the part of the social scientist and the physical scientist working together" in order to develop "a historical sense on the one hand and a sense of the emerging problems and needs on the other".[258] According to Stevan Dedijer—who founded the research policy institute at Lund University in 1972—one of the most impressive traits of the T&SC seminar was that there was "a continual striving by all the participants to transform the know-how knowledge, the conjectures and generalizations of practical men of affairs, into a scientific field of endeavor".[259] In fact, in

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256 Weinberg is perhaps best remembered for his promotion of the idea of the "technological fix". See Sean F. Johnston, *Techno-fixers: Origins and implications of technological faith*, Montreal: McGill-Queen's Press, 2020.

257 Alvin Weinberg "Seminar Minutes: Government, Education, and Civilian Technology," Columbia University Seminar on Technology and Social Change, March 12, 1964, 21. The University Seminars Digital Archive. Weinberg also told the seminar, "I think that the people down at Oak Ridge would become better citizens and a better community if our scientists became more aware of these social problems". He described a six-week seminar at the Oak Ridge National Laboratory (ORNL), as "a small attempt to bridge the gap between the two cultures". The seminar had brought together ORNL scientists with some thirty-five social scientists and humanists, and centered on the discussion of contemporary social problems. Weinberg considered the seminar a success and hoped that similar seminars would soon be repeated elsewhere. Weinberg organized the seminar with the help of Yale historian and bibliometrist of science, Derek de Solla Price. Teachers at the seminar included Robert Oppenheimer, Margaret Mead, and Melvin Kranzberg. See W. W. Grigorieff, "Science for Nonscientists: The so-called 'Humanities Conferences' at Oak Ridge Associated Universities," *Review: Oak Ridge National Laboratory* 2, no. 1 (Summer 1968): 18-26.

258 Editor's introduction to part 2 of the volume. They also wrote that "Scientific discovery and technological advance can be fruitless—indeed, in certain cases may prove dangerously disruptive and corroding—if the politician, the social scientist, and the philosopher do not participate actively and constructively in helping to solve the problems created by the impact of technological change on society". Morse and Warner, "Technological Innovation," 91.

259 Stevan Dedijer, "A Workshop on the Research Policy of the United States," review of *The Impact of Science on Technology,* by Aaron W. Warner. *Science* 148, no. 3678 (June 1965): 1708.

terms of both its content (e.g. the relationship between technology and social change—*societal impacts*; and the relationship between basic and applied research—*process*) and approach (e.g. interdisciplinary and problem-oriented), the seminar provided a model for new academic programs created towards the end of the 1960s.

Perhaps some of its closest links were with the Technology and Society program at Harvard—which was just one example of the seminar's lasting influence. Building on the success of the T&SC seminar, two years later IBM announced a $5 million dollar set-up grant in order to get the Harvard program up and running. In the announcement, Thomas Watson Jr. stated

> Today's technology creates extraordinary possibilities for conquering disease and poverty, for raising living standards and increasing leisure. At the same time, it confronts us with problems of considerable magnitude. We believe the Harvard studies will be useful in identifying and analyzing the effects of technological change and automation on individuals, the economy and government. Hopefully this work will help generate the understanding and ideas our country needs to get the full benefits of technology while minimizing disruption and hardship.[260]

He had previously declared, "Those responsible for technological change have some responsibility also to gauge its consequences for society".[261] In a statement before a Congressional committee Watson called for the creation of new programs that would "undertake a unified analysis of the problems inherent in change", programs which would "explore new and untried—and perhaps adventurous—approaches to their solution".[262] Brooks once provocatively quipped that perhaps the original motivation for this "rather open-ended" grant was the "guilty conscience on the part of Mr. Watson".[263]

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[260] IBM, "IBM Grants Harvard $5 million for Technology Study," *IBM National News*, June 10, 1964. Courtesy of IBM Corporation.

[261] Watson J. cited in Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge: MIT Press, 2012), 52.

[262] Watson Jr. also said that while "all agree that technology has eased man's burden… the problems created by technology touch all levels and aspects of our national life". He continued, "Automation and technological change are complex phenomena and not enough is understood about them. They have to be carefully analyzed if we are to find new economic and social solutions to the problems they create". U.S. Congress. House. Committee on Education and Labor, *National Commission Technology, Automation and Economic Progress; Hearings before the Committee on Education and Labor.* 88th Cong., 2nd Sess., 1964, 116-117.

[263] Harvey Brooks, "Autonomous Science and Socially Responsive Science: A Search for Resolution," *Annual Review of Energy and the Environment* 26, no. 1 (2001): 40.

Much like the T&SC seminar before it, the Harvard program focused broadly on the relationship between T&SC and put a great deal of emphasis on dialogue and discussion across disciplinary divides.[264] Research projects would identify and analyze the "impacts and effects of technological change on the economy, business, government, society, and individuals and to suggest possible action programs to anticipate, control, and adjust to such effects".[265] On the faculty committee responsible for hiring a new executive director for the program was Harvey Brooks, alongside fellow Deans Carl Kaysen (Public Administration) and Don K. Price (Kennedy School of Government)—who later became an important sparring partner for scholars in the emerging field of STS.

The committee appointed Emmanuel Mesthene—who had recently received his doctorate in philosophy at Columbia, having worked for some years as a policy analyst at the RAND Corporation and then at the Organization for Economic Cooperation and Development (OECD). Mesthene's ambition for the Harvard program was that it would mine the middle ground between the "military leaders and aerospace industrialists" who understood technology as the "motor of all progress," and the "artists, literary commentators, popular social critics, and existentialist philosophers" who declared technology to be an "unmitigated curse".[266] Mesthene hoped that the Harvard program would contribute to the creation of a "new vocabulary" as called for by Bell during the first year of the T&SC seminar.[267] In his own writing, Mesthene often emphasized the difference between first-order (e.g., changes to material conditions) and second-order (e.g., changes to institutions) impacts and effects, stressing the importance of anticipation in trying to align technological and societal values.[268]

[264] Initially, Watson had wanted the Harvard program to study the potential effects of computers on the workforce, given the widespread fear that they were going to cause massive unemployment. However, by the time the program got started, its design had become more comprehensive, much like the T&SC seminar at Columbia.

[265] In Wisnioski, *Engineers for Change*, 52.

[266] Mesthene, quoted in Wisnioski, *Engineers for Change*, 52.

[267] According to Mesthene, those involved in the program were "forced to forge a new language to deal with a theme that does not fall clearly within the sole competence of any known specialty that already has a fully developed language of its own". He described how much of the early discussions within the program were a case of "learning to talk", in the sense that as the program went on, they had "begun to talk with, rather than just at, each other." Emmanuel G. Mesthene, "An Experiment in Understanding: The Harvard Program Two Years After," *Technology and Culture* 7, no. 4 (1966): 481.

[268] See Emmanuel G. Mesthene, "How Technology will Shape the Future," *Science* 161, no. 3837 (1968): 135-143.

People who engaged with the Harvard program mostly recalled it having made positive and lasting impressions on them. For example, Anthony Oettinger, Director of the Program on Information Resources Policy at Harvard University, and former president of the Association for Computing Machinery (ACM) described his own involvement, suggesting that it had broadened his interests, opening him up to new disciplinary perspectives and ideas to which he had not been exposed before. He described having found the experience "remarkably stimulating".[269] Having initially been quite optimistic about technological developments, Oettinger recalled, in an oral history interview with Atushi Akera, that by the late 1960s he had become "quite skeptical about the promising hype" surrounding new technologies.[270] He spoke of how his exposure to the Technology and Society program had sensitized him to "the importance of the socio-political organizational context".[271] He said, "I've ever since been much more conscious of the need to look at organizational, legal, and cultural environments in thinking about the effective use of technology".[272]

Having bankrolled the Harvard program in 1964, IBM then provided a corporate gift of $150,000 for the establishment of an Institute for the Study of Science in Human Affairs at Columbia that opened in 1966.[273] The Columbia institute planned to study such topics as "The relationship between science and the making of public policy; the impact of the development of electronic music on the composer, the performer, and the audience; the effect of computer technology on medicine and medical education" and "the significance of radiation physics for public attitudes and fallout".[274] In charge of the Columbia institute was T&SC seminar regular Christopher Wright, a

[269] Anthony Oettinger "Oral History," interview by Atushi Akera, ACM History Committee, January 10, 2006, 16.
[270] Oettinger, "Oral History", 44-45.
[271] Ibid.
[272] Ibid.
[273] The primary source of funding for the institute was a $1 million grant from the Alfred P. Sloan Foundation. The Institute also received $150,000 from the Commonwealth fund in support of the Institute's studies of medicine and the biomedical science in human affairs. It also received $85,000 from the Russel Sage Foundation for a further program on science, technology and social change to be directed by Daniel Bell, and $75,000 from the Josiah Macy Jr. Foundation in support of the Institute's program on the history of medicine. See Anon, "Institute at Columbia Given $460,000 in Grants," *New York Times*, July 12, 1967, 26.
[274] Leroy F. Aarons, "Columbia Sets Science Impact Institute," *The Washington Post*, November 13, 1966, L4.

Columbia faculty member and former executive director of the University's Council for Atomic Age Studies.[275]

According to Wright, the institute represented "a commitment on the part of the University to anticipate problems before they become major issues… To look at the present and the past not just for themselves, but as to how they are relevant for the future".[276] He continued, "We must learn how the future is going to be different than the present so we can better prepare for it"—echoing a comment first made by Harvey Brooks at the T&SC seminar.[277] Even before Mesthene started talking about anticipation in relation to the Harvard program, Brooks had suggested during the seminar that, "We ought to worry more about controlling and directing this [technological] change—perhaps even anticipating it more than controlling it".[278] Given that Wright and Brooks were in close correspondence throughout the 1960s, and that, according to Oettinger, Brooks was effectively the "guru behind Mesthene" over at Harvard, it seems likely that both programs' orientation towards anticipating the effects of technological change were largely shaped by the ideas of Harvey Brooks.[279]

By the late 1960s, the Harvard program's output had begun to cause quite a stir. As Matthew Wisnioski has pointed out, the fact that "advising and communicating its findings" was "a Who's Who of the nation's power elite" meant that it soon became the "most prominent voice in the debate about technology in the 1960s".[280] For example (as we will see in the next chapter), Democrat Congressman Emilio Daddario repeatedly turned to Harvard program scholars for advice when composing new legislation regarding Technology Assessment (TA). At the same time however, the program's output was chastised by some for being vacant, abstract and overly sanguine.

In a response to Mesthene's report on the program's progress in its fourth year—that had been distributed (free) to the public—the Marxist philosophy professor John McDermott published an article in *The New York Review of Books*. In the article, he accused Mesthene of pursuing "a not new

[275] Christopher Wright also wrote the introduction for the second volume of proceedings.
[276] Wright quoted in Leroy F. Aarons, "Columbia set Science Impact Institute," 4.
[277] Ibid.
[278] Brooks, "The Interaction of Science," 58.
[279] Oettinger, "Oral History," 24.
[280] Wisnioski, *Engineers for Change*, 53.

but… newly aggressive right-wing ideology".[281] In 'Technology: The Opiate of the Intellectuals', McDermott argued that humanists and social scientists alike were being used in order to obscure the "evils that were being wrought in the name of progress".[282] But as Ruth Schwartz Cowan writes in her reflection on the piece, "McDermott's essay is 99 percent ideology and only 1 percent evidence" and his "technological pessimism" was essentially "profoundly snobbish".[283] The philosopher Larry Hickman also observed that while Mesthene and McDermott were both "ostensibly writing about technology", what they were actually writing about was "different issues under the same rubric".[284]

While the voices of dissidents and critics like McDermott were seen by some as being "shrill, superficial, illogical, confused, and irresponsible", reviews of Mesthene's report were decidedly mixed.[285] Peter Drucker (remembered as the man who invented management thinking), Anderson Hunter Dupree (a pioneer in the history of science and technology), and Simon Ramo (chief scientist 1954–58 of the U.S. intercontinental ballistic missile program), were full of praise in *Technology and Culture*. For example, Ramo wrote that he found the Harvard program to be "substantive, pertinent, and, overall, thoroughly worthwhile".[286] In *Science* meanwhile, Kenneth Boulding and George Basalla were less enamored with its output. Though Boulding acknowledged that despite its shortcomings, there was "a good deal of mature reflection" in Mesthene's report, which successfully deflated "a fair amount of popular nonsense on the subject"; Basalla called the report an example of "bland and sterile philosophizing" which promoted a "utopian outlook" and an "all-too-ready acceptance of the need for a ruling

[281] John McDermott, "Technology: The Opiate of the Intellectuals," in *Technology and Values*, eds. Kristin Shrader-Frechette and Laura Westra (Oxford: Rowman & Littlefield, 1997), 88. Originally published in *The New York Review of Books* July 31, 1969.
[282] Ruth Schwartz Cowan, "Looking Back in Order to Move Forward: John McDermott, 'Technology: The Opiate of the Intellectuals'," *Technology and Culture* 51, no. 1 (2010): 204.
[283] Ibid., 205.
[284] See Larry A. Hickman, "Populism and the Cult of the Expert," In *Democracy in a Technological Society*, ed. Langdon Winner (Springer, Dordrecht, 1992), 91-103. Another reason for McDermott's attack could have been personal, for as Schwartz Cowan notes, McDermott had once been a student of Mesthene's when he was teaching at a liberal arts college.
[285] George Basalla, "Addressing a Central Problem: Harvard University Program on Technology and Society, 1964-1972: A Final Review," *Science* 180, no. 4086 (1973): 584.
[286] Simon Ramo, "Comment: The Anticipation of Change," *Technology and Culture* 10, no. 4 (1969): 514.

technocratic elite".[287] In the end, IBM seemed to agree more with its critics than its supporters; unhappy with the lack of results, they terminated the program in 1972—two years earlier than planned; the Columbia program also came to an end that same year, though exactly why remains unclear.

Despite its premature demise however, the Harvard program was widely considered a pioneer and, if nothing else, to have been an "interesting and promising experiment".[288] According to Franklin Long, co-founder of Cornell's program on Science, Technology, and Society, the Harvard program was the "earliest" of its kind, in what would soon become "a well-trodden path". Long suggested that many of the later starters "tried to emulate its successes and to learn from its difficulties".[289] What subsequent programs often shared was that they sought to create new forms of expertise, producing "generalists" who could speak with some authority on the relationship between science, technology, and society, clearly bearing the influence of discussions at the T&SC seminar.

Whereas the creation of the programs at Harvard and Columbia relied on external grants and the input and leadership of social scientists, Cornell's program took a different route; having been funded internally and put together by a small team of scientists. The establishment of the Cornell program in 1969 was attributed "at least in part" to ongoing campus unrest, where it was seen as a response to the demand for more "interdisciplinary courses at the undergraduate level on topics relevant to the world's problems".[290] As explained in *Mosaic Magazine*, it was not only civil rights and the Vietnam War fuelling student protests nationwide, but also the "perceived detachment" of their education, and a desire to grapple "with the 'real world' of hard answers".[291]

When students began to march early that spring, Cornell's Science, Technology, and Society program had already been several years in the making. Since the mid-1960s, inspired by discussions at the T&SC seminar,

[287] Kenneth E. Boulding, "Tools on a Grand Scale: Technological Change," *Science* 168, no. 3938 (1970): 1442; and Basalla, "Addressing a Central Problem," 584.
[288] Franklin A. Long, "Harvard University Program on Technology and Society, 1964–1972: A Final Review," *American Scientist* 60, no. 6. (1972): 777-778.
[289] Other examples included Pennsylvania State University (1968 /69), Stanford University (1970/ 71), Lehigh University (1972), and MIT (1977).
[290] Franklin A. Long cited in Cutcliffe, *Ideas*, 10.
[291] Mosaic, "People and their Technologies," *National Science Foundation: Mosaic Magazine* 3, no. 1 (Winter, 1972): 15.

as well as by the creation of the programs at Harvard and Columbia, a small group at Cornell had already begun experimenting with different ideas for a new program, organizing their own seminar series in order to test the water.[292] Yet the program only officially got under way following the armed occupation of the Cornell student union building by the Black Panthers and Students for a Democratic Society in the spring of 1969. The Straight Hall takeover led to a variety of campus reforms, among which should be counted the two new undergraduate courses offered by the Science, Technology & Society program that fall.[293] Initially, 200 students signed up for an engineering course on the Social Implications of Technology, and 600 for a course on Biology and Society. The overall program drew upon over 150 Cornell faculty, "from every imaginable discipline", as well as external contributors and volunteers. The Monday evening lectures were something of a spectacle, with queues of students lined up around the block. During one lecture, a survey showed that more than a fifth of those in the audience were not even registered students. In fact, anyone in the vicinity could tune into the lectures that were also broadcast via Cornell's WHCU-FM.

Similar efforts were also underway on the West Coast. In 1969, for example, a group of young scientists organized a course of lectures on 'The Social Responsibility of the Scientist' at the University of California, Berkeley.[294] Like the T&SC seminar, key themes included the allocation of resources, the setting of priorities, the potentially harmful consequences of scientific development, and the responsibility of the scientist to become politically engaged in matters concerning the public interest. Stanford also started its own Science, Technology, and Human Values program in 1971.[295] Meanwhile in Europe in 1971, the Weizmann Institute—who had been in contact with Tannenbaum some years earlier—organized a major symposium

[292] Alongside Long, the other co-founders were Robert Morison, whose work concentrated on the ethical and legal implications of advances in biological and medical technology; Raymond Bowers, whose research centered upon technology assessment; and Max Black, who was interested in the interplay between science, technology, and the humanities. Initially the group had thought to focus the program on "the interaction of science and people", but they were later persuaded by students at Cornell to broaden the program to Science, Technology, and Society. .

[293] For an overview and additional sources on this, see Charles T. Clotfelter, *Unequal Colleges in the Age of Disparity*, Cambridge: Harvard University Press, 2018.

[294] See Santa Clara Conference, "The Social Responsibility of Engineers," *Technology and Culture* 11, no. 2 (1970): 241.

[295] See "A Brief History of the Field," Stanford University, accessed 14 June, 2022, https://sts.stanford.edu/about/brief-history-field

on 'The Impact of Science on Society' in Brussels. The meeting focused on the question of priorities, as well as on the consequences of scientific and technological change, bringing together individuals from a number of different countries including scientists, politicians, writers, and industrialists.[296]

In October that same year, the OECD published a "landmark" report entitled *Science, Growth, and Society—A New Perspective*.[297] Chaired by Harvey Brooks, the report introduced many of the themes discussed almost a decade earlier at the T&SC seminar.[298] According to Jean-Jacques Salomon, Head of the OECD's Science Policy Division (and speaker at the Weizmann symposium in Brussels), the report reviewed the "achievements, deficiencies, and limitations" of science policy in the 1960s, before suggesting a new "new framework and new approaches" to science policy in the 1970s. It also acknowledged that lessons drawn from discussions about science and technology policy in the U.S. during the 1960s were relevant for other local and/or international contexts. As we will see over the course of the next chapter, concerns and questions initially raised during the T&SC seminar not only influenced proto-STS programs in the late 1960s and early 1970s, but also played an important role in the policy context as well; particularly as a means of justifying the need for new approaches, such as technology assessment.

[296] See the proceedings of the seminar, published by Anthony R. Michaelis and Hugh Harvey, "Scientists in Search of Their Conscience," New York: Springer, 1973.

[297] For a contemporary review of the report see James J. Zwolenik, "Science, Growth and Society: A New Perspective," (1971): 457-464.

[298] The report was produced by an ad hoc committee of eight "distinguished" members, including: Harvey Brooks (Chairman), Harvard University; John B. Adams, Organization for Nuclear Research (CERN); Umberto Colombo, Montecatini-Edison; Michel Crozier, Centre de Sociologie des Organisations; Carl Kaysen, Institute for Advanced Studies, Princeton; Thorkil Kristensen, Institute for Development Research, Copenhagen; Saburo Okita, Japanese Economic Centre, Tokyo; and Carl F. von Weizsacker, Max Planck Institute on the Predconditions of Human Existence in the Modem World, Starnberg, Germany. Associated with the members were Jacques Spaey, OECD Committee for Science Policy and Alexander King, Director-General for Scientific Affairs, OECD. The secretary was Jean-Jacques Solomon, Science Policy Division. Ibid.

Conclusion

According to Matthew Wisnioski, "it is difficult to overstate the profusion of ink spilled about the nature of technology in the 1960s". As we have seen, the period did indeed see the emergence of "a new genre of technology & society writing" that "cut across academic disciplines, political positions, and popular audiences".[299] In this chapter, what I have tried to show is that despite having been largely overlooked within histories of STS, the T&SC seminar was more than a "sounding board for ideas", having contributed in various ways to a "heightened awareness of technology-society interactions".[300] This was not only thanks to the seminar having pioneered publishing its proceedings under the Columbia University Press—with subsequent reviews appearing in the likes of *Technology & Culture*, *Science* and the *New Scientist*. An agreement was also reached between the steering committee of the seminar and the U.S. department of Labor—the Office of Automation, Manpower, and Training—ensured that copies of the proceedings could be broadly disseminated, so that "a larger group of interested citizens" might be "drawn into the vortex" of the seminar's discussions.[301]

The broad dissemination of the T&SC seminars proceedings, combined with their timely nature, meant that the seminar became something of an exemplar for proto-STS programs to follow. The seminar provided a space within which key figures like Charles DeCarlo, Isidor Rabi and Harvey Brooks could engage with issues surrounding technological change—in a more nuanced manner than was typically possible—highlighting the need for further research into the relationship between technology and society as well as the different understandings of responsibility which this rapidly evolving relationship implied.

It certainly appears that by the late 1960s, the technology and society "genre" could itself be described as an intellectual movement in the making. By then, it was a recognizable collective effort in pursuit of a research

[299] Wisnioski, *Engineers for Change*, 42.
[300] Granville Sewell, "Seminar Minutes: Some Reflections on Science-Technology-Society Studies in the Seminar's Tenth Year," Columbia University Seminar on Technology and Social Change, October 10, 1963. The University Seminars Digital Archive.
[301] Eli Ginzberg, ed., *Technology and Social Change*, 2.

program and though it did face (some) resistance from members of the intellectual community, it successfully created a number of institutional footholds. The network created at the T&SC seminar successfully brought together high-status intellectual actors who coordinated activities and enabled access to key resources. For example, opportunities for publication were provided through edited volumes like the T&SC seminar proceedings (the essays from which were often also published in other outlets), and academic jobs were created through the establishment of new programs, such as at Harvard and Columbia.

While many of these initiatives were short-lived, they did not disappear entirely. On the one hand, they can be seen as having tilled the ground, providing fertile pastures upon which the field of STS would soon begin to grow. On the other hand, many of the themes and topics discussed by the likes of the T&SC participants continued to shape developments in science and technology policy for many years to come. For example, in the U.S. through the creation of the Office of Technology Assessment (OTA), as well as internationally, through the likes of the OECD (as I will explore further in the next chapter). More recently, many of the issues first raised at the T&SC seminar can be traced through the evolution of R(R)I discourse, where some of the ambivalence first articulated in the 1960s has found new energy in relation to today's latest set of technological concerns.

As Emmanuel Mesthene put it, when the Harvard program got started, "the phrase 'technology and society' was little more than that—a phrase. There was no definition of a field of inquiry and there was little idea of where research should begin or how it might be structured".[302] Even Basalla mounted a defense for the program along these lines, acknowledging that when it got started a "theoretical framework for a study of the social implications of technology was virtually non-existent".[303] But by the mid-'70s all that had changed. What had initially been the subject of small discussion groups in pockets across the U.S. in the early 1960s, had become a topic of transnational debate by the start of the 1970s. Throughout the rest of the decade, an intellectual community began taking shape on both sides of the Atlantic. The emergence of 4S and the creation of the journals *Social Studies of*

[302] Emmanuel G. Mesthene, "Fourth Annual Report of the Program on Technology and Society," Boston: Harvard University, 1968: 6.
[303] Basalla, "Addressing a Central Problem," 584.

Science, and *Science, Technology and Human Values* signalling the steady establishment of a nascent field.

Despite significant interest in proto-STS programs from the outset, by the 1980s, many of them had either "died a quiet death or substantially lost momentum".[304] This suggests that in contrast to more triumphalist, linear narratives of R(R)I, there was something of a turn away from responsibility, or at least from the kinds of activities necessary to make responsibility matter within research and innovation. Though subsequent STS programs would later pick up on what their predecessors had dropped, there was quite a long gap within which responsibility didn't seem to matter, even to the kinds of people once involved in proto-STS *and* to those who would go on to become a part of a more professionalized STS. Perhaps as a result, in contrast to activist narratives and reform movements, which are (gradually) becoming an accepted part of the history of STS, little has been written about the role that proto-STS programs played in helping to create the conditions for the emergence of the field. Instead, they have typically been chastised for having been too safe, too traditional, and too ill prepared to seriously challenge the status quo; or, for having been too practical, too political, and too anti-technology in outlook.[305] While admittedly they did meet with mixed success, these programs remain important predecessors of STS, in that they sought to explore both the *process* and *societal impacts* of science and technology in order "to offer insights into better ways of controlling and directing them as societal forces".[306]

Through the course of the 1970s and 1980s, as the new field of STS sought to professionalize academically, it took a detour away from the sorts of heterogeneous commentators who had contributed to proto-STS (Low Church) activities like the T&SC seminar. Some scientists and engineers changed lanes; received training in the social sciences and went on to contribute to the consolidation of STS as an academic field (High Church). For example, in the Netherlands, consider the career trajectories of two STS stalwarts: Arie Rip and Wiebe Bijker. Rip has described his own career as

[304] Jasanoff, "A Field of Its Own," 196.
[305] See e.g. Jasanoff, "Floating Ampersand," 231; Jasanoff, "A Field of its Own," 196; and Cutcliffe, *Ideas*.
[306] Cutcliffe, *Ideas*, 11.

having been a “mixing of the two STSs”.[307] While Bijker has spoken of his “detour” away from natural science, engineering and activism into the academy, which reflected the path taken by many students of STS at the time.[308] Subsequently, bridge-building between the High and Low Churches has become a key part of the genre of STS autobiography. Yet the contribution of those who did not pursue a career in STS—other bridge-builders, like Harvey Brooks for example—seems to have been forgotten.

As I alluded to in the previous chapter, existing histories have examined how certain groups demonstrated particular ideologies of technological change, from the anti-nuclear scientists of the late 1950s and early 1960s, to members of the environmental and consumer movements of the ’60s and ’70s. I also suggested that actors within these movements often themselves reinforced the dichotomy between optimists and pessimists asymmetrically —depending on their own position—by gesturing towards abstract writings that were intended for a general audience. What we have seen in this chapter however is that, when taken at face value, it may very well be true that texts produced by the likes of Charles DeCarlo, Harvey Brooks, or Emmanuel Mesthene can sometimes read as highly polemical defenses of the dictum that “more technology will solve everything”. Yet when we look more closely at specific, concrete channels of communication, often a rather more nuanced picture emerges—where different conceptions of responsibility were made to matter in different ways.

At discussions like those held during the T&SC seminar, where specific people addressed each other *in the moment*, the dichotomy between optimists and pessimists often disappeared, and in its place, a far more complex, fuzzy, ambivalent picture emerged. Both DeCarlo and Mesthene spoke of the importance of finding new “middle” or “generalist” positions that would reveal more “subtle relationships” and ultimately deliver more “differentiated conclusions”. While Brooks and Wright emphasized the importance of anticipating societal needs and attempting to steer technological outcomes towards more desirable goals. Therefore, examining actors’ specific exchanges regarding the *process* and *societal impacts* of technological change

[307] Having studied chemistry before becoming a part of the science in society movement in the 1960s, Rip went on to help create a “Chemistry and Society Program” at the University of Leiden, becoming a high-status actor as the field developed through the 1980s. Arie Rip, "STS in Europe," 75.
[308] Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change,* (Cambridge: MIT press, 1997), 4-5.

suggests that in their attempts to negotiate a new common language, different dimensions of social responsibility played a key role. Ultimately, though their positions can seem internally inconsistent, or even contradictory, understanding them instead through the lens of ambivalence helps to illustrate how different visions of responsibility can co-exist, facilitating different movement outcomes beyond mere success or failure. In the case of the T&SC seminar, ambivalence appears to have presented opportunities for the growth and development of an emerging academic field: STS; enabling different actors to come together, and be flexible with regards to their approaches and agendas.

Chapter 3

Technology Assessment: More than an Early Warning System

"Technology: Hero or Villain?" So read the title of a 1967 op-ed article published in the *Los Angeles Times*. It read: where once "America had been a land of boundless optimism," by the late 1960s, increasing pessimism seemed to reflect a "sour assessment of 'progress'".[1] Concerns about poverty, crime, racial strife, sonic booms, smog, electronic "super-snooping", insecticides, and automation were all contributing to the "depressing feeling" that "technological 'progress' may create new problems as fast, or faster, than it solves old ones".[2] Across much of Western Europe too, science and technology were the subject of growing public ambivalence. For while modern technology may not have been producing the utopia it once promised, it was clear that its absence wouldn't either. To many, it seemed that the only way to cure technology's ills, was through some form of "technological fix"—i.e., the application of yet more technology.[3]

The early 1960s saw growing concerns about the direction and nature of technological change as public expenditures on science and technology continued to rise. In the U.S., 1963 was a particularly important year in that it

[1] Anon, "Technology: Hero or Villain," *Los Angeles Times*, June 4, 1967, K7.
[2] Ibid.
[3] See, for example, Sean F. Johnston, "Alvin Weinberg and the Promotion of the Technological Fix," *Technology and Culture* 59, no. 3 (2018): 620-651.

brought a number of changes to the Committee on Science and Astronautics. Created in 1957, the Committee on Science and Astronautics was the first standing committee created in the House in 11 years and the first committee since 1892 to be established in an entirely new area of jurisdiction, under which fell both the National Aeronautics and Space Council (NASA) and the National Science Foundation (NSF).[4] According to Ken Hechler, 1963 was particularly important as the NASA budget soared (once again) from $35 billion up to $54 billion (figures in this section have been inflation-adjusted)[5], being met—for the first time—by serious opposition.[6] Hechler notes "Congress and the Nation were becoming increasingly aware that overall Federal spending for research and development was rocketing upward. From $1.5 billion in 1940, the Federal price tag had mounted to $21.9 billion in 1953".[7] By 1963, that figure had leapt up once more to $116.5 billion.[8] As a result, many within Congress were becoming uncomfortable with the doling out of such huge amounts for research. As a result, 1963 saw the establishment of a Subcommittee on Science, Research, and Development, chaired by Representative Emilio Q. Daddario, a Democrat from Connecticut. One of the primary motivations behind the subcommittee's creation was to investigate just where all those research dollars were going. As we will see however, it later took on additional significance insofar as it was one of the prime contributors to the emergence of TA. [9]

Daddario had been the major spokesman in favor of creating a new subcommittee. Having become aware of the important role played by "men of science" during the War effort—Daddario worked for the Office of Strategic Services (the precursor to the Central Intelligence Agency)—Daddario was a charter member of the science and astronautics committee. He had played an active role as an expert in the life sciences and earned "a good reputation as a fair and thorough pilot of the Subcommittee on Patents and Inventions".[10] As such, when Daddario communicated to his friend,

[4] In 1974, the name of the Committee changed to the Committee on Science and Technology.
[5] Figures inflation-adjusted as of May 2022, using https://www.usinflationcalculator.com/
[6] See U.S. Congress, House Committee on Science and Astronautics, Ken Hechler, *Toward the Endless Frontier*, U.S. 96th Congress, 2nd Session (Washington, D.C: USGPO, 1980), 127.
[7] Ibid, 130.
[8] Ibid.
[9] U.S. Congress, *Toward the Endless Frontier*; and Daniel Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Alfred A. Knopf, 1978)
[10] U.S. Congress, *Toward the Endless Frontier*, 131

Committee Chairman George Miller, the importance of broadening the committee's jurisdiction (focused, as it was, almost explicitly on the space race), Miller was prepared to listen. According to Hechler, "Daddario was convinced that the time for talk was over, and the time for action was at hand".[11] From his position at the helm of the new subcommittee, Daddario soon set about proposing an organizational response to the growing concerns about the direction and pace of technological change. For at the time, as noted by the *LA Times*, there was no agency responsible for trying to foresee the "side effects" of science and technology, no one responsible for "sounding the alarm".[12]

On July 3rd 1967, Daddario submitted a statement on the subject of "Technology Assessment" (TA) to the Committee on Science and Astronautics. His subcommittee had recently produced a substantial report on public policy issues involving science and technology.[13] In his letter of submittal to the committee, Daddario described how the subcommittee's report had shown "beyond all doubt" that science and technology was "a force to be dealt with by the Congress".[14] Four months earlier, Daddario had submitted a bill within which he recommended the creation of an "Office of Technology Assessment" (OTA)—which the *Times* article referred to as a most "sensible proposal".[15] Daddario suggested that an OTA could "provide a method for identifying, assessing, publicizing, and dealing with the implications and effects of applied research and technology".[16] Over the next few years the TA legislation proceeded through a lengthy series of discussions with committee advisory panels, a seminar, three contract studies, and two sets of hearings—all of which had important implications for what TA would become.

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[11] Ibid.

[12] Anon, "Technology: Hero or Villain," K7

[13] Born in 1918 and raised in Boston, the son of Italian immigrants, Daddario had what he considered to be an ordinary upbringing. He nurtured a passion for science as a schoolboy before electing to study Law at Wesleyan University in Connecticut. He gained fame as an athlete during his time at Wesleyan and paid his way through Law School playing professional football with the Providence Steamrollers and the Hartford Blues. See Emilio Q. Daddario, "Science and its Place in Society," *Science* 200, no. 4339 (1978): 263.

[14] U.S. Congress, House Subcommittee on Science, Research and Development of the Committee of Science and Astronautics, "Technology Assessment, Statement of Emilio Q. Daddario," U.S. 90th Congress, 1st Session (Washington, D.C.: USGPO, 1967), iii.

[15] Anon, "Technology: Hero or Villain," K7.

[16] On March 7, 1967, Daddario Introduced H.R. 6698. Cited in U.S. Congress, "Technology Assessment, Statement of Emilio Q. Daddario," 3.

In 1970, Daddario was forced to abandon his efforts regarding OTA, answering the call of his party chairman to return to Connecticut and run for what turned out to be a losing race for the governorship. As Hechler notes, "his departure stimulated an outpouring of statements of regret, not only by his colleagues but by the entire scientific community".[17] Franklin Long, a chemist and co-founder of Cornell's program on Science, Technology, and Society, in a letter to *Science,* characterized Daddario as "having earned a well-deserved reputation as one of the most honest, concerned, and effective Members of Congress". He continued, "Daddario, as well as the subcommittee which he chairs, has been a principal channel of communication between Congress and the U.S. scientific community, and his special knowledge and qualities will be greatly missed".[18]

Yet when the bill for the establishment of OTA finally passed two years after Daddario's departure in 1972, an article published in *Science* suggested that the politicians smiled, while the scientists winced. Columnist Deborah Shapley wrote that despite TA's development having "proceeded at a speed only comparable to that of the advance of the Ice Age," many of the "high priests of science, with a bow to their old pal Daddario" remained "highly skeptical of the measure".[19] As Shapley put it, if nothing else, the vote in favor of the bill was "a revelation", indicating that this "legislative Lazarus" had been not "dead but only sleeping".[20] The fact that not everyone was on board with what OTA became after its founding, hints at several underlying tensions regarding what TA could or should be.[21] Unpacking these tensions helps to explain why quite so much time passed between Daddario's original proposal and the eventual passage of the legislation.

[17] U.S. Congress, *Toward the Endless Frontier*, 161.
[18] Ibid.
[19] Deborah Shapley, "Technology Assessment: Congress Smiles, Scientists Wince," *Science,* 175, no. 4025, March 3, 1972, 970-972.
[20] Ibid.
[21] In this sense, the founding of OTA was not unlike the founding of the NSF which also took several years and rounds of negotiation with regards to its purpose and organization. While Congress debated what form it should take, other agencies—primarily military agencies like the—filled the vacuum, with long-lasting consequences for U.S. science policy. See Daniel Kevles, *The Physicists;* and Daniel Lee Kleinman, *Politics on the Endless Frontier: Postwar Research Policy in the United States* (Duke University Press, 1995).

The bill's path to approval had been "rocky" to say the least.[22] Larry Ruff, a professor of Economics at the University of California, San Diego, was unabashed in his criticism during the testimony he gave before Daddario's subcommittee. A firm believer in the capacity of the market to deal with technological problems, Ruff "was suspicious of the 'micromanaging' nature of the idea of TA".[23] As Gregory Kunkle argues

> Champions of unfettered technological innovation, especially leaders from industry, feared 'harassment by hysterical (and hardly democratic) scientific Philistines, principally from the sinister side of the political spectrum,' while some even went so far as to claim that 'TA can subvert the principles at the very heart of democracy'.[24]

Yet alongside the concerns of economists and leaders of industry that TA would stifle innovation and technological commercialization, another explanation for the lethargic pace in passing the initial legislation was the sheer ambiguity of the term *technology assessment*.

Writing in 1995, Alan Porter, then director of the Georgia Tech Technology Policy and Assessment Center, noted, "It should not shock us that two general, widely used, and ambiguous terms—'technology' and 'assessment'—when combined, do not yield a singular meaning".[25] Not unlike R(R)I, interpretative flexibility regarding the scope and meaning of TA still remains the norm today. Nevertheless, with both TA and R(R)I, there have been moments of solidification and stabilization around particular definitions. For example, much as von Schomberg's definition became dominant within R(R)I, the most popular definition of TA—following the creation of OTA—also belonged to one of its leading proponents. The futurist Joseph Coates defined it as "a class of policy studies which systematically examine the effects on society that may occur when a technology is introduced, extended, or modified. It emphasizes those

[22]Gregory C. Kunkle, "New Challenge or the Past Revisited? The Office of Technology Assessment in Historical Context," *Technology in Society* 17, no. 2 (1995): 180.
[23] Ibid.
[24] See Leon Green of Lockheed Corporation and William O. Baker of Bell Laboratories, quoted in Derek Medford, *Environmental Harassment or Technology Assessment? (New* York: Elsevier, 1973), 52. Cited in Kunkle "New Challenge or the Past Revisited?" 181.
[25] Alan L. Porter, "Technology Assessment," *Impact Assessment* 13, no. 2 (1995): 135.

consequences that are unintended, indirect, or delayed".[26] In other words, TA deals with the potential *societal impacts* of technological change.

Yet in the early days, Coates' definition was by no means predominant. Before OTA opened its doors, a number of different visions of what TA could, or should, look like travelled far beyond the confines of Washington; raising the question: *what was technology assessment before the Office of Technology Assessment*? Whereas R(R)I's folk histories tend to accept OTA as TA's spiritual home, the legislation's lethargic progress between 1967 and 1972 was a time during which the TA movement gathered considerable momentum outside Congress, both across the U.S. and internationally. According to Bodo Bartocha, the head of the Office of International Programs at the NSF in the late 1960s, TA became "a household word among legislators, government administrators, the public at large, and a good many other followers".[27] As Langdon Winner put it, while compared to parallel movements of the day TA may have been "less disruptive in the streets" and "less prominent in the headlines"; yet it nonetheless "promised to be highly consequential in the long run".[28]

According to Winner, the "members of the TA movement believed that there was an urgent need to recognize that new science-based technologies would have a profound influence upon the shape of society's future".[29] In fact, to the extent that TA travelled beyond a relatively narrow circle of Washington sophisticates, some even claimed that it "marked a turning point in the public's attitude toward science and technology".[30] Despite such claims however, by the time OTA legislation finally passed, TA was seen primarily as a way to mitigate growing public ambivalence towards technological change. As a result, "classic TA"—as the OTA variant has come to be called within histories of TA—is remembered narrowly as a top-

[26] Cited in Norman J. Vig and Herbert Paschen, "Introduction: Technology Assessment in Comparative Perspective," in *Parliaments and technology: The Development of Technology Assessment in Europe*, ed. Norman J. Vig & Herbert Paschen (New York: Suny Press, 2000), 8.
[27] Bodo Bartocha, "Technology Assessment: An Instrument for Goal Formulation and the Selection of Problem Areas," in *Technology Assessment in a Dynamic Environment,* ed. Marvin J. Cetron & Bodo Bartocha, (London: Gordon & Breach Publishing Group, 1973): 338.
[28] Langdon Winner, "The Democratic Shaping of Technology: Its Rise, Fall, and Possible Rebirth," Bernal Prize Acceptance Speech, Annual meeting of the 4S, Online, August, 2020.
[29] Ibid.
[30] Marvin J. Cetron, "Some Modest Conclusions in Technology Assessment," in *Technology Assessment in a Dynamic Environment,* ed. Marvin J. Cetron & Bodo Bartocha, (London: Gordon & Breach Publishing Group, 1973): 1033.

down policy tool with an "early warning" function, identifying and drawing attention to the potentially undesirable consequences of new technologies.

As I will discuss in the next section, histories of R(R)I—indeed most histories of TA itself—tend to take OTA as their starting point. But the conversations which gave rise to OTA indicate that the topic of TA required broad based discussions which relied on a wide range of expertise. In this chapter, I will therefore primarily explore ideas surrounding TA while it was *in the making*. But instead of focusing exclusively on the development of the TA legislation—which eventually resulted in the creation of OTA—I will examine the ways in which TA was envisaged more broadly as a way of making technological change more responsible.[31] Secondly, in contrast to histories of TA and R(R)I which typically build on the assumption that "classic TA" was top-down and conceptually narrow, I will show how multiple, sometimes conflicting, ideals and visions were commonplace in the pre-OTA years. In this case, in contrast to ambivalence opening up opportunities for action (chapter 2); I will argue that ambivalent attitudes appear to have served as a successful "framing" strategy, enabling support to be enrolled from a variety of different stakeholders. Finally, approaching TA as an intellectual movement I will also reflect on the relationship between intellectual movements and institutional change. In so doing, I will try to show how the realization of OTA in 1972 was dependent upon years of institutional work by the likes of Daddario, as well as the emergence of a broader TA movement that both shaped, and was shaped by, the successful institutionalization of TA at OTA.

For most of this chapter I will zoom in on moments that are emblematic of pre-OTA discussions; as in the previous chapter though, these close readings will be bookended by a brief survey of standard historical narratives of TA as well as how ideas about TA travelled both within and beyond the U.S. context. As I will argue, by paying attention to TA's pre-1972 history, we will see that TA was imagined initially not only as an early warning system that would help mitigate against undesirable *social impacts*, but also as a way or making the *process* of technological change more responsible.

[31] For a rich analysis of the congressional hearings concerning the OTA legislation, see Sylvia Doughty Fries, "Expertise against Politics: Technology as Ideology on Capitol Hill, 1966–1972," *Science, Technology, & Human Values* 8, no. 2 (1983): 6-15.

The Emergence of "TA"

In the years that followed the creation of OTA, several commentators reflected on its emergence, as well as on TA's historical antecedents. For example, in 1977 Arlene Inouye, a sociology graduate, and Charles Susskind, a Professor of Engineering Science, reviewed TA's potential predecessors for *Technology & Culture*. They described how previous attempts at assessing technology had typically either focused on a specific technology (e.g. the mechanization of harvesting cotton, or steam boilers), or on a specific social problem (e.g. healthcare, or pollution).[32] They argued that while these assessments may have helped shed light on the need for new regulations, they largely took place behind closed doors and had relatively little impact on policy-making.[33] According to Inouye and Susskind, if we take Daddario's broader, more "global" definition of TA as our starting point, then the "*ur*-technology assessment of them all" was a report submitted to President Roosevelt in 1937: *Technological Trends and National Policy, Including the Social Implications of New Inventions*.

In his letter of submission to the President, the chairman of the Subcommittee on Technology to the National Resources Committee, Harold Ickes, stated that the report was "the first major effort to attempt to show the kinds of new inventions which may affect living and working conditions in America in the next 10 to 25 years".[34] Produced by William Ogburn, the report stated

> The most important general conclusion to be drawn from these studies is the continuing growth of the already high and rapidly developing technology in the social structure of the Nation, and hence of any planning that does not take this fact into consideration. In view of the findings regarding the importance of

[32] Daddario also often referred to these examples, see e.g. Emilio Q. Daddario, "OTA: Mixing Technology and National Goals," *Civil Engineering—American Society of Civil Engineers* 45, no. 12 (1975): 80.
[33] Arlene Inouye and Charles Süsskind, "'Technological Trends and National Policy,' 1937: The First Modern Technology Assessment," *Technology and Culture,* 18, no. 4, October, 1977, 596.
[34] U.S. Congress, House Subcommittee on Technology, "Technological Trends and National Policy," Report on the National Resources Commission, U.S. 75th Congress, 1st Session (Washington, D.C.: USGPO, 1937).

> technology and applied science, it is recommended that the Federal government develop appropriate agencies for continuous study of them.[35]

It therefore comes as no great surprise that Daddario referred to this report, using this very same quote in his statement on TA—lamenting how it was unfortunate that its "recommendations went largely unheeded".[36] Despite such previous attempts at institutionalizing assessment however, Daddario outlined that what was needed in the 1960s was assessment in "a new, different, and insistent way as compared to former times".[37] Under the heading 'Responsibility for the Results of Technology' he argued that neither the market, the legal system, nor the court of public opinion was any longer sufficient when it came to understanding the *social impacts* of technological change.

Beyond gestures towards Ogburn's report as a concrete predecessor of TA, the senior editor of *Chemical and Engineering News*, David M. Kiefer, went as far as to suggest, "In a narrow and rudimentary fashion… the appraisal of technology probably is as old as technology itself".[38] However, the first attempts to officially define and organize TA in a systematic way are still commonly attributed to the creation of OTA in 1972. As Wayne Boucher writes, though the principle itself may not have been new, "the intensity of commitment" and "the emphasis being given to this function" certainly was.[39] According to Jathan Sadowski and David Guston, "when one thinks of institutionalized technology assessment, whether in the context of the United States or elsewhere, one invariably calls to mind the Office of Technology Assessment".[40] As a result, most efforts in TA ever since have been considered, in one way or another, to be the "intellectual progeny of OTA".[41]

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[35] U.S. Congress, "Technology Assessment, Statement of Emilio Q. Daddario," 6. On William Ogburn, see Benoît Godin, "Innovation without the Word: William F. Ogburn's Contribution to the Study of Technological Innovation," *Minerva* 48, no. 3 (2010): 277-307.
[36] Ibid.
[37] Ibid, 3.
[38] David M. Kiefer, "Technology Assessment: A Layman's Overview," in *Technology Assessment in a Dynamic Environment,* ed. Marvin J. Cetron & Bodo Bartocha, (London: Gordon & Breach Publishing Group, 1973): 7.
[39] Wayne Boucher, "The Future Environment for Technology Assessment," in *Technology Assessment in a Dynamic Environment,* ed. Marvin J. Cetron & Bodo Bartocha, (London: Gordon & Breach Publishing Group, 1973): 405.
[40] Jathan Sadowski and David H. Guston, "Technology Assessment in the USA: Distributed Institutional Governance," *TATuP-Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis* 24, no. 1 (2015): 53.
[41] David H. Guston and Daniel Sarewitz, "Real-Time Technology Assessment," *Technology in society* 24, no. 1-2 (2002): 97.

Bruce Bimber and David Guston suggest that despite OTA having been disbanded in 1996, it remains "the central symbol of the 'technology assessment' movement," which first emerged in the 1960s. It also "served as a model for the creation of a number of parliamentary technology assessment agencies in Europe".[42] As such, long after its demise, OTA left behind it a movement on both sides of the Atlantic, which continued, "to be concerned with the practice of understanding and orienting technical change and applying that practice to improve public policy".[43]

"Classic TA" is typically characterized as having been focused on making "concrete predictions of technological consequences" so as to "gain advance knowledge on technology options in order to make better decisions".[44] This understanding is based upon TA as it was practiced at OTA, whose functions included: "the identification of impacts of technology, assertion of cause-and-effect relationships and identification of alternative programs and options".[45] Over the years, numerous scholars, journalists, and OTA staffers have written about OTA's history and methods; typically attributing its creation to a number of factors, the most common of which include: the growth of the U.S. government's science and technology budget; the growing "tech-lash" surrounding the unintended social impacts of technological change; the increase in legislative issues which concerned science and technology; and concerns about the balance of power between the Executive Branch and Congress.[46]

[42] Bruce Bimber and David H. Guston, "The End of OTA and the Future of Technology Assessment," *Technological Forecasting and Social Change* 54 (1997): 125.
[43] Ibid.
[44] Michael Decker and Craig Ladakis, eds. *Bridges between Science, Society and Policy: Technology Assessment - Methods and Impacts* (Berlin: Springer, 2004), 1.
[45] Ibid.
[46] See e.g. Bruce Bimber, *The Politics of Expertise in Congress: The Rise and Fall of the Office of Technology Assessment* (Albany, NY: State University of New York, 1996); Bruce Bimber and David H. Guston, "Politics by the Same Means: Government and Science in the U.S.," in *Handbook of Science, Technology and Society,* Sheila Jasanoff, et. al., eds. (Beverly Hills: Sage, 1994), 554-571; Adam Keiper, "Science and Congress," *New Atlantis* (Fall 2004–Winter 2005), https://www.thenewatlantis.com/publications/science-and-congress; Robert M. Margolis and David H. Guston, "Origins, Accomplishments, and Demise of OTA," in *Science and Technology Advice for Congress*, ed. M. Granger Morgan and Jon M. Peha (London: Routledge, 2003); Morgan, M. Granger and John M. Peha, eds., *Science and Technology Advice for Congress* (Washington, DC: RFF Press, 2003); and David H. Guston, "Insights from the Office of Technology Assessment and Other Assessment Experiences," in Millet Granger Morgan and John M. Peha, eds., *Science and Technology Advice for Congress* (Washington, DC: RFF Press, 2003) 77–89.

In Europe, despite an early interest in TA at OTA, both institutional and constitutional barriers resulted in TA's uptake being rather slow.[47] It didn't help that OTA staff developed a somewhat "pragmatic and eclectic approach" to TA.[48] As Norman Vig and Herbert Paschen point out, it was "something of a joke to say that OTA's definition of technology assessment was 'TA is what OTA does'".[49] This meant that for those wanting to use OTA as a model, "the concept of technology assessment remained murky at best".[50]

In the European context, as public concern about rapid technological change (e.g. genetic engineering and telecommunications) and major environmental disasters (e.g. Bhopal, Chernobyl, and acid rain) continued to grow in the 1970s and 1980s, technological development was also seen as an important means of overcoming economic recession and dealing with high unemployment. According to Vig and Paschen, the "relaunching" of TA in Europe was therefore "aimed at making TA more 'usable,' more 'useful' and more 'democratic'" through a series of "reorientations and modifications".[51] European TA would be: more focused on stimulating "awareness of the options technology offers to (potential) users"; more problem-driven—taking "emerging social, economic, resource, or environmental problems" as their starting point; more focused on supporting decision-making—by bridging "the gap between the supply of scientific and technological possibilities and the social wishes and needs of society"; and more participatory—involving "nonexpert participation in TA studies".[52]

As a result, through the course of the 1980s, five nations (the UK, France, Germany, Denmark, and the Netherlands) and the European parliament established small parliamentary TA agencies "modeled in part after OTA".[53] It is no coincidence, of course, that these nations all had burgeoning STS communities at the time and have subsequently played an important role in the spread and uptake of R(R)I. These "little OTAs" developed a "positive rationale for selecting and steering new technologies"

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[47] Norbert Vig and Herbert Pashcen, "Introduction: Technology Assessment,"
[48] Ibid, 10.
[49] Ibid.
[50] Ibid, 13.
[51] Ibid, 16.
[52] Ibid, 16-17.
[53] Ibid.

in order "to assure both higher economic growth and social acceptance of technological change".[54] This approach laid the basis of what would later be called "constructive technology assessment" (CTA).[55]

In 1990, the five little OTA's formed the European Parliamentary Technology Assessment (EPTA) network as "an organization to promote cooperation and exchange of ideas on technology assessment across national borders".[56] A number of other countries soon followed suit and the EC then supported the development of the European Technology Assessment Network. Over time, divisions emerged between countries such as the UK and Germany who stuck closely to the OTA model, seeing TA as a "method of expert policy analysis"; and countries like the Netherlands and Denmark, who saw TA as an open process "for involving the public in policy dialogues and building societal consensus on issues of technological change".[57]

Through the course of the 1990s, TA's institutionalization continued through various governmental and non-governmental efforts.[58] Academic research centers played an increasingly important role. For example, CTA was initially developed in the Netherlands and largely influenced by scholars in STS. CTA emphasized that the impacts of new technology were "a joint product of the technology, the actors involved, and wider interactions".[59] As Sadowski and Guston describe, academic research groups increasingly "grew up around the TA-like funding schemes from public and private sponsors". Though these groups all worked differently depending upon "the parameters, goals, and conditions inherent to external funding" there was nevertheless a "general family resemblance" and a shared focus on "epistemic contributions, dialogue, and critique"—all of which reflected the culture of the academic context.[60] Over time, new approaches proliferated, many of which built on

[54] Ibid, 14.
[55] See Arie Rip, Thomas J. Misa and Johan Schot, eds., *Managing Technology in Society* (London: Pinter Publishers, 1995).
[56] Ibid, 5.
[57] Ibid, 18.
[58] An overview of the institutional landscape of both governmental and non-governmental efforts in TA since the 1990s is provided in Jathan Sadowski and David Guston, "Technology Assessment in the USA,"
[59] Arie Rip, "Technology Assessment," in *International Encyclopedia of the Social & Behavioral Sciences, Second Edition* (Amsterdam: Elsevier, 2015), 125-128.
[60] Jathan Sadowski and David Guston, "Technology Assessment in the USA," 57.

the insights of CTA and remained firmly rooted in the social constructivist paradigm.[61]

What these new approaches shared was that they were anticipatory and proactive (rather than "classic TA" which was predictive and reactive). So-called "early" or "upstream engagement" became increasingly important, as did ethical deliberation and public participation. New activities were created through the application of social science perspectives to new and emerging technologies. For example, in the US, the activities within the ELSI program of the Human Genome Project as well as research attached to the National Nanotechnology Initiative.[62] This "next-generation" of TA explored "the potential of proactive, practice-based, interdisciplinary collaborations between social and natural researchers for integrating wider ethical and societal considerations in research decisions".[63]

Today, both TA and R(R)I avowedly distance themselves from "classic" TA. Yet, as I will show, when we look closely at the period of which "classic" TA was a product, we find that ideas about TA were not as far removed from ideas about contemporary TA and R(R)I as we might imagine. As the snapshot just provided demonstrates, many have described OTA's creation; its accomplishments and struggles; as well its demise and legacy; it is fair to say that the rise and fall of OTA has been chronicled authoritatively. [64] However, few have focused on the period that directly preceded its emergence, on the original conceptualizations, motivations, and ambitions of TA pre-OTA.[65] As a result, histories of TA tend to overlook the ways in which TA could very well *have been otherwise*—bypassing the different ways in which TA was envisaged during the "classical" period. This can be explained,

[61] See Rinie Van Est and Frans Brom, "Technology Assessment: Analytic and Democratic Practice." *Encyclopedia of Applied Ethics*, Fourth Edition (Amsterdam: Elsevier, 2012), 306-320.
[62] Examples of the latter are the two Centers for Nanotechnology in Society, one at Arizona State University (CNS-ASU) and the other at University of California, Santa Barbara (CNSUCSB).
[63] Neelke Doorn, Daan Schuurbiers, Ibo Van de Poel, and Michael E. Gorman, eds. *Early Engagement and New Technologies: Opening up the Laboratory* (Dordrecht: Springer, 2013), 7.
[64] See e.g. Peter D. Blair, *Congress's Own Think Tank: Learning from the Legacy of the Office of Technology Assessment (1972–1995)* (New York: Palgrave Macmillan, 2013); Genevieve J. Knezo, "Technology Assessment in Congress: History and Legislative Options," Congressional Research Service, May 20, 2005; Office of Technology Assessment. *OTA Legacy*, CD-ROM Collection (Vols. 1–5), GPO Stock No. 052–003–01457–2, (Washington, D.C.: USGPO, 1996); Bruce Bimber, *The Politics of Expertise in Congress*; Keiper, "Science and Congress"; Gregory Kunkle, "New Challenge or Past Revisited"; Robert Margolis and David H. Guston, "Origins, Accomplishments, and Demise of OTA"
[65] Two notable exceptions are Sylvia Doughty Fries, "Expertise against Politics," and M. Anthony Mills, "Reviving Technology Assessment: Learning from the Founding and Early History of Congress' Office of Technology Assessment," Report for the American Enterprise Institute, May 2021, 1-21.

in part, by the crafty salesmanship of Daddario whose strategic ambivalence helped enroll a broad base of support for TA. However, this does not negate the fact that important choices were made along the way; choices that indicate that other forms of TA could just as easily have ended up being caricatured as "classic" TA. As we will see, ideas about TA before OTA were far more speculative and exploratory than accounts of "classic TA" would have us believe, meaning that the "early warning" characterization may be somewhat misleading.

In order to demonstrate that Daddario contributed more to TA than the "classic" caricature denotes, I will argue in the next section that before the founding of the OTA he first created a "command post"—that is, a bureaucracy with "some jurisdiction over critical policy domains".[66] From there, Daddario soon set about enrolling the support of the scientific community. Through his engagements with a wide range of institutional actors, Daddario then successfully put TA on the agenda as a way of dealing with the potential *social impacts* of technological change. However, he was not only interested in TA as an effort to predict the consequences of new technologies. As Gregory Kunkle hints at, there was more on Daddario's mind than merely improving the sort of advice that was available to Congress.[67] Daddario also saw TA as an opportunity for legislators and scientists to become more responsible, through an increased engagement with the *process* of technological change.

Whereas institutional scholars, such as Mayer Zald and Michael Lounsbury, have spoken about the potential influence of social movements on command posts—in terms of both putting issues on the agenda as well as challenging policy directives— intellectual movements, unlike most social movements, are not extra-institutional forces. Instead, intellectual movements, like command posts, are deeply embedded in a "wider field of organizations, cultural beliefs, and critical interests that shape policy formulation, key decisions and actions".[68] In the case of TA pre-1972, insider/outsider ontologies were often blurred and attitudes towards

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[66] Mayer N. Zald and Michael Lounsbury, "The Wizards of Oz: Towards an Institutional Approach to Elites, Expertise and Command Posts,"=: *Organization Studies* 31, no. 7 (2010): 982.

[67] As Gregory Kunkle notes, "It seems clear that there was more on Daddario's mind, and indeed more to the subcommittee's mandate, than merely improving scientific and technical advice available to Congress." Gregory Kunkle, "New Challenge or the Past Revisited?" 175–96.

[68] Mayer Zald and Michael Lounsbury, "The Wizards of Oz", 965.

technological change ambivalent. As we will see, early ideas about TA were therefore more wide-ranging and holistic than is often remembered, meaning that pre-OTA discussions also made responsibility matter in ways that have since become important within the discourse surrounding R(R)I.

Getting the Scientific Community on Side

The mandate of Daddario's subcommittee was broad: to conduct an overall evaluation of research and development throughout the country; to strengthen congressional sources of information and advice with regards to science and technology; to assess in how far scientific and engineering resources were being effectively utilized; and to provide congressional oversight of the NSF. In the subcommittee's statement of purpose, published in 1963, it was written that in undertaking a "review of the technological scene" the subcommittee was part of a "more positive and efficient effort" to consider "the results and impact of technological change" and to "prepare interdisciplinary approaches in the attack on social ills".[69]

The creation of Daddario's subcommittee reflected the growing awareness within Congress that a better understanding of both the *process* and *societal impacts* of technological change was required. In a feat of institutional entrepreneurship, Daddario managed to orchestrate a new institutional arrangement—his subcommittee—and soon began mobilizing resources in an attempt to tie together the functions of a disparate set of institutions.[70] In this vein, Daddario quickly recognized that the success of the subcommittee was largely dependent upon the support of institutions like the NSF and the National Academy of Sciences (NAS); both of which had, historically, been oriented towards the Executive Branch and typically only dealt with Congress at arm's length.

[69] U.S. Congress, House Committee on Science and Astronautics, Subcommittee on Science, Research, and Development, "A Statement of Purpose: The First Progress Report of the Subcommittee on Science, Research and Development," U.S. 88th Congress, 1st Session (Washington, D.C: USGPO, 1963), ii.

[70] Institutional entrepreneurship refers to the "activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones". These actors then "create a whole new system of meaning that ties the functioning of disparate sets of institutions together" See Raghu Garud, Cynthia Hardy, and Steve Maguire, "Institutional Entrepreneurship as Embedded agency: An Introduction to the Special Issue." *Organization Studies* 28, 7 (2007): 957-969.

When the subcommittee's activities first got underway, the relationship between the scientific community and Congress could be described as frosty, at best. As far as Daddario was concerned however, the responsibility for improving this situation was not a one-way street. In a letter to Miller in 1963, he wrote how "the public and the Congress must make a serious and determined effort to inform themselves of the possibilities—and the risks—of science".[71] At the same time, he stressed, "Scientists must take all practicable steps to post clearly the trails they are blazing into the unknown to make their importance and significance clear".[72] Despite having the impression that most scientists "would have preferred not to deal with Congress," Daddario took it upon himself to start building "stronger", "more personal bridges" with the scientific community.[73]

During the subcommittee's initial hearings in 1964, his efforts already appeared to be being paying off. Big hitters like former Presidential Science Advisor, George Kistiakowsky, and President of the NAS, Frederick Seitz, spoke up in support of his subcommittee. Jerome Wiesner, of the Massachusetts Institute of Technology (MIT) and Harvard's Don K. Price also joined several leaders of industry in forming an advisory panel to the subcommittee, which would provide guidance and support, specifically concerning the "management and policy control of large and costly applied research and development programs".[74] Daddario met regularly with members of the advisory panel in order to "'brainstorm'… about the best use the Congress might make of science and technology 'to attack public problems'".[75]

A further sign that the scientific community was warming to Daddario came in the form of a new agreement between the NAS and his subcommittee. Following the 1964 hearings—during which Seitz explicitly offered Daddario his support—a contract was drawn up through which the NAS' Committee on Science and Public Policy (COSPUP) would conduct a study for use by Daddario's subcommittee. The subsequent report *Basic*

[71] Ibid, iii.
[72] Ibid.
[73] U.S. Congress, "Toward the Endless Frontier"
[74] U.S. Congress, "A Statement of Purpose," 2. Members of the research management advisory group included: Jerome Wiesner (MIT), James Fisk (Bell Labs), Sam Lehner (DuPont), Guy Suites (General Electric), Don K. Price (Harvard), Wilfred Mcneil (Grace Lines), and James Gavin (Arthur D. Little)
[75] Sylvia Doughty Fries, "Expertise against Politics," 7.

Science and National Goals was published in 1965.[76] While reviews wrote that the report was never going to win any academic prizes, it undoubtedly represented something of a watershed moment.[77] For Daddario, it was a "ground-breaking study" and a "creative effort of genuine utility".[78] He suggested that it had opened up "a new channel and a new method of providing experienced guidance to the legislative branch in its consideration of the proper Federal role in scientific affairs".[79] It was also, he suggested, the first time a concentrated study had been focused on the "thorny question" of how far and how fast government should go in its support of fundamental research.[80]

Perhaps unsurprisingly, in response to questions about the federal support of science, COSPUP members were unanimous: they wanted more money. The dominant themes throughout the report were that the future of basic research in the U.S. was closely tied to the fortunes of the NSF, and that increased support for the NSF was essential for the future strength of the U.S. Given Daddario didn't have the power to increase the budget for the NSF, he decided instead that the next best thing would be to reorganize it. In a follow-up report entitled 'The National Science Foundation, Its Present and Future', Daddario described the Foundation as having an "extraordinary voice" with which "it should make itself heard, and should be listened to, accordingly".[81] He made clear his expectation that the NSF should "step forward and speak with the loud voice of a senior partner" rather than be

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[76] National Academy of Sciences, "Basic Science and National Goals," Committee on Science and Public Policy, Prepared for Committee on Science and Astronautics, U.S. House of Representatives (Washington, D.C.: USGPO, 1965). The panel responsible for *Basic Research and National Goals* brought together a diverse mix of "hawks" and "doves", including: George Kistiakowsky, Harvard University (chairman), Lawrence Blinks, Stanford University, H.W. Bode, Bell Telephone Laboratories, Harvey Brooks, Harvard University, Frank Horsall, Jr., Sloan-Kettering Institute for Cancer Research, Harry Johnson, University of Chicago, Arthur Kantrowitz, Avco-Everett Research Laboratory, Carl Kaysen, Harvard University, Saunders MacLane, University of Chicago, Carl Pfaffmann, Brown University, Roger Revelle, Harvard University, Edward Teller, University of California, Berkeley, John Verhoogen, University of California, Berkeley, Alvin Weinberg, Oak Ridge National Laboratory and John Willard, University of Wisconsin.

[77] Robert C. Cowen, "House Study Analyzes U.S. Research," *The Christian Science Monitor,* April 26, 1965, Box 33, Emilio Q. Daddario Collection, Wesleyan University Archives.

[78] Emilio Q. Daddario, "Remarks at the NAS Panel Meeting," April 24, 1965, Box 33, Emilio Q. Daddario Collection, Wesleyan University Archives.

[79] Ibid.

[80] Ibid.

[81] Emilio Daddario cited in Daniel S. Greenberg, "Daddario Study Says NSF Should Be in Forefront of Policymaking," *Science* 151, no. 3707 (1966): 177-179.

"reduced to the nodding mechanism of a junior colleague or the note-taking silence of a staff operation".[82]

In his review of the *Basic Science* report, *Science* columnist Daniel Greenberg accused Daddario of being almost "embarrassingly friendly" towards the NSF.[83] Yet, as he pointed out, Daddario's reimagining of the agency did manage to upset those who clung to the notion that the NSF had been "explicitly conceived on the assumption that, amidst the clamor of competing demands for federal funds, it would be desirable to have one agency whose sole objective would be the long-term health of basic research".[84] Daddario's subcommittee was now "telling this carefully conceived, non-truculent creation of basic science that science is too powerful and the Foundation is too important for either to cling to a sheltered position in the governmental structure".[85]

As far As Daddario was concerned however, the revision of the charter directly responded to the criticisms made in the *Basic Science* report, concerning its "relatively slow evolution in relation to the swelling, fast-changing contemporary problems of the nation and in regard to the Foundation's underutilized potential as a member of the Executive's scientific and technology family".[86] The reorganization of the NSF was also an opportunity for Daddario to reorient its goals around a number of issues that were important to him—not least, that science and technology should be responsive to society. A new charter broadened its aims to include applied research, with a clear orientation towards societal benefits, as well as research in the social sciences, which Daddario felt would enable a better understanding of the relationship between science and society.

As a part of the reorganization, a new Science Policy Research Division (SPRD) within the Legislative Reference Service (LRS) of the Library of Congress was also established—in order to provide on-demand reviews and informational packets for members of Congress. In presenting the reform bill, Daddario said that the NSF had been "too passive" and had "not kept

[82] Emilio Q. Daddario, "A Revised Charter for the Science Foundation," *Science* 152, no. 3718 (1966): 43.
[83] Daniel S. Greenberg, "Basic Research: The Political Tides Are Shifting," *Science* 152, no. 3730 (1966): 1724.
[84] Daniel S. Greenberg, "Daddario Study Says," 179.
[85] Ibid, 177.
[86] Emilio Q. Daddario, "A Revised Charter," 42.

pace with the demands of society".[87] He suggested that going forwards; it "should be dealing more actively with emerging problems faced by industry and society as well as the academic community".[88] Indeed, the very title of the NAS' report itself—tying basic research to national goals—suggests an approach towards the *process* of technological change that departs from the more traditional linear model, where basic research is conceived as purely curiosity driven.

According to Greenberg, while *Basic Research* "did a stout job of sermonizing to the existing true believers" it could not be demonstrated that it "brought forth an additional penny or changed any attitude one whit".[89] However, what the engagement between the subcommittee and COSPUP did engender was a deep respect for Daddario. He had successfully persuaded the community to offer him their endorsement—even if they remained ambivalent about his aims. Most agreed that Daddario had been running his subcommittee in a responsible and intelligent fashion and as a result, it had developed into an important channel of communication between the scientific community and the Congress. For example, Theodore Wirths of the NSF suggested that its operating style was in "many respects a model for producing good legislation".[90] He continued

> Entirely in keeping with its interests, the Committee's approach has certain essential elements of good science and good scholarship. Its approach to problems involves research, analysis, recommendations, examination of those materials, presentation of them for general discussion and assessment and then a repetition of this process at least once and sometimes many times. Eventually, the Committee brings forth a recommended legislative package that has been studied with great care, has an intelligent and credible record and is trusted by those involved or interested as a responsible approach.[91]

Not all were as convinced as Wirths; Greenberg, for example, described the reorganization as a "grotesque revamp"—yet, the scientific community

[87] U.S. Congress, "Toward the Endless Frontier," 145.
[88] Ibid.
[89] Daniel S. Greenberg, "Daddario: Scientific Community's Friend on the Hill Is Leaving," *Science* 169, no. 3952 (1970): 1291.
[90] Cited in U.S. Congress, "Toward the Endless Frontier," 143.
[91] Ibid.

tentatively accepted the new charter.[92] Daddario's "responsible approach" had won them over to such an extent that many felt that if the reform had been led by anyone else, it would likely have met with a great deal more resistance. But thanks to Daddario's efforts, the subcommittee's engagement with the NAS soon developed into "a pattern which proved very successful" with subsequent reports being commissioned over the next few years.[93]

Dealing with the Dangers of New Technologies

Through his reorganization of the NSF, Daddario had demonstrated a clear desire to better align scientific research and technological development with societal needs. Though he held great faith in the potential of technological solutions, he was by no means naïve when it came to recognizing that technological change often came at a price.[94] His own writing is littered with references to environmental heavyweights like Rachel Carson and Barry Commoner. He spoke regularly of "inspired social critics and writers", who recognized the extent to which many unwanted consequences had been "labeled as the price of progress" adding "mature reflection suggests that the price need not have been paid at all if a thorough understanding had been gained of what was happening in the ecological system at an earlier date".[95]

While COSPUP were busy preparing the *Basic Science* report, Daddario continued to meet regularly with members of the subcommittee's advisory panel. The panel's members, like Daddario, were said to be driven by a sense of urgency in response to the "emotional movement… to protect the environment".[96] At the same time, like Daddario, they too remained wary that any program designed to try to identify the impacts of future technologies should be seen more as a "diagnostic device" than as an "assault on technological progress".[97] It was actually during one of these informal get-

[92] Daniel S. Greenberg, "Daddario: Scientific Community's Friend," 1291.
[93] U.S. Congress, "Toward the Endless Frontier," 138.
[94] Daddario had long taken a keen interest in environmental issues. For example, in 1955, a series of floods had racked his home state of Connecticut prompting him to advocate for the construction of Colebrook River Dam and reservoir project. Some years later, in 1964, he endorsed "legislation to establish a National Wilderness Preservation System to preserve primitive areas still unspoiled in the nation". See Gregory Kunkle, "New Challenge or Past Revisited," 82.
[95] U.S. Congress, "Technology Assessment, Statement of Emilio Q. Daddario," 7.
[96] Sylvia Doughty Fries, "Expertise against Politics," 7.
[97] Ibid.

togethers that MIT's Jerome Wiesner reportedly remarked that what was needed was some sort of *early warning system* in order to help protect man against his own inventions. Wiesner's remark struck a chord with Daddario. The reason why deserves a brief digression for it helps illustrate how and why Daddario became quite so enamored with the idea of TA.

A few months earlier, in 1964, an article published in *The Reader's Digest* had given Daddario an idea; that assessment was a crucial mechanism in trying to balance the promises and perils of new technologies. Entitled 'Is Civilization Progress?' the piece had been penned by fellow Connecticuter—and first man to fly solo over the Atlantic—Charles Lindbergh. From a young age, Lindbergh had wrestled with the "dialectical relationship" between technology and human values.[98] Where once he had symbolically represented the technologically optimistic fearless adventurer; he had fallen from grace during the Second World War given his pro-Nazi isolationist stance and by the 1960s, he had retreated completely from public life becoming something of a recluse.

It was during this period that Lindbergh had found himself increasingly interested in conservationism and deeply concerned about the consequences of unbridled technological development.[99] In *The Digest* article, he wrote about the prospects of supersonic transport (SST) in light of a recent trip he had taken to Africa. He wrote

> Lying under an acacia tree with the sounds of dawn around me, I realized more clearly facts that man should never overlook: that the construction of an aeroplane, for instance, is simple when compared to the evolutionary achievement of a bird; that aeroplanes depend upon an advanced civilization; and that where civilization is most advanced, few birds exist. I realized that if I had to choose, I would rather birds than aeroplanes.[100]

[98] See Susan M. Gray, *Charles A. Lindbergh and the American Dilemma: The Conflict of Technology and Human Values* (Wisconsin: Popular Press, 1988).
[99] Kenneth Davis suggests "the man himself is amazingly symptomatic of certain dominant moods in recent American culture, and his life describes a remarkably pure symbolic curve across the turbulence of our times". Kenneth Sydney Davis. *The Hero: Charles A. Lindbergh and the American Dream* (New York: Doubleday, 1959), 10.
[100] Charles A. Lindbergh, "Is Civilization Progress?" *Reader's Digest* 85 (July 1964): 69.

Lindbergh repeatedly questioned the relationship between science and technology, in light of their ongoing impacts on nature and ecology, making clear his feeling that innovation required greater regulation.

Lindbergh's sentiments echoed Daddario's own and he soon set about trying to get in touch with him—which ended up taking more than eight months to achieve. The meeting eventually took place at the beginning of 1965, in Daddario's office in the House Office Building in Washington. Edward Wenk, then science policy research chief of LRS, and Philip Yeager joined Daddario and Lindbergh. After two hours of intense discussion, Daddario felt that Lindbergh's ideas about technology's secondary effects were too convincing to be dismissed. He later wrote that Lindbergh's insights had been extremely useful to his subcommittee, he told Lindbergh that their meeting had turned out to be "a most significant day in the life of our committee; indeed, it was the direct forerunner to the whole concept of Technology Assessment which has now taken root throughout the government, the country and, in fact, the world".[101] He told Lindbergh how he planned to utilize a number of the points they had discussed regarding "the difficult environment which technology is creating for our present day civilization".[102] Daddario explained that there would soon be an "extensive inquiry" into the effects of technology on society and that he hoped this would provide an opportunity to look at this problem in much the same basic terms that Lindbergh had described so well.[103] Lindbergh was encouraged by his discussions with Daddario, and found cause for optimism in the subcommittee's work. In response to Daddario he told him that he was impressed by the wisdom of his "new approach to scientific research and development through consideration of its effect on the future of mankind".[104]

As a result of his interaction and correspondence with Lindbergh, Daddario was primed toward the notion of assessment when Wiesner made his "early warning quip" a few months later. Shortly thereafter, a general

[101] Correspondence from Emilio Q. Daddario to Charles Lindbergh, April 8, 1970, Box 38, Emilio Q. Daddario Collection, Wesleyan University Archives.
[102] Ibid.
[103] Correspondence from Emilio Q. Daddario to Charles Lindbergh, January 14, 1965, Box 37, Emilio Q. Daddario Collection, Wesleyan University Archives.
[104] Correspondence from Charles Lindbergh to Emilio Q. Daddario, July 1, 1970, Box 33, Emilio Q. Daddario Collection, Wesleyan University Archives.

strategy was agreed upon, and in the subcommittee's second progress report, the words "technology assessment" appeared for the first time in a public document. Published under the somewhat confusing title, 'Inquiries, Legislation, Policy studies, re: Science and Technology', a few anxious paragraphs outlined several concerns about the *societal impacts* of technological change. Under the heading 'Dangers of New Technology,' automation, chemical waste, automotive vehicles, and overfishing were amongst the examples provided. One of the major points repeatedly emphasized was about the deterioration of the natural environment. One section reads

> Every year, because of conditions science and technology has either induced or made possible, we bury millions of acres of land and vegetation under asphalt, cement, schools, factories, houses, or other structures. Every year we scrape away all vegetable life from hundreds of thousands of acres with modern instruments of strip mining. Every year our mushrooming fleets of modern aircraft fly higher and higher, pouring tons of strange exhaust into the little-understood upper atmosphere. Every year our technically advanced maternity wards turn out a bumper crop of new humans—oxygen-consuming, heat-and-CO2-producing entities which, physically speaking, came from non-metabolic substance.[105]

The report described the unknown side effects of technology as "so strong" and "quite possibly so dangerous" so as to "pose a genuine threat to man to his physical, mental, and spiritual environment".[106] As such, it was suggested that while all the problems of society pointed to the need for more science and technology, new developments had to be accompanied by "careful and improved methods of putting that knowledge to work".[107] The alternative, it warned, was to "strangle in the coils of an unplanned, unwanted, but unstoppable technocracy".[108] The very last page of the report then outlined the subcommittee's recommendation: the creation of a 'Technology Assessment Board'.[109]

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[105] U.S. Congress, House Committee on Science and Astronautics, Subcommittee on Science, Research and Development, "Inquiries, Legislation, Policy Studies Re: Science and Technology: The Second Progress Report of the Subcommittee on Science, Research and Development," U.S. 89th Congress, 2nd Session (Washington, D.C.: USGPO, 1966), 26.

[106] Ibid, 24.

[107] Ibid.

[108] Ibid, 20.

[109] The report joked that the acronym "TAB" was particularly appropriate, as the board would be a means of "keeping tab on the potential dangers, as well as the benefits inherent in new technology and simultaneously informing the public of the nature of them". Ibid, 28.

In a short section—taking up less than half a page in total—the board was proposed as a way of "becoming cognizant of what technology is doing to us—the bad as well as the good".[110] Its purpose would be to provide an "early warning" signal, by gauging the potential difficulties or side effects of technology "well in advance of their crystallization".[111] Though privately Daddario expressed doubt as to whether the conception of a board, as such, would be a practical means of achieving this end, he stressed his hope that the proposal would, at the very least, stimulate discussion on how to tackle the problem.[112] Despite his best intentions however, the Technology Assessment Bill that followed was "misunderstood" by many as an attempt on the part of Congress to "hobble science".[113] It was clear that once again Daddario was going to need to get the scientific community on side.

From Daddario's point of view, the timing couldn't have been better. Shortly after he submitted the TA Bill, COSPUP published the second report commissioned by his subcommittee. *Applied Science and Technological Progress* effectively picked up where *Basic Research* had left off; dealing with the special problem of how to effectively apply the resources of science to the development of technology. By the time *Applied Science* was being prepared, COSPUP had come under the chairmanship of the Dean of Engineering and Applied Science at Harvard University, Harvey Brooks—whom we met in chapter 2. Brooks had already played an active role within COSPUP for a number of years; in fact, despite George Kistiakowsky having been chair two years earlier, Brooks had taken the lead on *Basic Science* as well.[114]

Brooks' interest in science policy—particularly the challenge of finding the right balance between intellectual opportunities and societal needs (as we saw in chapter 2)—was only heightened during his tenure as chair of COSPUP. He regularly spoke of the distinction between "policy for science" and "science for policy" and recognized that social scientists and science advisors often found themselves torn between these two poles.[115] In his introduction to *Applied Science*, Brooks spoke at length about the breadth and

[110] Ibid, 27.
[111] Ibid, 28.
[112] Nigel Calder, *Technopolis* (New York: Simon and Schuster, 1971), 17.
[113] John Lear, "Science/The Endless Search," *Saturday Review*, March 28 1970, Box 40, Emilio Q. Daddario, Wesleyan University Archives.
[114] See U.S. Congress, "Toward the Endless Frontier"
[115] See Harvey Brooks, "Autonomous Science and Socially Responsive Science: A Search for Resolution," 39.

complexity of applied science and the relationship between universities and mission oriented institutions. Dominant themes throughout the report included the Government's "special responsibility" for the "integrity and sufficiency of man's environment" and "for dealing with the social questions" that arose out of such concerns. Though the report warned of the dangers of "excessive democracy", it largely reflected the willingness of the scientific community to introduce social parameters into the consideration of research priorities.[116]

The report's recommendations were largely in keeping with the NSF's recent reorganization. Amongst them were that studies concerning the history and sociology of applied science would prove to be increasingly important. So too, would the notion that the environment was a growing federal responsibility. The report also suggested, that where possible, there should be increased efforts to forecast technological development—providing Daddario with the backing he needed regarding his proposal for TA. When he followed up his TA Bill with a statement on TA a few months later, he could lean on the findings of the *Applied Science* report for support. As a result, the idea of TA gradually started being taken more seriously.

So far, I have argued that Daddario's relationship with COSPUP helped him to get the scientific community on side, as well as providing legitimacy to the idea of TA as a means of dealing with the potential dangers of new technologies. However, despite being remembered as the "godfather" of TA or the "original architect of the OTA legislation", David Dickson argues that Daddario served more as a conduit than an instigator; and it was actually the likes of Wiesner and Brooks who were really the ones pulling all the strings.[117] According to Dickson, even though Brooks and Wiesner were instrumental in the institutionalization of TA, they contributed little to—or even resisted—the growing calls for a democratization of approaches to technological change that Daddario and others championed. Instead, Dickson argues Wiesner and Brooks (as former members of the PSAC), were primarily concerned with their rapidly diminishing influence in the White

[116] David Dickson, *The New Politics of Science* (Chicago: University Chicago Press, 1988), 233.
[117] Ibid.

House.[118] As such, they turned their attention towards Congress in a desperate bid to maintain sway, while simultaneously defending their autonomy from excessive democratic control.[119]

It is an interpretation with considerable merit; especially given Wiesner's role on the subcommittee's advisory panel and Brooks' involvement in COSPUP. However, another less cynical interpretation is also possible. As I will discuss in the next section, in addition to Daddario's intention to improve relations between Congress and the scientific community, as well as his desire to increase the societal responsiveness of scientific research and technological development more broadly; Daddario also wanted scientists like Wiesner and Brooks to step up and take a leading role—which he saw as an important part of discharging their role responsibilities, as scientists.

Responsibility is a Two-Way Street

Based on the advice of the COSPUP report, Daddario's subcommittee organized a seminar on TA which was held on September 21st and 22nd 1967 and brought together directors of existing projects and studies concerned with 'technology and society'. Since many of the personnel affiliated to those existing projects and studies were also affiliated to the T&SC seminar at Columbia (as was Daddario himself), the T&SC seminar was particularly well-represented at the subcommittee's event. The TA seminar involved participants such as Christopher Wright, Director of Columbia's Institute for the Study of Science in Human Affairs; Emmanuel Mesthene, Director of Harvard's program on Technology and Society; the historian of technology Melvin Kranzberg from Case Western Reserve University; and *Science* journalist Dael Wolfle. Though discussion at the subcommittee's seminar largely centered upon what participants considered to be appropriate general functions of a new federal institution for TA; the design and practice of TA more generally was also considered. With regards to the general functions of

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118 For a detailed analysis on the rise and fall of the PSAC and why Wiesner and Brooks may have had cause for concern, see Zuoyue Wang, *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (Ithaca, NY: Rutgers University Press, 2008).
119 Ibid.

a new federal institution for TA, the suggestions included: 1) the coordination of disperse, existing TA activities, 2) a public information service, which would not only deliver information but also invite discussion, 3) an aid to the academic community, as well as 4) a guide in setting national goals (though this function was highly contested amongst the participants). Of course, the overlap with the T&SC seminar wasn't only in terms of people, the subcommittee event also picked up on many of the intellectual discussions that had featured during the Columbia seminar. For example, discussion topics included the role of scientists and engineers in TA; the role of social scientists in TA; the perceived need for a multi- or interdisciplinary approach to TA; and the need to produce TA expertise through dedicated educational programs.

During the seminar, Daddario made it clear that his interest in TA was not only to provide some sort of early warning regarding the potential impacts of new technology, but also to encourage scientists, legislators, and laymen to take responsibility in dealing with the challenges presented by technological change. For example, in his opening remarks he said, "Faith in science, and awe of technology, have been supplanted by a recognition of a grave responsibility for decision—that is, what should we do with what we know?"[120] As far as Daddario was concerned, TA was "a major key to discharging that responsibility".[121]

Delivering a public lecture at the autumn meeting of the NAS one month later, Daddario returned to the theme of responsibility, saying

> We need lots of practice in making the best possible choices among options—and both scientists and politicians are key players in this game… Ours is one of the weightiest and most fateful responsibilities of modern history. We must, of course, face up to these problems. As the sign on Harry Truman's desk used to say: 'The buck stops here!' It stops right here, with you and me.[122]

For Daddario, the time had come for scientists to acknowledge that they did not work in a political vacuum. He continued

[120] U.S. Congress, House Subcommittee on Science, Research and Development of the Committee of Science and Astronautics, "Technology Assessment Seminar, September 21 and 22, 1967," U.S. 90th Congress, 1st Session (Washington, D.C.: USGPO, 1967), 2.
[121] Ibid.
[122] Emilio Q. Daddario, "A Challenge to the Scientific Community," *Proceedings of the National Academy of Sciences of the United States of America* 59, no. 2 (1968): 306.

> Not long ago, the time did indeed exist when the door between us was closed and we were not facing the issues. We tended to regard each other with brooding suspicion, the long-hair in the ivory tower versus the hard-wheeler with his fist in the pork-barrel. Now the door is open—although I sometimes suspect it blew open—and we have each found that the monster on the other side is not quite as monstrous as we thought.[123]

Daddario accepted that there existed a tendency within Congress to "paint" all scientists and engineers with "the same tarred brush" of "anti-ness": "anti-this, anti-that, anti-something and always complaining… but nonetheless always demanding".[124] But just as in Congress, where legislators were having to learn "at least a little of the facts of scientific life" he argued that so too did the scientific community need to "recognize some of the facts of political life".[125]

Recognizing that establishing an allegiance would not be an easy task, Daddario described his own experience in Congress.[126] He outlined how legislators had to walk "a kind of tightrope"; those who were too sympathetic to the scientists might be called a "patsy" whereas those who were too interrogative may be "relegated to the ranks of the Neanderthal reactionaries".[127] At the same time, he acknowledged that scientists who engaged with legislators often faced similar hostility; being considered "impure" when their peers detected "the odor of the political arena and the hedonistic sounds of the secular world".[128] Nevertheless, Daddario argued, closing the door to the ivory tower meant "shirking reality and one's duty as a part of the 'new priesthood'".[129]

At the end of his talk, Daddario summarized his basic thesis: that societal problems were "not going to be cured either by government or by science alone" but they would not "be cured without them either".[130] He suggested that technical and subjective values were increasingly intermingled

[123] Ibid, 308.
[124] Ibid, 309.
[125] Ibid, 308.
[126] See also Emilio Q. Daddario, "Academic Science and the Federal Government," *Science* 162, no. 3859 (1968): 1249-1251.
[127] Emilio Q. Daddario, "A Challenge to the Scientific Community," 309
[128] Ibid.
[129] Ibid.
[130] Ibid, 310.

and should therefore be included in both the scientist's and the legislator's methods of operation. He said

> We must find ways, democratic ways, to increase efficiency in dealing with our national problems. This is the task before both of us. We cannot blame everything on politics, on parties or personalities. We are all part of the same ball of wax. You are citizens first, scientists second. We are citizens first, politicians second. Our responsibility is indivisible.[131]

For Daddario, TA was therefore not only a way to engage members of the scientific community in thinking more critically about *societal impacts*, but also a way to potentially democratize the *process* of technological change. As he explained to the Division of Biological Chemistry's symposium on the relationship of science and society one year later, TA would be a way "to relate scientific and technological advances to social values" because the important question was no longer simply "What can science and technology do?" but "What is it that we want?" and "Is it right?"[132]

Based on the input received during the 1967 seminar, the next phase of TA's development got underway, once again involving COSPUP as well as the National Academy of Engineering's parallel Committee on Public Engineering Policy (COPEP). Daddario commissioned the two groups to conduct extensive studies: COSPUP's on the methodology of the assessment procedure and COPEP's on a series of pilot assessment projects. A third study was also conducted by the SPRD, concerning past legislative issues, detailing instances in which Congress had sought advice and information with regards to technological-social-political situations since the Second World War.

Of the three reports—all of which were published in 1969—the "most widely publicized" and "best received" was the NAS report, *Technology: Processes of Assessment and Choice*.[133] Chaired by Harvey Brooks, the final report was less methodological guideline and more philosophical overview. In his letter of submittal to the President of the NAS, Philip Handler, Brooks

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131 Ibid, 311.

132 Chemical & Engineering News, "Science: Relevance to Society," September 22, 1969, 16. Box 33, Emilio. Q Daddario Collection, Wesleyan University Archives.

133 The NAS report exhausted its first print run of 10,000 copies in the first few months. See John Lear, "Science/The Endless Search"

described how much the panel had enjoyed the assignment—which was notable given they had begun the task "with a good deal of skepticism".[134] The panel featured two T&SC seminar regulars, Norman Kaplan and Melvin Kranzberg; as well as Raymond Bowers—co-founder of the Cornell program on Science, Technology, and Society; and Herbert Simon—whom we encountered in chapter 1; as well as a number of science journalists; policy specialists; and leaders of industry.

Within the report, the panel identified the different goals to which TA could be directed, including: the preservation of the environment; the evaluation of social change; improved foresight and planning; improved allocation of public resources; and better policy evaluation—all of which, the report stated, "reflect some awareness of the fact that the interplay between technology and man's natural and social environments significantly affects the problems and opportunities that more frequently dominate the choices of contemporary life".[135] The panel suggested that Daddario's proposal for TA had taken "aim squarely at the technology-society interface" asking "how the interactions at this interface might be better observed and more wisely managed".[136]

Though the NAS report argued that TA should be "detached" and "neutral" with regards to the issues brought before it—which became a foundational principle at OTA—it also reflected Daddario's ambition that TA extend cost-benefit analysis to include other factors which went beyond considerations solely of economic feasibility. Though the way in which TA was eventually realized at OTA didn't live up to this promise; failing to provide a comprehensive picture of the complexity of technological change, it is still worth noting that this broad ambition can be traced through much of the pre-OTA discussion. Many of the programs explored in the previous chapter—not least the Harvard program on Technology and Society—played a significant role in these early discussions. Indeed, according to Brooks, the NAS report drew rather considerably on the work of the program on Technology and Society—which is hardly surprising given that both Brooks

[134] National Academy of Sciences, "Technology: Processes of Assessment and Choice," Committee on Science and Public Policy, Prepared for Committee on Science and Astronautics, U.S. House of Representatives (Washington, D.C.: USGPO, 1969), i; See also Harvey Brooks and Raymond Bowers, "The Assessment of Technology," *Scientific American* 222, no. 2 (February 1970): 14.
[135] Ibid, 6.
[136] Ibid.

and Daddario were members of the program's advisory panel right from the start and that Brooks was on the panel responsible for hiring its director. Nevertheless, during the hearings on TA, which followed in 1969 and 1970, the discussion moved away from the idea of TA as a wide-ranging, holistic effort geared towards understanding the secondary and tertiary consequences of technological change, focusing instead on the specific functions and operational structure of the proposed OTA.

Outside the Congressional hearings however, the 1967 seminar catalyzed scholarly interest in studies of TA. The program of Policy Studies in Science and Technology at George Washington University (GWU), for example, continued to contribute to ongoing discussions regarding the broader conceptualization of TA. Having been established in 1964 with financial support from NASA, by the late 1960s, the program was dedicating a great deal of attention towards the subject of TA. Between January and July 1969, the program organized an influential series of seminars, the goal of which was to consolidate the fragmented efforts of a number of individuals who were developing TA across different institutions. Participants were invited from academic, industrial, and governmental organizations to provide an up to date overview of emerging ideas on the subject.

Alongside university-led activities at GWU, research institutions like Arthur D. Little, the RAND Corporation, the Stanford Research Institute, and Batelle Memorial Institute were also showing an interest in TA and producing a number of reports on different methodological approaches. The Mitre Corporation also conducted a series of pilot studies for the Office of Science and Technology, which were put together by management consultant Gabor Strasser as a sort of "how to go about it exercise".[137] The NSF had carried out some two dozen comprehensive TAs and related studies on topics including mining and off-shore drilling, automobile propulsive systems, videophones and solid waste disposal systems. The new Research Applied to National Needs (RANN) program also explicitly earmarked funds for research in TA, largely spearheaded by Joseph Coates. Both RANN and its predecessor the Interdisciplinary Research Relevant to Problems of Our Society (IRRPOS) program reflected an emphasis on relevance—IRRPOS

[137] Thomas J. Knight, *Technology's Future* (Florida: Robert E. Kreiger Publishing Company, 1982), 62.

being another development to have been spearheaded by Daddario.[138] Meanwhile the science and technology councils of ten States were also working on ways of operationalizing the concept of TA.[139] Within industry, companies in the petroleum, aerospace, and agricultural sectors had begun showing an interest; for while concerns regarding increasing government control were still prevalent on the shop floor, corporate headquarters favored TA as in part contributing to their role as "good corporate citizens".[140]

All of these activities suggest that there was a lot going on in the pre-OTA days. They demonstrate the extent to which the idea of TA was taken up and experimented with outside of Washington, implying that histories of TA should extend well beyond the reach of OTA. If we take Daddario's ideas about TA as anything to go by, then TA pre-OTA was imagined as a way of sharing responsibility for the future among a diverse set of stakeholders—not just between scientists and legislators. From this point of view, there is a sense in which the creation of OTA may have actually closed down conversations regarding what TA could, or should, be. As we will see in the next section, the extent to which these conversations travelled beyond the U.S. are also indicative of the broad conversations surrounding TA that were commonplace before the OTA.

An Intellectual Movement on the Move

By the late '60s and early '70s, the TA movement had begun to attract considerable interest internationally. The UN, the OECD, the United Nations Educational, Science, and Cultural Organizations (UNESCO), and the Council of Europe were all devoting time to the study of TA. Brooks had been involved with the OECD throughout his time on COSPUP, taking part in a number of panels on science and public policy. He was also in regular correspondence with Alexander King, co-founder of the Club of Rome and Director General for Scientific Affairs at the OECD, and hosted Jean-Jacques Salomon, head of the OECD's Science Policy Division, during

[138] See Thomas J. Knight, *Technology's Future*.
[139] Ibid.
[140] U.S. Senate, Subcommittee on Computer Services of the Committee on Rules and Administration United States Senate, "Technology Assessment for Congress," Staff Study (Washington, D.C.: USGPO, 1972), 36.

Salomon's time in Boston as a research fellow at MIT. In 1969, the Secretary General of the OECD invited Brooks to chair a prominent group of international scientists to make a reassessment of science policy for the 1970s. The so-called "Brooks Report" made the case for TA on the international stage. The OECD Observer summarized the report's take on TA as follows

> The key requirement is a wider range of options in the early stage of the innovation process, combined with a more sensitive, comprehensive and rigorous process of choice as the various options progress towards application. This involves deeper consideration and exploration of alternatives at the beginning, with a larger number of checkpoints in the process of selecting options.[141]

Following the council of Science Ministers meeting in 1971, the creation of the Project on the Management and Control of Technology, sponsored by the Committee on Scientific and Technological Policy, provided major impetus for the uptake of TA. The project's goal was the "more effective management and control of technology in the public interest".[142] Daddario chaired a seminar on TA in Paris in 1972, resulting in the formation of an advisory group who began collecting case studies. The seminar is a good indication of the extent to which TA had spread internationally, given that there were delegates from sixteen countries in attendance.

In addition to the OECD seminar, a number of other events also took place in 1972—the year that OTA first opened its doors. Back in the U.S., at the request of Congress, the third Engineering Foundation Conference in New Haven focused on the feasibility of TA; while in Europe, Austria hosted the fourth Salzburg Assembly, a conference on the Impact of New Technology, and in Italy, a North Atlantic Treaty Organization (NATO) conference (in conjunction with the NSF and the new International Institute for the Management of Science and Technology), both of which centered their discussions on the concept and methodology of TA.[143] In addition, the

[141] Anon, "A Science Policy for the 1970's," *The OECD Observer*, no. 53, August, 1971, 8.
[142] Thomas J. Knight, *Technology's Future*, 9.
[143] Given that the SAINT and NATO conferences were held at the same time, some participants even earned themselves the title of international conference-hopper, dashing back and forth across the Alps to attend both meetings. On NATO's interest in non-defense science during this period see e.g. Jacob Darwin Hamblin, "Environmentalism for the Atlantic Alliance: NATO's Experiment with the "Challenges of Modern Society"," *Environmental History* 15, no. 1 (2021), 54-75; and Simone Turchetti,

UN Conference on the Human environment and other high profile international events also had sessions on TA, helping to spread awareness of the growing movement. But there is perhaps no better example of the scale of the TA movement outside of Washington than the International Society for Technology Assessment (ISTA).

Formed in 1971, the society's first conference took place in The Hague in 1973, providing a "snapshot of TA" in the early '70s.[144] During talks and discussions, participants reflected on the period through which the field "was born and grew through adolescence to the vigor of young professionalism".[145] Having been put together by a small group of Dutch scholars, led by Claudius Chorus, President of Inter Scientas N.V. and the futurist Frederik L. Polak, ISTA's first president was Walter Hahn. Having worked for several years as a senior specialist at the SPRD, Hahn had produced a number of reports for Daddario's subcommittee—primarily on the subject of TA.[146] His office worked in close cooperation with scholars at GWU, Harvard and the NSF. In fact, according to Thomas Knight—who published an overview of the conference—the Washington TA group were "the driving force to put TA in international perspective from the beginning" and it was therefore not "altogether far-fetched to suggest that the conference was an experiment in the international transfer of the TA movement from the seventh floor of the George Washington University Library, the Library of Congress mezzanine, and the fifth floor of the NSF".[147]

Hahn was keen that ISTA would not be "just another academic organization"—"where scholars talk more and more esoterically to fewer and fewer colleagues".[148] Nor was it to be "a kind of think tank directly engaged in the day-to-day business of performing assessments, or as some kind of quasi-partisan agent of change with a hard line and a gift of the gab".[149] He felt that TA should learn from the misfortunes of related movements, such as "operations research", "management science", "systems analysis", "policy

Greening the Alliance: The Diplomacy of NATO's Science and Environmental Initiatives (Chicago: University of Chicago Press, 2018).

144 Thomas J. Knight, *Technology's Future*, 6.

145 Rustum Roy, "Foreword to the Second Enlarged Edition," in Thomas J. Knight, *Technology's Future*, vii.

146 Thomas J. Knight, *Technology's Future*, 6.

147 Ibid, 26.

148 Ibid, 13-15.

149 Ibid.

science", and "futurism".[150] Hahn's vision for ISTA was that it should provide an international, institutional framework for discussion regarding the "problems, methodologies, programs, and goals relating to the technical parameter of mankind's doings".[151] He hoped that it would provide a more systematic and organized forum for such discussions, away from the "*ad hocness* of international conference and seminar-going".[152] Hahn admired the Dutch for having the courage to back the formation of a society with "their reputation and their money", suggesting that the group demonstrated the "foresight to see technology assessment as an emergent concept popping up in many places in the world beyond the organizational activities in the United States".[153]

When it came to the organization of the conferences in 1973, there was a great deal of uncertainty about whether anyone would actually turn up. Hahn described how a "small band of [conference] conveners huddled over chattering telexes to sweat out the decision to go or to abort the meeting only six days before it started".[154] But their "fears turned to relief" as 225 people from 20 nations were soon gathered in the Toneelzaal, the main hall of the glass-and-steel Belair, nestled within the Hague's newly planned greenbelt.[155] In keeping with his vision for the society, Hahn wanted the conference to avoid "narrow professional interests" and "specialized jargon".[156] He stressed that TA should not fall into the same trap of "talking a specialized language that cuts it off from the mainstream of public policy" suggesting that to be effective, assessors would have to become "as wise as serpents and as gentle as doves".[157] As such, in contrast to prior academic, intergovernmental and world organization meetings on TA, ISTA's conference was the first non-invitational TA event. Those who attended "came to tell and to learn about

[150] Ibid.
[151] Ibid.
[152] Ibid.
[153] Ibid. In fact, according to Knight, the editorial board of *Technology Assessment*, ISTA's publication, "read like a who's who in international science management with representatives from Canada, Great Britain, Japan, Switzerland, France, Spain, Israel and Uruguay, as well as the Netherlands and the United States". Ibid, 18.
[154] Walter Hahn, "Foreword to the Second Enlarged Edition," in Thomas Knight, *Technology's Future*, x.
[155] Thomas Knight described participants arriving into the Netherlands, descending on "great machines of human invention", while glancing out of the aeroplane windows down to the "deep-green farms" and "token windmills". He wrote that "a more happy marriage of society and technology, past and future, nature and science, the local and the international would be hard to imagine". Ibid, 2.
[156] Ibid, 13.
[157] Ibid, 209.

TA, its practitioners, institutions, methods, actual and potential benefits and risks, and of course to gain a sense of direction of the future of TA".[158]

Established forecasting and futures groups were unsurprisingly well represented, including those from the OECD and NATO, the Teilhard Center, and the World Future Society. Other participants came from research institutes such as the Hudson and Stanford Research Institutes. Government agencies attended, including the Dutch Science Ministry, the United States Atomic Energy Commission and the NSF as well as a number of corporations operating on an international level, such as Shell, Swiss Aluminium, Monsanto Chemical, and General Electric.[159] Academics, urban planners, and civil servants were also in high numbers. Public interest groups were notably absent and politicians were under-represented, despite many having expressed an interest in the meeting. Daddario—who was also an honorary chairman of the conference—was scheduled to chair a session on the legal and political aspects of TA, but was forced to cancel last minute.[160] Similarly, Jan Terlouw, a Dutch M.P., also had to pull out. Tony Benn, then chairman of the Labour Party in the UK, flew in for three hours to chair the concluding session during which he primarily questioned the "timidity of TA".[161]

What became clear during the meeting was that however much the terms and mechanisms for TA differed depending on the socio-political context—Hahn quipped that during the meeting TA was "no doubt defined 225 different ways"—there was considerable overlap with regards to the overall objectives of TA, at least among Western European states.[162] As Knight summarized, these included "to guarantee economic prosperity and minimum inequality in distribution of income, to provide and conserve energy and natural resources, to improve social delivery systems, and to

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[158] Ibid, 17.
[159] Ibid.
[160] The other honorary chairs were Tony Benn and Robert Polak. Alongside Hahn the program committee consisted of Derek Medford, professor at the International Institute for the Management of Technology in Milan; Marvin Cetron, editor of ISTA's journal Technology Assessment; Hans Saur of West Germany's Ministry of Research and Technology; Henry Bianchi of the Center for Research and Life in Paris; Alvin Toffler of Future Shock fame; and Philip Wilmot of Cia-Geigy in Basel. Ibid, 19.
[161] Ibid, 18.
[162] Walter Hahn suggested that Knight captured it best, when he observed that three schools emerged throughout the week, "those who thought TA not *scientific* enough, not *social* enough, and not *moral* enough". Hahn, "Foreword to Second Enlarged Edition," x.

provide suitable popular participation in the decision process".[163] Looking over the conference program, it is clear that Daddario's broader ideals of societal responsiveness and shared responsibility were central. Knight even joked that for any approach invented to replace TA—such as R(R)I, one might say—the Hague congress was as "good a place as any to find a sketch if not a blue-print".[164] Particularly salient themes included the relationship between expertise and public participation; the assessor as a sort of "change agent"; and TA as a platform for wider reform.

By the time the second congress was held in Ann Arbor, Michigan in 1976, it was clear that TA was losing ground to rivals with which it was deeply entangled: "to the technological planning movement in non-market economies and to the appropriate technology movement in developing countries".[165] According to Knight, the history of TA since the Hague conference was thus marked by "the rapid rise of rival technology-management schemes and by a continued effort to gain legitimacy with policy-makers".[166] Knight writes that where "intellectually, many were becoming convinced; behaviorally, few were changing their actions".[167] Continuing, "Only the thinkers seemed eager. The doers were holding back".[168] As we will see in the next chapter, the appropriate technology movement in particular was framed from the start as a "doers" initiative, only to later be criticized for lacking any theoretical foundation.

By the start of 1977, ISTA itself was facing the bankruptcy of its first publisher; an unsuccessful lawsuit against said publisher to cover alleged debts from the Hague Conference; and the withdrawal of a number of corporate backers.[169] Despite optimism amidst its members, an upcoming conference on "TA for and in Industry" at the new University of Technology in France was cancelled; the newsletter, book series, and journal all folded; and members' renewal fees were returned. While some saw ISTA's downfall as a failure, Hahn suggested that perhaps it had simply "served its purpose".[170] What the demise of ISTA did facilitate was a winnowing down

[163] Thomas J. Knight, *Technology's Future*, 11.
[164] Ibid, 235.
[165] Ibid, 213.
[166] Ibid, 214.
[167] Ibid, 216.
[168] Ibid.
[169] Ibid, 232.
[170] Cited in Knight, *Technology's Future*, 232.

of what TA could or should be; like the creation of OTA in the U.S., the demise of ISTA served to close down the conversation regarding the possibilities for TA, constituting a further step towards the narrowing down of TA towards the caricature of "classic" TA that is remembered today.

Nevertheless, ISTA played a crucial role in launching TA on the world stage, enabling its integration into the decision-making process at the international, national, and sub-national levels. For many, it even served as an "informal transnational institutionalization of the TA movement".[171] Through the course of the 1970s, ISTA successfully created a loose network of TA researchers, practitioners, and industry and government users becoming the most visible linking mechanism at the international level. Through its journal, newsletter, book series, and meetings it kept "assessment issues in the public eye in an era when the search for a 'technological quick fix' for the food and energy crises could easily have become predominant".[172]

Through the course of the 1980s, the issue of TA survived even if the organization did not.[173] In the U.S., efforts were largely concentrated at the NSF and OTA—despite it experiencing its own ongoing organizational issues. In 1973, after his failed run for governor, Daddario had become the Director of OTA and helped the agency to establish a solid reputation. However his failure to assert the agency as a policy-influencing mechanism was a disappointment—not least to Daddario himself, who became increasingly disillusioned with TA given the organizational constraints and technocratic, top-down nature toward which it was developing at OTA. When Daddario stepped away from OTA in 1977, the idea of TA lost its

[171] Ibid, 51.

[172] Ibid, 213.

[173] A number of international meetings took place throughout the 1970s which conveyed the "momentum of the technology assessment concept if not its practice". Ibid, 215. These included, for example: in Tokyo, November 1974, an "international Symposium on TA" jointly sponsored by ISTA and the Japan Techno-Economic Society; in Ottawa, February 1975, a meeting on "TA and the Limits to Growth" jointly sponsored by ISTA, Bell Canada, and the Canadian Ministry of State for Science and Technology; meetings of an expert group on TA organized by the UN in June 1975; in Monaco, October 1975 and in Texas, October 1976, international conferences on marine TA, jointly sponsored by ISTA and the European Oceanic Association; in New York, May 1976, on the "TA of Energy Alternatives", jointly organized by ISTA and the Rensselaer Polytechnic Institute; in June 1976, a follow up meeting of the Engineering Foundation, "TA: an Evaluation of Ten Years' Experience"; in Michigan, October 1976, the second ISTA congress, "Technology Assessment: Creative Futures"; in Hawaii, in June 1977, a conference on "Technology Assessing: The Quest for Coherence"; in Vienna, July 1977, a conference on "Systems Assessment of New Technologies: International Perspectives"; and in India, October 1978, a meeting on "TA for Development", organized by the UN office of Science and Technology. For a more detailed overview see Thomas J. Knight, *Technology's Future*, 214-218.

biggest champion in Congress. Writing in 1982, one TA scholar described the organizational environment in which OTA operated as "one that is sometimes hostile, sometimes supportive, but largely indifferent to [OTA's] work," continuing "Congressional politics has traditionally not been characterized by an interest in comprehensive, long-term assessments of the 'physical, biological, economic, social, and political effects' of technological applications".[174] Given the nature of TA and the loss of Daddario's broader vision, OTA therefore evolved into a "more information-oriented agency, as opposed to a policy advocate 'assessing' alternatives".[175] As a result, in the early 1990s, those calling for the OTA's elimination—largely fueled by Newt Gingrich's Republican ascendancy in Congress—rallied around the notion that it merely duplicated the efforts of other information-oriented service agencies.[176]

Elsewhere in the 1980s, TA did continue to institutionalize outside the OTA and outside the United States. For instance, the Engineers Joint Council established a panel on TA consisting of various engineering society representatives who spread the word about TA through newsletters, journal articles, a TA "primer", and television tapes.[177] Internationally, the OECD continued to pursue TA through a program of meetings and publications. Other centers of research, practice, and teaching included the Science Policy Research Unit (SPRU) in Sussex; the Japan Techno-Economic Society in Tokyo; and the International Institute for Applied Systems Analysis (IIASA).[178] As we saw earlier in the chapter, TA also continued to be of interest to philosophers of technology and STS scholars, with a number of volumes providing refined and adapted versions of TA being published throughout the decade. It appeared, as Knight suggested, that no matter how "disorganized" or "marginal" TA continued to be, it "retained much of its appeal among academic and, to a certain extent, scientific and managerial elites" because it spoke to "the crucial issue of social responsibility".[179]

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[174] Cited in M. Anthony Mills, "Reviving Technology Assessment," 18.
[175] Ibid, 10.
[176] Ibid, 11.
[177] Thomas J. Knight, *Technology's Future*, 214.
[178] Ibid, 214.
[179] Ibid, 215.

Conclusion

Through the course of the 1970s as questions about the impacts and consequences of science and technology became more deeply embedded in public institutions, the OTA model came to serve as both inspiration and guide to budding TA organizations around the world. Indeed, the creation of OTA seems for many to mark the moment when the idea that the consequences of new and emerging technologies should be taken seriously first became firmly institutionalized.[180] Looking at the emergence of the TA discourse more broadly however, especially as it travelled outside of Washington, demonstrates that the eventual passing of OTA legislation in 1972, far from marking the creation of TA, in many ways closed down conversations regarding its conceptualization and functions. Ultimately, as Mills points out, "the political arguments for OTA that won the day were not those that appealed to a democratic demand for "social control" of technology but rather—and perhaps unsurprisingly—those that appealed to Congress' institutional needs".[181]

As we have seen however, by 1972 the concept of TA had already spread into the activities of the Executive Branch, into the affairs of industry, and into the deliberations of international organizations—reinforcing the notion that TA as it became known at OTA is only a part of the story. That the conference drew over 200 participants from 20 different countries in 1973 gives some idea of the scale of the TA movement pre-OTA. As outlined at the start of this chapter, through the course of the 1980s, TA continued to be taken up internationally, being molded and rebranded in different national and political contexts. Yet many of these developments remained highly dependent on a network that was forged in the pre-OTA period, a network of individuals who discussed and debated TA as more than just an early warning system.

While according to Brooks, the recommendations of the COSPUP reports may only have had a modest impact, they did help to "establish the

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180 See Bruce E. Seely, "Societal Implications of Emerging Science and Technologies: A Research Agenda for Science and Technology Studies (STS)," in *Nanotechnology: Societal Implications II,* ed. Mihail C. Roco and William Sims Bainbridge (Dordrecht: Springer, 2007), 211-222.
181 M. Anthony Mills, "Reviving Technology Assessment," 10.

agenda" and set "the terms of the debate".[182] The reports provided a "carefully selected menu of opportunities" which ultimately shaped the subcommittee's actions, from the reorganization of the NSF, to the long-term study of an appropriate advisory mechanism for Congress—OTA. In the end, the relationship between Congress and COSPUP turned out to be relatively short-lived, as close and sustained working relations never fully developed. Nevertheless, the arrangement played a crucial role in helping to get TA off the ground—not least because it helped cement Daddario's standing amongst the scientific community and enabled him to build strong and lasting relationships with a number of key figures, such as Wiesner and Brooks.

Within the congressional hearings, much of the discussion concerning TA focused on the growth of undesirable side-effects, the realization that no methods existed for dealing with this, and organizational discussions about where such a function should be performed—issues that were all intimately tied to the evolving legislation regarding OTA.[183] Ultimately, whether OTA itself was a product of the legislative process, or whether it came from the scientific community is a matter that remains open to debate.[184] What such debates have overlooked up until now however is the way in which ambivalent attitudes towards technological change provided the initial impetus for TA, and in turn gave shape to the emergence of a wider TA movement.

As we have seen, Daddario's approach to TA—gradually introducing and refining the concept over a number of years—enabled the TA movement to develop in parallel with the formal policy discourse, rendering some issues—such as public participation, for example—more or less visible to different groups at different moments.[185] As the TA movement grew, it

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[182] I. Bernard Cohen, "A Conversation with Harvey Brooks on the Social Sciences, Natural Sciences, and Public Policy," in *The Natural and Social Sciences: Some Critical and Historical Perspectives*, ed. I. Bernard Cohen (Dordrecht: Springer, 1994), 382 -383.

[183] Gabor Strasser, "Methodology for Technology Assessment—Case Study Experience in the United States," in *Technology Assessment in a Dynamic Environment,* ed. Marvin J. Cetron & Bodo Bartocha, (London: Gordon & Breach Publishing Group, 1973): 906.

[184] See also Barry M. Casper, "Rhetoric and Reality of Congressional Technology Assessment," in *Science, Technology, and National Policy*, ed. Thomas J. Kuehn and Alan L. Porter (Ithaca, NY: Cornell University Press, 1981).

[185] As Mills points out, some early advocates of TA pushed for more radical forms of "citizen participation". As we saw earlier in the chapter, this sort of "participatory technology assessment," was formalized in European institutionalizations through the course of the 1980s and 1990s. For examples of

transformed the discussion concerning TA from one primarily preoccupied with the creation of OTA, to one interested in TA as a more plural, responsibility-oriented discourse. This growth also necessitated the creation of novel organizations like ISTA—even if only temporarily. Members of the TA movement, including several individuals we met in chapter 2—such as Chris Wright—later took up positions at OTA, suggesting that despite ISTA running out of steam fairly early on, the movement continued to shape the "personnel, decision structures and premises of elites and command posts".[186]

Given the role OTA played in putting TA on the map, it is no surprise that "classic TA" is largely remembered as a top down, institutionalized effort, yet attention to the pre-OTA years demonstrates that Daddario did at least try to distribute responsibility for the conceptualization of TA right from the start. While Daddario was clearly keen on the idea of an advisory function for Congress, his motivation was also shaped by a deep concern about the impacts and consequences of technological change—particularly with regards to the environment; the need to align research priorities with societal needs; a desire for broader participation in determining the direction of scientific and technological development; as well as the responsibility of both legislators and scientists to take such questions seriously. In this sense, the initial motivations for TA were not all that far removed from contemporary approaches like R(R)I.

What does remain somewhat surprising however is why the pre-OTA period has been so overlooked in histories of both TA and R(R)I. Perhaps one explanation is that a number of social scientists and humanities scholars were amongst TA's earliest critics.[187] As M. Anthony Mills points out, it is "ironic—and somewhat puzzling" that early critics chastised TA for "excluding the non-quantitative methods of the social sciences and

early discussions regarding participatory approaches however, see James D. Carroll, "Participatory Technology," *Science* 171, no. 3972 (February 1971): 647–53; and Hazel Henderson, "Information and the New Movements for Citizen Participation," in *Science, Technology, and National Policy*, ed. Thomas J. Kuehn and Alan L. Porter (Ithaca, NY: Cornell University Press, 1981).

[186] Mayer N. Zald and Michael Lounsbury, "The wizards of Oz," 981-982.

[187] See e.g. Henry Skolimowski, "Technology Assessment as a Critique of a Civilization," in *Boston Studies in the Philosophy and History of Science*, ed. R. S. Cohen et al. (New York: Springer, 1974); Lynn White Jr., "Technology Assessment from the Stance of a Medieval Historian,"; Joe A. Tarr, ed., *Retrospective Technology Assessment—1976* (San Francisco, CA: San Francisco Press, 1977); and Peter Drucker, "New Technology: Predicting Its Impact Is Perilous and Futile," *New York Times*, April 8, 1973.

humanistic disciplines".[188] Especially given that Daddario stressed that "Technology Assessment must include many non-technological factors," emphasizing that "Other voices of society are also necessary for we are interested in assessment in terms of human values as well as natural science statistics".[189] Though Brooks remained wary of the feasibility and desirability of public participation, he explicitly contrasted TA with "cost-benefit analysis, systems analysis, 'planning-programming-budgeting,' and other forms of 'objective' or scientific analysis' that function to 'legitimiz[e] political consensus and turn . . . aside criticism' but which, in reality, 'represents a different set of value presuppositions'".[190] As we have seen throughout this chapter, TA was conceptualized in a variety of different ways; yet its qualitative and interdisciplinary character was rarely, if ever, in doubt.

Through the course of the mid to late '60s, TA underwent a lengthy gestation period. As Raghu Garud, Cynthia Hardy, and Steve Maguire explain, "through particular frames, new practices can be justified as indispensable, valid, and appropriate".[191] This in turn, "can help mobilize wide ranging coalitions of diverse groups and to generate the collective action necessary to secure support for and acceptance of institutional change".[192] As we have seen, TA was the product of a number of different constituencies, each with different visions for what TA could, or should be. Its institutionalization was effectively orchestrated through a number of movement intellectuals, such as Daddario, Brooks, and Hahn. Their activities and interests helped articulate the knowledge interests of the TA movement, despite the lack of any real consensus.

The "paradox of embedded agency" assumes that actors embedded within institutions struggle to reflect and act upon taken-for-granted institutional arrangements. Yet as an institutional entrepreneur, Daddario

[188] M. Anthony Mills, "Reviving Technology Assessment," 18.
[189] Daddario cited in ibid, 9.
[190] Brooks cited in ibid, 18. See also Harvey Brooks, "Technology Assessment in Retrospect," *Science, Technology and Human Values* 1, no. 4 (1976): 17–29.
[191] Raghu Garud, Cynthia Hardy, and Steve Maguire, "Institutional Entrepreneurship as Embedded agency," 962. See also
Evelyn Micelotta, Michael Lounsbury, and Royston Greenwood, "Pathways of Institutional Change: An Integrative Review and Research Agenda," *Journal of Management* 43, no. 6 (2017): 1885-1910; and Marc Schneiberg and Michael Lounsbury, "Social Movements and the Dynamics of Institutions and Organizations," In *The Sage Handbook of Organizational Institutionalism,* edited by Royston Greenwood, Christine Oliver, Thomas B. Lawrence & Renate E. Meyer, (London: Sage Publications, 2017), 281-310.
[192] Ibid.

successfully brought together a diverse set of institutions, including Congress, the NSF, and the NAS—as well as a number of influential individuals, such as Wiesner and Brooks, in order to provide the resources and micro-mobilization contexts within which the concept of TA could be explored. Subsequent arrangements, such as the contract between the subcommittee and COSPUP, created structures through which responsibility could be distributed across different constituencies. Similarly, the 1967 seminar enrolled further interest, by bringing TA to the attention of newly formed proto-STS programs.

Much like in the previous chapter, where divisions between the "two churches" of STS have become solidified through retellings of the field's history, the notion that early TA was similarly divided, this time between the worlds of academia and policy, has similarly become a stable part of TA's history. According to Porter, this divide was already visible in the 1960s, when hearings concerning OTA legislation engendered lively discussions between the two. Porter suggests that while one stream "sought to devise an effective policy analysis mechanism to help the U.S. Congress better cope with Executive Branch proposals," the other was more "philosophical in bent" and "concerned the broad roles of technology in society, seeking to help society better manage technology".[193]

However, as I have shown through the course of this chapter, such clear-cut boundaries rarely existed in practice. In fact, like the "bridge-building" metaphor discussed in the previous chapter which draws attention to those who can then position themselves as "bridge-builders"; so too does the "early warning" metaphor draw attention to a specific image of "classic TA", one that is typically associated with OTA. These metaphors are particularly useful when taken up within folk histories insofar as they provide a logical justification for, in this case, the reimagining of TA through numerous subsequent iterations, such as "participatory TA", "constructive TA", or even R(R)I. But while each iteration has undoubtedly contributed to the development of new concepts and practices, renewed empirical attention to alternative histories which sit outside established narratives demonstrates that ideas about how to make technological change more responsible have

[193] Porter, "Technology Assessment", 135.

come in and out of focus at different times in different places. All of which suggests that a far less triumphalist version of R(R)I's history *is* required.

Chapter 4

Whatever Happened to Appropriate Technology?

> Elliot Richardson read 100 pages one evening while sipping brandy before his London fireplace. Ralph Nader carries a worn copy in his raincoat for reading on airplanes. Jerry Rubin presses it on to friends because he loves the book. And at a recent press conference, Governor Jerry Brown of California waved a copy in front of reporters, declaring, "If you want to understand my philosophy, read this".[1]

The book receiving such adulation in a 1976 *Newsweek* article was Ernst Fritz Schumacher's *Small is Beautiful*: *A Study of Economics as if People Mattered*. According to Nicolas Jéquier and Gérard Blanc, in a report they wrote on appropriate technology (AT) for the OECD in 1983, "cultural revolutions", "are often crystallized and sometimes ignited by the written word, and notably by a best-selling book of major symbolic significance which captures the spirit of an emerging but still inchoate shift in values, and provides it with both legitimacy and substance".[2] They suggest that where the ecological movement had Rachel Carson's *Silent Spring* and the consumerist movement

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[1] Kenneth L. Woodward, John Barnes and James Bishop, "Thinking Small," *Newsweek*, March 22, 1976, 50.

[2] Nicolas Jéquier and Gérard Blanc, *The World of Appropriate Technology: A Quantitative Analysis* (Paris: Development Centre, Organisation for Economic Cooperation and Development, 1980), 163.

Ralph Nader's *Unsafe at any Speed*; the AT movement had Schumacher's *Small is Beautiful*.[3] Today, Schumacher is widely remembered as the founding father of the AT movement, and *Small is Beautiful*—a collection of essays published in 1973—as its manifesto.

Instead of portraying technology simplistically as either "good" or "bad", AT advocates recognized the importance of "technology choice"; that is, the importance of understanding the needs, capabilities, and context within which technological design and development takes place. The movement stressed that technology was not "neutral" and that "particular technologies embody in various ways the characteristics of the political setting from which they originate".[4] As Kelvin Willoughby argues, AT was, in that sense, "part of a trend in scholarship and polemics away from reliance upon reductionist and single discipline analyses towards multifaceted and holistic analyses".[5] AT was therefore not "a narrow notion about technology *per se*", but a "broad political-economic critique" of the sociotechnical system.[6]

According to the 1976 *Newsweek* article cited above *Small is Beautiful* was an "unpretentious paperback" that "made disciples of mavericks as well as Establishmentarians".[7] Yet despite being ranked as one of the 100 most influential books published since World War II, when *Small is Beautiful* was first published it sold a paltry 17,000 copies and was virtually ignored by reviewers. When Schumacher first visited the U.S. in 1974, he reportedly got "a tremendous reception from the hippies"; but when the environmentalist Byron Kennard tried to arrange meetings for him with some of the higher-ups, "nobody ever seemed to have heard of him".[8] By the time Schumacher returned to the U.S. in 1976, all of that had changed. Word-of-mouth endorsements and the translation of *Small is Beautiful* into 15 languages had seen sales soar to more than 100,000. His second trip stateside consisted of a

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[3] E. F. Schumacher, *Small Is Beautiful: Economics as if People Mattered,* 1973. Reprint. New York: Harper & Row, 1989.
[4] Kelvin Willoughby, *Technology Choice: A Critique of the Appropriate Technology Movement* (Boulder: Westview Press, 1990), 214.
[5] Ibid, 215.
[6] Ibid, 47.
[7] Kenneth L. Woodward, John Barnes and James Bishop, "Thinking Small," 50.
[8] William Delaney, "An Appreciation of 'Small is Beautiful': Obituary of E.F. Schumacher," *Washington Star*, n.d. Box 3, Folder 8, E.F. Schumacher Archive, The Schumacher Center for a New Economics, Great Barrington, Massachusetts.

6-week coast-to-coast tour with more than 160 speaking engagements.[9] Reports suggest that during his trip approximately 60,000 people heard him speak. Local newspapers described standing room only venues, where eager listeners crammed into hallways and people sat cross-legged around his lectern like schoolchildren.

Schumacher's grand tour of the U.S. could not have come at a more opportune time. With the U.S. (temporarily) emerging from an agonizing recession, and ongoing energy and water shortages nationwide, people were eager to listen to what he had to say, and the press scurried after him "as if he were a star".[10] For despite *Small is Beautiful* concentrating largely on the "under-developed" economies of the world, the arguments it contained were considered broad enough to accommodate problems associated with over-development as well—potentially providing an alternative model to Keynesian economics. Though the notion of AT had been gaining ground in the "developing countries" already in the 1960s, interest in the concept surged in the "developed nations" in response to the 1973 oil crisis.[11]

The publication of *Small is Beautiful* and the looming energy crisis were both key moments for the budding AT movement, in that they helped bring AT into the spotlight. In that AT reflected broad environmental concerns regarding the impacts of industrial society, it is often associated with hippies and back-to-the-land types. But whereas fellow travellers on the counter-cultural trail focused their critique on the technocratic tendencies of capitalism, AT offered specific alternatives in terms of both the *process* and *societal impacts* of technological change.[12] As such, what began with a few "lone pioneers" quickly evolved into a recognizable movement with a high degree of political legitimacy.[13]

The number of organizations worldwide that identified with the concept of AT grew from just a handful prior to 1970, to over 500 by 1977,

[9] William Delaney, "Theory to 'Think Small' Draws Rapt Audience," *Washington Star*, March 3, 1977. Box 3, Folder 8, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.

[10] Chuck Fager, "E. F. Schumacher," *The San Francisco Bay Guardian*, March 11, 1977. Box 3, Folder 7, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.

[11] Denton E. Morrison, "Soft Tech/Hard Tech, Hi Tech/Lo Tech: A Social Movement Analysis of Appropriate Technology," *Sociological Inquiry* 53, no. 2-3 (1983): 230.

[12] See Adrian Smith, "The Alternative Technology Movement: An Analysis of its Framing and Negotiation of Technology Development," *Human Ecology Review* 12, no. 2 (2005).

[13] Nicolas Jéquier, and Gérard Blanc, *The World of Appropriate Technology*, 165.

reaching an estimated 1000 by 1980.[14] During this period, the AT movement produced a large literature and saw the emergence of several AT-related institutions: "public and private; state, federal and local; high-tech and low".[15] All of which would seem to suggest that the movement achieved at least a moderate degree of success. Yet, much like R(R)I, AT's institutionalization was highly dependent upon prevailing policy winds and sympathetic political climates. By the mid-80s, many felt that these institutions had either "disappeared" or at least "lost their momentum".[16]

The decline of the movement was attributed to a broad range of factors, including: lack of political commitment; the notion that AT was more feminine than the hegemonic technology; and the failure of AT to develop a clear philosophy, instead remaining "a nebulous concept with indistinct boundaries and vague criteria".[17] As a result, AT commentators concluded that AT had not accomplished terribly much at all.[18] Politically, it had failed to mobilize mass support and demands for resource redistribution seemed fanciful. Economically, its technologies had contributed little to development; as efforts to develop the local capacity required in order to assimilate and improve AT *in situ* had been vastly underestimated. And, ideologically, the criticisms offered by proponents of AT about conventional technological practices "had no bite"; "they failed to challenge the opposition because they were perceived as irrelevant, innocuous, or sadly lacking in a mature appreciation of the 'facts of life' regarding the production system".[19] According to some, in the end, AT was a movement that only lasted about 4 years and ended with Ronald Reagan's inauguration.[20] Though the post-1979 recession may have played a role in some people in the U.S.—farmers, for instance—looking for cheaper, more appropriate alternatives, that desire appears to have dissipated fairly quickly once the recession ended around

[14] Richard Whitcombe and Marilyn Carr, *Appropriate Technology Institutions: A Review*, I.T.D.G. Occasional Paper #7 (London: Intermediate Technology Publications Ltd., 1982), p. 2 cited in in Willoughby, *Technology Choice*, 50.
[15] Carroll Pursell, "The Rise and Fall of the Appropriate Technology Movement in the United States, 1965-1985," *Technology and Culture* 34, no. 3 (1993): 629.
[16] Ibid.
[17] Richard S. Eckaus, "Appropriate Technology: The Movement has only a few Clothes on," *Issues in Science and Technology* 3, no. 2 (1987): 63.
[18] Ibid.
[19] Stanley R. Carpenter, "A Conversation Concerning Technology: The 'Appropriate' Technology Movement," In *Technology and Contemporary Life*, ed. Paul Durbin (Springer, Dordrecht, 1988): 88.
[20] Ibid, 87.

1983. And while Reagan's neoliberal policies became enshrined as more effective than models like AT, for a time AT did provide a serious alternative and potentially presented a real threat to big corporations. But by the end of the '80s, AT was largely considered "passé" and the question on many people's lips was "Why then bother about AT?"[21]

Against the back-drop of AT's relatively low-impact history, which casts the movement as a "failed effort" made by "well-intentioned tinkerers",[22] in this chapter, I am interested in asking *what can we learn from looking at AT from a perspective that extends forward and backward from the usual endpoints of the movement that most observers work with*? That is, how did the AT movement come to be and what sort of legacies did it leave behind? According to Kelvin Willoughby, AT was "not just an intellectual fad of the 1960s and 1970s".[23] Rightly understood, it was "a serious concept accompanied by a sizeable international social movement and a notable record of practical accomplishments"—especially given the fact that it "stemmed largely from the independent activities of grass roots organizations and committed individuals".[24] From this point of view, AT had broad goals and drew on a broad base of support.

As I have argued throughout this book, new fields and practices are often "constructed from the rubble, or flotsam and jetsam, of previous institutions or paths not taken".[25] I have argued, therefore, that to make sense of R(R)I's history, we need to look at how its various "building blocks" came to be "littered around the social landscape".[26] As R(R)I has increasingly tried to embrace discourses which problematize the feasibility and desirability of endless economic growth it seems to me that the AT movement might be a relevant and important forebear in that it too helped put the notion of responsibility on the agenda.

Existing analyses of AT have tended to discuss the movement in terms of two broad divisions or streams: one was concerned predominately with

[21] Ibid.
[22] Paul Polak, "The Death of Appropriate Technology," cited in Jessie Lissenden, Siri Maley, and Khanjan Mehta, "An Era of Appropriate Technology: Evolutions, Oversights and Opportunities." *Journal of Humanitarian Engineering* 3, no. 1 (2015): 32.
[23] Kelvin Willoughby, *Technology Choice*, 332.
[24] Ibid.
[25] Marc Schneiberg and Michael Lounsbury, "Social Movements and the Dynamics of Institutions and Organizations," 302.
[26] Ibid.

the so-called "less developed" countries and problems surrounding "technological dependency", "technology transfer" and "technological underdevelopment"; the other on the wealthier industrialized countries and the need for "either a transformation or a renewal of technological growth and technological systems".[27] Despite the different concerns of both streams, each claimed that its ideas were relevant to the other and significant parallels did exist between them. In fact, in the transition Jéquier observed from a "first generation" to a "second generation"—with the former being characterized by "minority philosophical, polemical and experimental activities at the 'grass root's level" and the latter by "large scale diffusion and acceptance as part of the status quo"—the two streams appeared to converge around four key foci: economics; technology; the environment; and people.[28]

In this chapter, I have chosen to follow Adrian Smith's slightly different take on the AT movement. Smith suggests that AT was made up of *two communities*, each with slightly different orientations. AT's "intentional communities", "left the urban rat race and sought a rural idyll", where they could "build autonomous housing, use renewable energy and practice organic farming". On the other hand, AT's "communities of intent", "engaged in political lobbying, created community projects, worked with trade unions, set up small AT businesses, and became involved in education and research; all tactics that challenged technocratic forms of development and sought technologies open to greater social control".[29] These groups effectively "sought social movement opportunities and alliances into which their AT projects could be incorporated and advanced".[30] Focusing on AT's communities of intent branch not only allows me to apply to approach AT as a scientific/intellectual movement, but also to adopt a far more transnational perspective.

Following ideas about AT as they travelled, I will argue that AT's communities of intent made responsibility matter in ways that are clearly visible within the discourse surrounding R(R)I and that AT also provided a number of institutional footholds for successor movements like R(R)I to step

[27] Kelvin Willoughby, *Technology Choice*, 51.
[28] Ibid, 47.
[29] Adrian Smith, "An R&D Lab for Utopia? Alternative Technology Centres in the UK," in *Paper for the European Consortium for Political Research Joint Sessions Workshop on the Politics of Utopia: Intentional Communities as Social Science Microcosms* (Uppsala University, Sweden, 2004): 1.
[30] Ibid.

into. In order to do so, I will need to show just how institutionalized AT became. To start with, I will outline the activities of two of AT's pioneering organizations, the Volunteers for Technical Assistance (VITA)—supported by science policy heavyweights like Harvey Brooks; and the Intermediate Technology Development Group (ITDG)—founded by Schumacher. I will argue that three strategies became central to their success. First, in that their primary goal was to provide technical assistance to those in need, both groups quickly recognized that responding to problems required the support of interdisciplinary teams. Second, both groups relied heavily on the support of high status individuals, who were a part of strong communication networks that were connected through overlapping organization units, friendships, meetings and conferences. Third, both groups actively engaged with universities, helping to foster the spread of research into, and educational projects based on, AT. As we will see, the success of these strategies eventually enabled the establishment of international infrastructures for AT. At the same time however, the difference between Brooks' and Schumacher's ideas surrounding AT came to underwrite a broader division within the AT movement as to whether its main goal was rather to tinker with, or transform, the status quo. As ideas about AT continued to grow, they therefore developed in different contexts under different rubrics.

As in previous chapters, I will start by providing an overview of the AT movement's historiography and the different ways in which AT has been defined. I will then make the argument that these histories largely reinforce a "rise and fall" narrative of the movement.[31] However, as Jéquier and Blanc point out, the position and influence of AT advocates contributed to a far subtler phenomenon, which they describe as a "termite-like penetration into the decision-making of government, industry, banks, political parties, and trade-unions".[32] In order to trace such efforts, towards the end of the chapter I will zoom back out and take a more transnational perspective. Doing so, as I will argue, provides some hefty indications that AT-related ideas continued to circulate well beyond the movement's supposed demise.

Finally, whereas in previous chapters I have highlighted how ambivalent attitudes can provide different opportunities for action, or

[31] See Carroll Pursell, "The Rise and Fall".
[32] Nicolas Jéquier and Gérard Blanc, *The World of Appropriate Technology*, 164.

support the enrollment of a broad base of support, in this chapter, I want to suggest that ambivalence can also be misinterpreted as irrelevance. As discussed earlier, ambivalence often goes unmeasured and undetected. The result of which is that historical narratives tend to favor those who had clear and pronounced views. In the case of AT, perhaps the sort of ambivalence that appears to have been inherent within the movement is one explanation for why it has yet to be seriously considered as a relevant part of R(R)I's history; despite having made important contributions to making responsibility matter in thinking about both the *process* and *impacts* of technological change.

The Emergence of "AT"

In a report co-produced by the U.S. Agency for International Development (AID), the World Bank, and the OECD in 1979, William Ellis, George McRobie, and Ken Darrow, map AT's roots geographically. In Europe, the movement had a theoretical base.[33] This was largely based on the ideas of Jacques Ellul, as "one of the first modern philosophers to sound the warning that society was becoming enslaved by a science and technology that proceeded with its own rules of logic".[34] They pointed to exemplary European approaches as voiced in books like *Radical Technology* by Godfrey Boyle and Peter Harper, *The Politics of Appropriate Technology* by David Dickson; in periodicals such as *Undercurrents* and *Resurgence*; and in political actions such as the Lucas Aerospace Combine Shop Stewards Committee—where Lucas staffers proposed to combat redundancies by shifting towards more socially useful production.[35]

In the U.S. meanwhile, AT's roots could be found in Rachel Carson's *Silent Spring* and Ralph Nader's *Unsafe at Any Speed*. They were in "Martin

[33] William Ellis, George McRobie and Kenneth Darrow, *Appropriate Technology Development in the United States and their Relevance to the Third World* (Paris: Development Centre, Organisation for Economic Cooperation and Development, 1980).
[34] Ibid, 3.
[35] Godfrey Boyle and Peter Harper, eds., *Radical Technology* (London: Wildwood House, 1976); David Dickson, *Alternative Technology and the Politics of Technical Change* (Glasgow: Fontana, 1974); On the Lucas Aerospace workers see Mike Cooley, *Architect or Bee? The Human/Technology Relationship* (Sydney: Transnational Coop., 1980); and Adrian Smith, Mariano Fressoli, Dinesh Abrol, Elisa Arond, and Adrian Ely. *Grassroots Innovation Movements*. (London: Routledge, 2017).

Luther King's march on Selma Alabama and the growing concern for individual rights and local self-reliance," as well as "in Watergate and the loss of faith in big government, big industry, big labor, and big science to meet the nation's needs".[36] Finally, in the "Third World", AT's roots lay in the need to meet human needs—food, housing, clothing, transportation, health, and communication. In this context, the AT movement was a response to "the failure of Conventional Development Strategies (CDS)", which relied on "'modernization', 'technology transfer', 'industrialization', and 'trickle down' to bring economic development to the masses while bringing wealth to a small elite".[37] They highlight the work of scholars like Ponna Wignaraja in Thailand and Amilcar Herrara in Argentina who called for an "Alternative Development Strategy (ADS)" which would start "with the people" and assist them "to meet their own needs with technologies of their own designs built from local resources".[38] Subsequent histories of AT tend to map its origins in a similar way.[39]

In the early 1970s, Willoughby suggests that AT was used to denote a "philosophical framework"; "an economic theory"; "an ideology"; "a form of dogma"; as well as "an approach to innovation".[40] According to the philosopher Thomas Simon, AT was essentially a "code" for "new ways of thinking about the social implications of technological choice".[41] AT was seen variously "as a means of ushering in a New Age, as an alternative to high technology, as a social movement, and, by some, as utopian delusion".[42] Business experts Jessica Lipnack and Jerry Stamps summarized it best, stating, "Appropriate technology has had as many descriptions as it has had applications, ranging from very fuzzy notions of sometimes crazy-looking contraptions to more generalized, value-oriented definitions".[43]

[36] William Ellis, George McRobie and Kenneth Darrow. *Appropriate Technology Development,* 4.
[37] Ibid.
[38] Ibid, 5.
[39] See e.g. Langdon Winner, *The Whale and the Reactor* (Chicago: University of Chicago Press, 2010), 61-84; Craig A. Decker, *Tilters with Windmills--the Coevolution of the Appropriate Technology Movement in America*, PhD diss., Massachusetts Institute of Technology, 1988; Raphael Kaplinsky, *The Economies of Small: Appropriate Technology in a Changing World* (London: Intermediate Technology Press, 1990); and Jordan B. Kleiman, *The Appropriate Technology Movement in American Political Culture*, PhD Diss., University of Rochester, 2000.
[40] Kelvin Willoughby, *Technology Choice,* 45.
[41] Thomas Simon, "Appropriate Technology and Inappropriate Politics," in *Technology and Contemporary Life*, ed. Paul Durbin (Springer, Dordrecht, 1988), 107.
[42] Ibid.
[43] Jessica Lipnack and Jeffrey Stamps, *The Networking Book: People Connecting with People* (New York: Routledge & Kagan Paul, 1986), 55.

Much like TA and R(R)I, thinking about AT clearly entailed a fair amount of interpretive flexibility. As the sociologist Denton Morrison put it

> The terms "appropriate" and "technology" have meanings in the ordinary language; it may seem reasonable that the meaning of their conjunction in "appropriate technology" can be easily derived by logical/common sense considerations. But this is not the case. The meaning of AT is given-albeit loosely-by the AT movement.[44]

So while AT may have meant different things to difference people, as Morrison makes clear, these meanings were largely provided in and through understanding AT as a movement; and as a movement, AT was part of a much larger ecosystem.

AT was tightly bound up with numerous overlapping ideas which included (but were not limited to): alternative technology; intermediate technology; low cost technology; soft technology; radical technology; participatory technology; community technology—and so the list goes on. Generally speaking, each of these concepts had one or more dominant traits which distinguished it from the rest. So, as one AT commentator suggested, "low cost technology" concentrated on economic factors; "intermediate technology" on engineering aspects; and "appropriate technology" on the socio-cultural impacts.[45] Gradually—not unlike R(R)I—AT became something of an umbrella term. This was despite assertions that the concept of "appropriateness" was "the most fluctuating in time and space", and "heavily influenced by value judgements and ideological considerations".[46]

Through the course of the 1970s, the list of technology prefixes continued to swell, with different concepts continuing to highlight different priorities. Many organizations identified several key characteristics of AT, rather than providing any one fixed definition. As Simon observed, AT proponents were fond of this sort of definitional strategy, providing a "shopping list of features", which implied they could be "expected to be found in the appropriate technology store".[47] Robin Clark, of Biotech

[44] Denton Morrisson, "Soft Tech/Hard Tech", 244.
[45] M. R. Bhagavan, *A Critique of "Appropriate" Technology for Underdeveloped Countries* (Uppsala: Uppsala Offset Center, 1979) 8.
[46] Ibid.
[47] Thomas Simon, "Appropriate Technology and Inappropriate Politics," 110.

Research and Development, provided one of the most comprehensive and oft quoted lists which included some thirty-six dimensions; contrasting technology programs and approaches that were either "hard" or "soft". The hardness or softness of a technology depended upon the sorts of effects and impacts it had on the social and physical environment in which it was being introduced—not all that dissimilar to ideas about "soft impacts" within R(R)I today.[48]

Frede Hvelplund, from the School of Business Administration in Aarhus, Denmark, identified a somewhat more modest fifteen criteria, stressing that AT should be seen primarily as a process, not a product. Former president of Appropriate Technology International (ATI), Ton de Wilde, described Hvelplund's approach as follows

> He suggested that if it was possible to take a photograph of AT, the photo might indicate a small-factory in action. A static picture will show us many of the technical details which have been characterized as labor intensive, simple, local, etc. If instead, we could take a moving film, we would see a dynamic process, and would notice the relationship between people and technology, between groups of people and technology, between technology and organizations in the local social-economic structure. In trying to describe this process we can distinguish four main components: the resources, the people, the technologies, and the economic and political structure.[49]

Despite the existence of more process-oriented criteria like Hvelplund's however, AT commentators like Langdon Winner derided these "paradise-for-Christmas *versus* the sordid-perils of modernity lists" as "shallow social criticism".[50] Others also dismissed them as vague, indistinct, and unhelpful. Whatever their shortcomings however, what these lists had in common was that they stressed that the criteria for technology choice needed to go beyond

[48] Robin Clarke, "Some Utopian Characteristics of Soft Technology", notes for Biotechnic Research and Development, United Kingdom, published in David Dickon, *Alternative Technology,* 103-104. For a more recent take on "soft impacts", see Tsjalling Swierstra, "Identifying the Normative Challenges Posed by Technology's 'Soft' Impacts," *Etikk i Praksis—Nordic Journal of Applied Ethics* 1 (2015): 5-20.
[49] Ton de Wilde, "Some Social Criteria for Appropriate Technology," in Introduction to Appropriate Technology, ed. Richard J. Congdon (Emmaus: Rodale Press, 1977), 162.
[50] Thomas Simon, "Appropriate Technology and Inappropriate Politics," 111.

the economic and the technical, so that AT included a "broader range of criteria than had been true in the past".[51]

During the course of the 1970s and 1980s the literature on AT typically provided case histories and examples of best practices, often in the form of handbooks and manuals.[52] Directories were also a staple of the period, many of which were produced by international organizations. Numerous historians, philosophers and sociologists, many of whom were associated with proto-STS activities at the time (see chapter 1), were drawn to AT as an object of analysis.[53] A number of these scholars considered themselves AT advocates, or in the very least supporters of AT—at least in the early years. Much of the literature they produced evaluated AT's desirability, feasibility, and potential efficacy in practice.

However, many of AT's early supporters soon turned to criticism, as they charted the movement's failings and documented its fall from grace. For example, the architect Witold Rybczynski, argued that AT had "been hoisted by its own technological petard" but soon found itself "outflanked by the 'high' technologists" who were "ready, willing and able to produce appropriate technologies, not instead of, but in addition to, the other kind".[54] Similarly, Winner—who had initially believed that AT held great potential—lamented that in the end the general idea of the movement seemed to be "build a better mousetrap and the world will beat a path to environmental and social well-being".[55] As a result of these sorts of takes, Caroll Pursell's

[51] Matthew J. Betz, Pat McGowan and Rolf T. Wingard, *Appropriate Technology: Choice and Development* (Durham: Duke Press Policy Studies, 1984), 3.
[52] A thorough overview of this material is provided in Kelvin Willoughby, *Technology Choice*.
[53] For example, Franklin Long, co-founder of Cornell's program in STS and Paul Goodman, a regular at Columbia's seminar on Technology & Social Change. See Franklin A. Long and Alexandra Oleson, eds. *Appropriate Technology and Social Values—A Critical Appraisal* (Cambridge, MA: Ballinger Publishing Co., 1980); and Paul Goodman, "Can Technology Be Humane?" In *Technology and the Future*, ed. Albert H. Teich (New York: St. Martin's Press, 1986).
[54] Cited in Craig Decker, *Tilters with Windmills*, 9. During the 1970s, Rybczynski studied solar distillation, wind power, and waterless sanitation alongside Colombian architect Alvaro Ortega at McGill University's Minimum Cost Housing Program (MCHG). Through his work at MCHG, Rybczynski became aware of the Brace Research Institute (also based at McGill), which had close ties with ITDG in London.
[55] Winner had hoped that AT would pick up from where socialist theorists had left off, building on their critiques of advanced capitalism, by promising a "fundamental re-evaluation of the place and meaning of technology in human activity". Winner described appropriate technologists as having "revived a project which had been abandoned with the eclipse of 19th-century utopianism: the work of proposing a clear and systematic notion of the good life" that could be "translated into principles and criteria of institutional design". Socialist thinkers, he wrote, "have produced increasingly refined, devastating critiques of advanced capitalism". But with few exceptions (i.e. the nineteenth-century utopian socialists, William Morris, and the Guild Socialists, who together comprised a dissenting minority within the

depiction of the "rise and fall" of AT quickly became the dominant way of framing the movement's trajectory.

In general, AT's critics described it as some sort of "technological fixation";[56] a form of "hardware fetishism";[57] or simply, a "grab bag of vague ideas".[58] However, according to Willoughby, such accusations were largely unfounded as they looked upon AT's protagonists as "concerned only with technical-empirical considerations".[59] As such, Willoughby states, much of the criticism against AT was "superficial, ambiguous, based upon misinformation or prejudice, sometimes dishonest and sometimes incoherent".[60] This was partly due to lazy scholarship; partly due to ideological bias; and partly due to the heterogeneity of the movement, all of which helped create space "for the proliferation of confusing or misplaced criticisms".[61]

Political criticisms regarding AT's "narrow technicism" or tendency towards "technological determinism" were harder to dismiss—though as Willoughby argues, still typically based on a "largely fictitious portrayal" of AT and an "inconsistent, or at least highly ambiguous" interpretation of determinism.[62] While much of the criticism was "little more than dogmatic assertions or tirades by commentators predisposed against the movement", others took "the form of balanced or sympathetic reviews".[63] These largely came from scholars who felt some affinity with the movement and who sought to "bring out cogent political critiques for the purpose of enhancing

socialist tradition), "the theorists of socialism" failed to "keep alive an idea of what the institutional alternatives to capitalism might be". Winner cited in Kleiman, *The Appropriate Technology Movement in American Political Culture* , 12-13.

[56] Richard S. Eckaus, "Appropriate Technology: The Movement has only a few Clothes on," 70.

[57] Langdon Winner, "The Political Philosophy of Alternative Technology: Historical Roots and Present Prospects," *Technology in Society* 1, no. 1 (1979): 81.

[58] Thomas Simon, "Appropriate Technology and Inappropriate Politics," 107.

[59] Kelvin Willoughby, *Technology Choice*, 310.

[60] Ibid, 259.

[61] Ibid.

[62] Ibid, 247-250. Kelvin Willoughby provides four retorts to the accusation of technological determinism: "Firstly, Appropriate Technology is not a disguised doctrine of technological determinism. Secondly, the movement nevertheless views technology as a formative influence on society, but at the same time sees the need for conscious social and political action as a formative influence on technology. Thirdly, the concept of Appropriate Technology avoids creating a dichotomy between the category "politics" and the category "technology". Fourthly, most of the technological-determinism criticisms directed at Appropriate Technology are based less on substantive grounds than on the need for "ideological culprits" against which political and sociological theorists may contrast their views". Ibid, 251.

[63] Ibid, 242.

the concept and movement".[64] These critiques also demonstrated the tendency with the movement toward self-criticism and reflexivity—foreshadowing a similar tendency within contemporary R(R)I.

Through the course of the 1970s, ambivalence regarding the nature of policy actions on the part of both national governments and development agencies started to grow. Many within the movement saw the uptake of AT by development agencies as a cause for alarm, as they feared their support would strengthen the notion already prevalent that AT was a way of pushing a "second best technology" or simply a new attempt at cultural domination.[65] AT was, in some ways, both paternalistic and anti-colonial at the same time. For AT practitioners however, the AT movement presented an opportunity to break with "the traditional foreign assistance process in which the Industrialized West tells the Third World what is best for them".[66]

A survey of AT practitioners in the US regarding collaboration with the "Third World" concluded that AT relied on the notion "that technology ought to support a humanistic way of life"; that "it should be innovated, understood, built, and controlled by people themselves"; and that "the participation of people" was "the most important ingredient of AT and any program of collaboration with the Third World must be in the context of process not product".[67] As one respondent put it "It is not a matter of designing technology *for* traditional society, but designing technology *in collaboration with* traditional society".[68] The groups surveyed stressed that AT was "by the people"; "location specific", "holistic", and "futuristic"—insofar as it signaled, "Where we want to be in the future, or perhaps more accurately, where we can be under the restraints of population and world resources".[69] AT therefore foregrounded the social and cultural dimensions of innovation; emphasized the role of value judgements in technological choice; promoted participation; and was fundamentally process oriented—all of which continue to be central tenets within R(R)I today.

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[64] Ibid.
[65] One rejoinder to the "second best option" criticism is that "it implies that there is only one form of acceptable modern technology—that which industrialized countries use". See Canadian Hunger Foundation and Brace Research Institute, "Appropriate Technology Primer," *Ekistics* 43, no. 259 (1977): 360-367.
[66] William Ellis, George McRobie and Kenneth Darrow, *Appropriate Technology Development,* 3.
[67] Ibid, 7.
[68] Ibid, 14.
[69] Ibid, 7.

As I will argue in the next section, to understand AT's communities of intent, we need to look at some of the earliest pioneers of AT, like VITA and ITDG. What we will see is that both groups had similar motivations and approaches based on striking the right balance with regards to what Stewart Brand would later refer to as the "talk/do ratio"—indeed Schumacher himself was famously of the opinion that "an ounce of practice" was "worth more than a ton of theory".[70] At the same time however, VITA and ITDG were quite different in terms of their primary goals and this difference generated a considerable amount of ambivalence within the movement. For some, the goal of AT was to stimulate reform through making minor improvements to the status quo; whereas for others, the goal was more transformational through a critical revaluation of technological change. The tension between these goals—of incremental evolution versus broader transformation—has clear parallels with different expectations regarding the goals of contemporary R(R)I (see chapter 1).

Within their general theory of scientific/intellectual movements, Frickel and Gross rely on traditional social movement theory identifying success and failure as a movement's two main outcomes.[71] Yet within the literature on social movements, the language of success and failure has gradually shifted to a language of outcomes and consequences. For example, the outcomes could be substantial (e.g. changes to the material environment); procedural (e.g. changes to rules or laws); structural (e.g. changes in institutional structure); or sensitizing (e.g. changes to the political agenda and/or public attitudes).[72] The outcomes or consequences of a scientific/intellectual movement could be similar; as movements continue to shape the individuals, organizations, or networks, which continue to exist beyond a movements collapse.[73] AT therefore provides a lens for examining the outcomes and consequences of a scientific/intellectual movement, rather

[70] E.F. Schumacher, *Small is Beautiful*, 25.
[71] Scott Frickel and Neil Gross, "Scientific/Intellectual Movements,"
[72] See Marco Giugni, "Outcomes of New Social Movements," in *New Social Movements in Western Europe,* eds. Hanspeter Kriesi, Ruud Koopmans, Jan Willem Duyvendak, and Marco Giugni (Minneapolis: University of Minnesota Press, 1995); and Hein-Anton Van Der Heijden, "Environmental Movements, Ecological Modernisation and Political Opportunity Structures," *Environmental Politics* 8, no. 1 (1999): 199-221.
[73] See Jasper M. James, "Cultural Approaches in the Sociology of Social Movements," in Handbook of Social Movements across Disciplines. Handbooks of Sociology and Social Research, eds. Bert Klandermans and Conny Roggeband (Boston: Springer, 2010), 59-109.

than focusing on its successes or failures. In what follows I'll first zoom in on VITA and ITDG in order to show how they paved the way for AT to develop as a scientific/intellectual movement. I'll then explore the outcomes and consequences of AT as a scientific/intellectual movement, beyond the broader movement's supposed demise in the early 1980s. In doing so, I'll make the case that AT's history is both relevant and interesting from the perspective of R(R)I.

Tinkering with Technology: VITA

In 1959, while studying technical assistance to "underdeveloped countries" for a discussion program, Robert Walker—a nuclear physicist at the GE in Schenectady, New York—discovered just how small the commitment of technical people was to such work in terms of both time and money. He realized that in the Schenectady area alone, the salaries of scientists and engineers far surpassed the entire 1959 UN budget for technical assistance. Shortly thereafter, at a meeting with 13 members of the Mohawk Association of Science and Engineers (MASE)—a discussion group for technical people in the local area—Walker suggested that they might spend some of their spare time providing technical assistance. As he would later recount, he had realized that "if one percent of the scientists and engineers in the United States would devote five hours a week to using their knowledge to help the Third World, it would dwarf all existing efforts".[74]

The group set about writing letters and visiting the offices of agencies like the Committee for American Relief Everywhere (CARE); UNESCO; several philanthropic foundations; and the Maryknoll organization (also known as the Catholic Foreign Mission Society of America). Their inquiries ran something to the effect: "Can you, in your organization, visualize a use for our group?"[75] The initial response was far from encouraging. According to William Kennedy, writing in *The National Observer*

[74] Cited in Bess Williamson, "Small-Scale Technology for the Developing World: Volunteers for International Technical Assistance, 1959–1971," *Comparative Technology Transfer and Society* 6, no. 3 (2008): 241.
[75] William Kennedy, "Leisure Time of Skilled Technicians Brings Answers to Knotty Problems," *The National Observer*, February 1, 1965. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.

> One Foundation responded, in effect, 'good idea, but don't call us, we'll call you'. UNESCO said: 'Our specialists work abroad on long-term assignments… your aid is not feasible; if you want to help, go on a care mission for a year or two.' CARE promised to look into the matter. But Maryknoll came up with a problem. Could a simple flashlight slide projector be adapted to show film strips?[76]

Rather than brood on the general lack of enthusiasm, the volunteers began work on the Maryknoll problem—Robert DeVries, a mineralogist at GE inventing what they had asked for.[77]

Soon after, CARE also presented the group with a problem: "Could a simple solar stove for home cooking in rural areas of underdeveloped countries be devised?" Within weeks, an affiliate of AID got wind of the project—it turned out the Government was also interested in the development of a simplified solar cooker. AID then provided the group with its first major income in the form of a $25,000 study grant. The group reviewed existing solar cookers finding them to be too costly, too complex, or too fragile. Dr. William B. Ellig, a physicist at GE, took on the assignment, spending a year's worth of evenings and weekends developing a cooker that could be made easily, using the simplest of tools. He first identified the Fresnel reflector, "an eighteenth-century device that was used by lighthouse operators to broadcast candlelight".[78] He then came up with a design that consisted of an iron pot mounted on a base of "concentric, reflective metal panes after the historical model".[79] Ellig's solar cooker could be built in 8 hours and cost $2.65.[80] In a temperate climate in the afternoon, it provided the equivalent heat of a medium burner on an electric stove; boiling water in 12 minutes and cooking bacon in 3.[81]

In addition to contacting existing agencies, Walker reached out to Harvey Brooks, who as we know from earlier chapters was an influential science policy figure—and former GE employee—in order to draw legitimizing support for the organization. Writing to Brooks, in 1964, Walker explained the organization's three principal goals as "to establish contact with people working in the less-developed countries, to develop a roster of

[76] Ibid.
[77] Ibid.
[78] Beth Williamson, "Small-Scale Technology," 241.
[79] Ibid.
[80] William Kennedy, "Leisure Time of Skilled Technicians."
[81] Ibid.

technical people here who are capable of helping, and to couple the two together in an effective way".[82] Brooks immediately saw potential in the idea and quickly became one of VITA's most valued supporters and fundraisers.

Brooks mobilized his network in support of the organization—often apologizing for "trespassing" on personal friendships along the way.[83] For example, he wrote to President Eisenhower's Science Advisor, James Killian, then Chairman of MIT, explaining how many potential donors were hesitant given the lack of any competent management within the organization, and how a board composed of "largely well-known industrial figures" (such as Killian himself) could really make all the difference.[84] Though many seemed reluctant at first, Brooks' efforts appeared to pay off. VITA co-founder Ben Coe often commented on Brooks' unrivalled ability to drum up support for the organization, and one VITA staffer wrote to Brooks that his "participation in solicitation" had once again "turned the trick".[85] With Brooks' help, VITA soon attracted the interest of several high-status figures. Killian joined the advisory council alongside the likes of Owen Chamberlain—Nobel Prize winner; Fred Seitz and Philip Handler—successive Presidents of the NAS; Herbert Hoover Jnr.; and David Rockefeller. Brooks also helped VITA secure the support of several multi-national corporations, such as Cargill, Exxon, John Deere, and IBM.

While Brooks helped provide VITA with legitimacy and support, the group also increased their publicity, to recruit more volunteers, and hired a part-time secretary, in order to help manage incoming requests. Articles were published in the *New York Times* and the *Reader's Digest* and several notices appeared in journals like *Chemical Engineering*, *Product Engineering*, *Food Technology*, and *International Development Review,* all of which "helped spread the

[82] Correspondence from Robert Walker to Harvey Brooks, September 15, 1964. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[83] For example, in a letter to Simon Ramo, Brooks wrote "I hope you don't mind my trespassing on my friendship with you to enlist your interest". He continued, "It has been exciting to see how eager technical people who cannot go overseas are to give their spare time to help in problems of development, once they are given a practical and effective way to do so". Correspondence from Harvey Brooks to Simon Ramo, December 1, 1966. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[84] Correspondence from Harvey Brooks to James Killian, July 22, 1965. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[85] Correspondence from Dick Loth to Harvey Brooks, June 30, 1971. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.

word among the American Professional community".[86] An article in the *Reader's Digest* in 1965, under the heading "VITA has the Answer" revealed just what a little publicity could do, generating more than 600 responses—over 250 of which were from outside the US.[87]

Having originally been thought of as a Schenectady enterprise, VITA soon received more requests than they could manage and created chapters in 7 cities. Like GE and Schenectady, subsequent chapters were similarly associated with local industry. For example, in New Holland, Pennsylvania, VITA volunteers came largely from the agricultural sector, namely the New Holland Machine Co.; the Detroit chapter operated within the Engineering Society of Detroit; in Rochester, New York, volunteers worked at Eastman Kodak; and in San Francisco, VITA operated with the support and facilities of the Chevron Research Lab.[88] As a result, as Beth Williamson notes, "the growing network of volunteers seemed to be able to handle just about any challenge".[89]

From the outset, VITA emphasized the importance of personal interaction, and tried to avoid providing stock answers to the requests that they received; their goal was not to impose ready-made solutions. As Williamson argues, "the small-scale technologies they [VITA] designed drew on an ideal of politically neutral technology transfer based on one-on-one correspondence about practical issues rather than overarching ideological interpretations".[90] Walker felt that technical people were eager to make meaningful contributions to society, and that their day jobs often failed to satisfy that desire. VITA therefore satisfied an emotional need, where both the volunteers and those receiving assistance got something out of the exchange. It provided volunteers with a creative outlet, "outside of the military-industrial context of their day jobs".[91] According to one write up, published in the *Journal of Engineering Education*, "the engineer is basically a doer, and through VITA he can do things which do make the world a better

[86] Bess Williamson, "Small-Scale Technology," 242.
[87] Paul J. Brennan, "VITA," *The Engineer*, November 1967. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[88] Bess Williamson, "Small-Scale Technology," and William Kennedy, "Leisure Time of Skilled Technicians,"
[89] Bess Williamson, "Small-Scale Technology," 241.
[90] Ibid, 239.
[91] Ibid, 238-289.

place to live in".[92] Essentially, the piece concluded, "the altruism and naturalness" of the original VITA concept "offered a meaningful outlet to thousands of engineers".[93]

Supporters like Brooks agreed with the notion of AT insofar as it fostered after-hours tinkering as a way in which engineers could get involved with problems of a societal nature (the VITA approach), but became more critical as soon as it took on more ideological undertones (which was, as we will see, the ITDG/Schumacher approach). In fact, in correspondence with the economist Mançur Olson, for example, Brooks wrote that despite ITDG and Schumacher's *Small is Beautiful* garnering much of the credit for the concept of AT, the idea had actually been fully worked out several years earlier at VITA. He stressed that the original impetus for VITA "came almost entirely from industrial scientists" and that the organization had "less pretentious ideological overtones than were later propagated by Schumacher's book".[94] Brooks was quite clearly perturbed that Schumacher's book had shifted the focus away from engaging engineers with societal problems.

Crucially, and perhaps in an attempt to keep supporters like Brooks on side, VITA "did not pair its recommendations with a broader theory of political reform", preferring instead to keep politics at "arm's length".[95] Of course, this may also just have been in keeping with practicing (U.S.) engineers' own inclinations at the time; as those who made their careers in the profession tended to be those who were willing to cultivate an apolitical presentation of self.[96] According to Will Lepkowski writing in *Chemical and Engineering News*, people like Philip Handler and the White House Science Adviser Frank Press were the "symbolic chieftains" of a science policy process that represented "the view that science is neutral, its endeavor is pure, and any criticisms of its content simply constitute a shameless assault

[92] Benjamin W. Roberts and Walter Lowen, "Solving Technical Problems throughout the World," *Journal of Engineering Education*, 58, no. 7 (1968): 815. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[93] Ibid.
[94] Correspondence from Harvey Brooks to Mançur Olson, February 20, 1979. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[95] Bess Williamson, "Small-Scale Technology," 247.
[96] See e.g. Jessica Wang, (1999), *American Science in an Age of Anxiety: Scientists, Anticommunism, and the Cold War*. Chapel Hill: University of North Carolina Press; and Edwin T. Layton Jnr., (1986), *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession.* Baltimore: Johns Hopkins University Press.

on the citadel".[97] As Richard Holt, a policy analyst with the Department of Energy put it

> In general, I don't think people like Frank Press or Phil Handler are against appropriate technology. I just don't think they would consider it as a possible model for the future undertakings of science. I think they would continue to see continued specialization rather than diversification and generalization. They would not admit that the social, environmental, political, and institutional effects of the scientific endeavor are as tangled as they really are. They'd rather think of science as the source of truth.[98]

Given VITA's constituency of support, it is therefore perhaps unsurprising that their approach was a world away from its more politically charged successor, ITDG, for whom in addition to providing technical assistance, the goal was the promotion of a more transformational agenda. By the time ITDG got started in 1965, VITA was already an action group made up of thousands of scientists and engineers from corporations throughout the U.S., working on technical problems on their own time. According to the *Reader's Digest* article, it was a report published in a British scientific journal that had "sparked momentum to found a VITA counterpart in Britain".[99] However, despite ITDG setting out with some similar aims in mind—that is, to give attention to specific technical inquiries—ITDG's broader and more transformational goal also had longer roots.

Reimagining Technological Change: ITDG

Though ITDG may have only got started in 1965, it had been during a 6 month secondment from the UK's National Coal Board (NCB) in Burma in 1955 that Schumacher had first begun thinking about "Buddhist Economics".[100] Unlike Walker and other members of the Schenectady MASE

[97] Wil Lepkowski, "Appropriate Technology Prods Science Policy," *Chemical & Engineering News* 58, no. 24 (1980): 32.
[98] Ibid.
[99] James Daniel, "VITA has the Answer," *Reader's Digest* Re-print, 1965. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[100] See a detailed overview of the evolution of Schumacher's ideas, see George McRobie, "JP and EFS; A Most Productive Friendship," November, 1980, 2. Box 3, Folder 8 E.F. Schumacher Archive, The Schumacher Center for a New Economics, Great Barrington, Massachusetts; and Robert Leonard, "E. F.

group, Schumacher's ideas were shaped by both the postcolonial context within which he was travelling during the 1950s, as well as the industrial sector of which he found himself a part.[101]

Based on Schumacher's observations and conversations with politicians, laborers, and economists in Burma, he came to realize that economics were not free from metaphysics or values, despite economists "assuming that theirs is a science of absolute and invariable truths, without any presuppositions".[102] His daughter, Barbara Wood, suggested that he "did not believe that the problems he was analyzing were essentially economic [but rather that] the real problem was a moral one".[103] According to ITDG co-founder George McRobie, Schumacher considered Gandhi as "probably the greatest practical economist ever known" because as he wrote in his 1955 essay, "His [Gandhi's] economic thinking always and unfailingly started 'from people', whereas the thinking of modern economics, with the greatest methodical rigor, always and unfailingly starts 'from goods'."[104]

Despite accusations to the contrary, Schumacher never questioned the utility and value of science and technology; his basic complaint was that they did not exist in a moral vacuum. In 1963, in a report prepared for the Indian Planning Commission, Schumacher presented the concept of "intermediate technology".[105] The idea was based on his understanding of Buddhist economics which represented a "Middle Way" between growth and stagnation.[106] The concept of intermediate technology implied two things: first, that in matters of development there was a problem when it came to choosing the right "level of technology" in a particular context; and second, that in conditions of poverty, the technologies more appropriate for

Schumacher and the Making of "Buddhist Economics," 1950–1973," *Journal of the History of Economic Thought* 41, no. 2 (2019): 159-186.

[101] For a detailed analysis of Schumacher's biography and the importance of the NCB context and his travels around Burma and India see for the evolution of his ideas, see Robert Leonard, "E. F. Schumacher and Intermediate Technology," *History of Political Economy* 50, no. S1 (2018): 249-265; and Kelvin Willoughby, *Technology Choice*.

[102] E. F. Schumacher, *Small is Beautiful*, 37.

[103] Barbara Wood, *Alias papa: A life of Fritz Schumacher* (London: Jonathan Cape, 1984), x-xi.

[104] George McRobie, "JP and EFS," 6.

[105] Ibid.

[106] E. F. Schumacher, "Buddhist Economics," *Fellowship* 40, no. 10 (1974): 4-6. Proquest Historical Papers.

development would be in some sense "intermediate between…" as McRobie put it "(to speak symbolically) the hoe and the tractor".[107]

Within a year, the idea began gaining traction.[108] As a result, in the summer of 1964, Schumacher and a small network of close personal friends and colleagues, including David Astor—Editor of *The Observer*; Lord Robens—Chairman of the NCB; Julia Porter—Secretary of the African Development Trust; and George McRobie—a Scottish economist from the London School of Economics (LSE), began bringing people together from different professions with overseas experience who shared "the conviction that 'development' meant first and foremost the development of people" and "the knowledge that aid and development as currently practiced was by-passing the great majority of people in poor countries".[109] According to McRobie, Schumacher—allowing himself one of his "rare predictions"—expected that responses to the idea would go through three stages: "first widespread rejection; next we would be told that it was necessary, but impossible in practice, and finally, that it was both necessary and practical, but we weren't doing nearly enough of it"—as McRobie acknowledged, "that was about right, in the light of events".[110]

After a slow start, membership and support grew quickly and in 1966 ITDG became a non-profit registered charity. ITDG set about trying to fill the perceived "knowledge gap about self-help technologies" by means of: assembling information on self-help techniques; communicating that information within and across developing countries; and helping with the application of intermediate technologies through demonstrations and consultancy.[111] All of this foundational work was based on the view that much of the knowledge that was required was already in existence somewhere. Schumacher described ITDG's organization using what he

[107] George McRobie, "Technology for Development—'Small is Beautiful'," *Journal of the Royal Society of Arts* 122, no. 5212 (1974): 216.
[108] That is, after some initial skepticism largely from a group of Cambridge economists to whom Schumacher initially presented the idea in the UK. As Willoughby points out however, many of the ideas behind Intermediate Technology were not unique to Schumacher. Instead, "His unique contribution was to synthesize a wide array of material into a simple package with a broad scope for application". Kelvin Willoughby, *Technology Choice*, 60.
[109] George McRobie, "Technology for Development," 216.
[110] George McRobie, "Working with Fritz," *Appropriate Technology* 4, no. 3 (1977). Appropriate Technology 1974-1978, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[111] George McRobie, "Technology for Development," 216.

referred to as the "A-B-C-D concept", in that it relied on "Administrators", "Businessmen", "Communicators" and "Democratic forces".[112]

ITDG was a decentralized and economical organization that, much like VITA, focused on "action research and development".[113] The group's work program covered a range of activities considered essential for rural development, including agricultural tools and equipment; water; food technology; power; rural health; co-operative services; and transport. A panel of experts including engineers, scientists, doctors, architects, builders, and others tackled each work program—many of whom, like ITDG's founders, had wide overseas experience. The panels sought to identify basic needs; document appropriate methods and equipment; and demonstrate their practical application through overseas projects.

Both ITDG and VITA discovered early on that responding to societal needs required the creation of problem-based, interdisciplinary panels. As one VITA staffer put it, "applied technology needs more than merely mechanical skill, as Dr. Frankenstein discovered. It requires social responsibility as well… Technology and sociology are equally involved in this effort".[114] VITA's technical panels were equally diverse, made up of "physicists, engineers, physicians, architects, sociologists, anthropologists, bookkeepers, geologists, food technologists, teachers, and research chemists".[115] At both organizations, these interdisciplinary panels became a way of responding—responsibly—to requests for assistance, bringing together a diverse range of expertise, allowing volunteers to become engaged in a continuing exchange of experience.

In many ways, both VITA and ITDG followed a similar growth trajectory, initially offering a simple inquiry service, before later expanding into publishing. They each put out newsletters and professionally styled annual reports, as well as technical manuals and handbooks (VITA published the Village Technology Handbook in 1963 and ITDG's Tools for Progress

[112] Leanne Gibson, "Schumacher: End of an Era," The Daily Transcript Colorado 111, no. 46 (1977). Box 3, Folder 7, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[113] George McRobie, "Intermediate Technology: Small is Successful," *Third World Quarterly* 1, no. 2 (1979): 71-86.
[114] Adrienne Cameron Grenfell, "Technology Transfer through VITA: Volunteers for International Technical Assistance," *Human Factors* 10, no. 6 (1968): 590.
[115] William Kennedy, "Leisure Time of Skilled Technicians."

was published in 1967).[116] As the concept of AT became increasingly popular, both organizations began to use it. As Jéquier notes, while the semantics of the movement were the "subject of lively if somewhat inconclusive theoretical debates"; for practitioners working in the field, the terms required "little elaboration".[117] In the early 1970s, ITDG launched the *Journal of Appropriate Technology,* suggesting that by that time AT had become the most widely accepted label for their activities.

In addition to having a similar approach and strategy, VITA and ITDG were also both heavily dependent on the support of high profile figures like Brooks and Schumacher. However, perhaps the biggest difference between the two organizations is best understood by looking at Brooks' and Schumacher's different attitudes towards AT. According to Brooks, the development and diffusion of AT would be best served by "deemphasizing its ideological aspects and working on the best possible adaptation of all technologies to their circumstances of use, irrespective of whether they fit the definition of 'appropriate'".[118] AT's shopping list of criteria, according to Brooks, pointed to "an a priori superimposition of ideology" upon the natural, self-correcting, ideology-free process of technical refinement.[119] Organizations like VITA focused instead on technological practices, particularly on problem solving with an interdisciplinary perspective with a view to responding to societal needs. That was the version of AT that Brooks was prepared to get behind and, as we have seen, his standing in the scientific community undoubtedly helped open a number of doors for VITA.

Schumacher's approach, on the other hand, was more ideologically loaded. Schumacher saw AT as a way of reimagining economic activity: "in response to human need" rather than "in response to human greed"; this he considered "the central moral issue of the time". AT was a response to a societal obsession with growth for the sake of growth, based on a formula that he described as "unlimited engineering combined with unlimited moral

[116] VITA, *Village Technology Handbook* (Arlington: Volunteers in Technical Assistance, 1965) and ITDG, *Tools for Progress: Guide to Equipment and. Materials for Small-Scale Development* (London: ITDG, 1967).
[117] Nicolas Jéquier, *Appropriate Technology: Promises and Perils* (Paris: Development Centre, Organisation for Economic Cooperation and Development, 1976), 16.
[118] Harvey Brooks. "A Critique of the Concept of Appropriate Technology," *Bulletin of the American Academy of Arts and Sciences* (1981): 17.
[119] Ibid.

agnosticism".[120] So whereas Brooks saw VITA as an opportunity for technical people to engage with societal needs; Schumacher saw ITDG as a way of demonstrating to key decision-makers the need to reevaluate the entire process of technological change.

According to Republican Senator Charles Percy; Schumacher's reputation as an experienced economist helped "catapult" AT ideas from "the California counterculture into the Washington establishment".[121] Schumacher's involvement in mainstream, industrial, economic activities not only meant that senior statesmen took him seriously, but also that he had some experience when it came to playing politics.[122] Described in the *Chicago Reader* as a "reluctant guru", Schumacher was well adept at crafting his message to suit both context and audience.[123] Rybczynski noted that Schumacher would put forward "the evolutionary position when addressing a United Nations group", whereas "the revolutionary view" would predominate when he spoke at a seminar somewhere in California. Unlike Harvey Brooks and the volunteers at VITA however, Schumacher wanted to inspire action that would challenge the status quo. His witty and charming approach offered a good dose of hope along with his dire warnings; and though much to Brooks' disdain, Schumacher's cult-like status did help to bring the efforts of both ITDG and VITA into the public view.

By the late 1970s, VITA had over 7,000 volunteers representing 96 countries and 2000 corporations, universities and other institutions worldwide and had received over 25,000 requests for assistance, including from the Peace Corps, the UN, the OECD, Catholic Relief Services, Church World Service, the International Executive Service Corps, agencies of government, missionary groups, educational and research institutions, and private citizens.[124] By 1975, VITA's annual budget had swelled to $450,000. ITDG had also expanded fast. By the mid-1970s, the organization had established a number of independent subsidiary companies across three main divisions: operations activities, dissemination activities, and institution

[120] E. F. Schumacher, "Spaceship Earth—Questions of Growth," unpublished. Box 1, Folder 6, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[121] William Delaney, "Theory to 'Think Small' Draws Rapt Audience."
[122] See Robert Leonard, "E. F. Schumacher and Intermediate Technology."
[123] David Moberg, "Small is Beautiful: EFS' Plans for Progress," *Chicago Reader*, March 25, 1977, 2. Box 3, Folder 7, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[124] Adrienne Cameron Grenfell, "Technology Transfer through VITA," 589-591.

building activities. These included Intermediate Technology Industrial Services; The Appropriate Technology—UK Unit; Intermediate Technology Publications Ltd.; Intermediate Technology Consultants Ltd.; and Development Techniques Ltd.

As VITA and ITDG's profiles continued to grow, so too did the reach of AT ideas around the world and with the growth of the movement, came a new set of demands. As McRobie put it, what was required was "at least, a foundation of an international infrastructure for the development and promotion of appropriate technologies". He stressed that what was needed was not "a control system of any kind", but rather "a strengthening of this infrastructure".[125] Jéquier suggested that what was needed was a transition from a "first generation" to a "second generation" of AT.[126] As a part of this shift, the main innovators in AT would no longer be the "marginalists, the radicals, and the misfits" but instead the "national governments, industrial firms, existing research institutions, foreign aid agencies and development banks".[127]

While first generation AT organizations like VITA and ITDG still had an important role to play, what was needed by the mid-1970s was greater collaboration between existing groups in order to actually embed AT within the innovation system. With this goal in mind, a number of collaborative efforts emerged in the mid-70s. In the next section, I will zoom in on a knowledge sharing information system that was initiated by universities in the Netherlands; and an informal clearinghouse based in the U.S., which served to connect AT practitioners worldwide, as particularly good examples of the ways in which transnational collaboration helped foster the transition from a first to a second generation of AT. As we will see, both came about as a result of AT's rapidly expanding communities of intent, particularly educators interested in using AT problems in the classroom and scholars and social critics interested in mainstreaming ideas about AT.

[125] George McRobie, "Intermediate Technology: Small is Successful," 81.
[126] Nicolas Jéquier, "Appropriate Technology: The Challenge of the Second Generation," *Proceedings of the Royal Society of London. Series B. Biological Sciences* 209, no. 1174 (1980): 7-14.
[127] Ibid, 9.

An Intellectual Movement on the Move

Educators at technical universities were quick to observe the potential that problems gathered by organizations like VITA and ITDG offered for stimulating design challenges in the classroom. So much so in fact, that ITDG created a "University Liaison Unit" which collaborated with 20 British universities, technical colleges, and polytechnics, providing around 200 student projects on "real problems of the world".[128] Students reportedly found working on these projects "didactically very valuable".[129] With the help of a grant from the Alfred Sloan Foundation, VITA also began introducing technical design problems into engineering education programs at Rensselaer Polytechnic Institute, Union College, and the MIT. Other schools, including Brown University, Louisiana State University, University of Missouri, and Stanford University also used VITA problems for class projects and reported them to be an "exciting success".[130]

In *The Journal of Engineering Education*, VITA problems were described as growing out of "real cultural settings", which required taking a "variety of social factors into account".[131] The piece outlined how when designing a solar cooker, for example, it was not only important to find out what materials and skills might exist in any given context, but also to explore the broader economic and sociological conditions—i.e. a solar cooker would probably be of limited benefit in a place where meals were usually taken at night. Students and staff alike were advised that they would find VITA problems both "exciting and rewarding" and, in addition, they were told, "you will get some cultural insights which you will cherish, for the gulf of understanding between the United States and the developing world is immense. If you can gain such perspective, you will better understand yourselves and your role in the world".[132] In addition to providing real-world problems for students to work on, AT educational projects were a novel way of introducing students to the social and cultural dimensions of their work.

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[128] E. F. Schumacher, "Responsibilities of Scientists and Technologists in a Poor Country," unpublished. Box 1, Folder 6, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[129] Ibid.
[130] Benjamin W. Roberts and Walter Lowen, "Solving Technical Problems."
[131] Ibid.
[132] Ibid.

In addition to shaping technical education, by the mid-70's, the AT movement had begun influencing U.S. economic policies. For example, the Energy Research and Development Administration used part of its $10 million authorization to set up an AT office within its office of energy conservation.[133] Congress also authorized $20 million for AID in order to help develop small-scale machinery for the developing world. AID then channeled this money into ATI, a semiprivate corporation that supported local, small technology enterprises.[134] Furthermore, Congress approved two bills, authorizing several million dollars for the establishment of a national, and several regional R&D centers for AT.

Both the National Center for Appropriate Technology (NCAT) in Butte, Montana and California's Office of Appropriate Technology (OAT) were established in 1976. Both served to connect AT groups and provide links between regional AT efforts and the needs of low-income people. According to Ed Kepler, Director of the NCAT, AT advocates were concerned that "social values and cultural change—the values of democracy—will be lost sight of as big money comes through".[135] NCAT therefore tried to "play it both ways" by bringing together AT's countercultural roots with the interest of government and the private sector in solving the energy problem. As Robert Judd, the Executive Director of the California office put it

> The image of alternative technology programs that many of the legislators in our State had initially was based on the Whole Earth catalog, of some sense of organic gardening in bib overalls or counter-culture events. That, in effect, may be where some of these ideas came from. But in larger part, the programs are applied science and engineering. We see ourselves certainly as an advocacy group, but also as a professional services organization.[136]

[133] Wil Lepkowski, "Appropriate Technology Prods Science Policy," 31.
[134] See Stephen Macekura, *Of Limits and Growth* (Cambridge: Cambridge University Press, 2015).
[135] Wil Lepkowski, "Appropriate Technology Prods Science Policy," 31.
[136] U.S. Congress, House, Committee on Science and Technology, *Appropriate Technology: Hearings before the Subcommittee on Domestic and International Scientific Planning, Analysis, and Cooperation*, 95th Cong., 2nd sess., 1978, 191.

At around the same time, agencies like the OTA and the NSF were also conducting studies into AT.[137] At OTA, an AT task force cut across three research panels on R&D Policies and Priorities, which included a panel on the Health of the Scientific and Technological Enterprise, chaired by Harvey Brooks; a panel on the Applications of Science and Technology, chaired by Lewis Branscombe—then chief scientist at IBM; and a panel on Decision Making Processes, chaired by Edward Wenk—vice chairman of the OTA's advisory council. The AT taskforce was composed of citizen scientists from outside the scientific establishment and led by consumer activist Lola Redford.[138] At a meeting with OTA staff, the chair of the R&D panels, Ellis Mottur, another highly-respected science policy specialist, stated that AT had "lively, political appeal" and presented "a real issue for Congress" [139] A subsequent project organized by the OTA, "Assessment of Technology for Local Development" included a series of on-site surveys of 15 AT centers. It was hoped the project would "provide clues to how an institution such as Congress reacts to ideas that pose a challenge to the conventional ways of paying for and doing technology".[140]

Over at the NSF, support was provided for a number of individual projects across various divisions.[141] For example in 1977, as part of the Research Applied to National Needs (RANN) program, Eugene Eccli conducted the first comprehensive survey of AT in the U.S. Eccli suggested AT's concerns went "beyond avoiding excesses to a more positive image of creating local, participatory learning situations that enhance the abilities of people to work together".[142] He concluded, "This sense of social impact and social enhancement represents a new evaluative variable in the assessment of technology".[143] Two years later, in 1978, the NSF organized seven regional forums on AT in order to discuss the values which governed the choice of technology and the American Association for the Advancement of Science

[137] See Eugene Eccli, *Appropriate Technology in the United States: An Exploratory Study*, (Washington D.C.: National Science Foundation, Research Applied to National Needs, 1977) and Richard S. Eckaus, *Appropriate Technologies for Developing Countries* (Washington, D.C.: National Academy of Sciences, 1977).
[138] Barry M. Casper, "Rhetoric and Reality of Congressional Technology Assessment,"
[139] Memo regarding OTA Task Force, November 11, 1976. Box 39, Papers of Harvey Brooks, 1930s-1980s, HUGFP 128. Harvard University Archives.
[140] Wil Lepkowski, "Appropriate Technology Prods Science Policy," 34.
[141] The NSF provided more than $10 million in support for AT between 1973 and 1978 alone. See U.S. Congress, House, Committee, *Appropriate Technology*.
[142] Eugene Eccli, *Appropriate Technology in the United States,* 33.
[143] Ibid.

(AAAS) also hosted an international symposium on "critical value issues" in AT.[144] In 1980, the NSF established a small grants program that received over 100 unsolicited proposals. One project supported by the NSF was the Rock Castle Research Center run by the chemist and Jesuit priest Alfred J. Fritsch. The center promoted "public service science" in a newly built passive solar house in the woods off a road leading to a strip mine.[145] According to the director of the program, Robert Lamson, the AT philosophy was making inroads into science policy, though the problem was that people tended not "to start with the environmental and human values and move back into how technology can be designed from them", but rather "they still tend to start with technology and push it to the forefront for its own sake".[146]

Nevertheless, as federal support of AT grew, so too did the need for further research and dedicated AT units started popping up at a number of universities, including the Georgia Institute of Technology, the University of New Mexico, and MIT.[147] For example, at MIT, a group under David Noble in the program on Science, Technology, and, Society set up a program on "alternative industrial technology". According to Noble, the idea was to "design machinery to the specification of workers—machine tools that allow the workers themselves to do more of the programing, software systems that enhance communication between people".[148]

Of course, across many university campuses—not least MIT—disillusionment with science and technology had peaked during the student riots of the late 1960s.[149] As Jon Agar suggests, through the course of the

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144 U.S. Congress, House, Committee, *Appropriate Technology,* 329.

145 Ibid, 33.

146 Wil Lepkowski, "Appropriate Technology Prods Science Policy," 34.

147 Other institutions developed specialized courses designed to broaden the contexts within which technical problems were being considered. For example, universities that offered AT related degrees or courses included the University of Edinburgh, the University of Reading, the University of Warwick, and the University of East Anglia in the UK, and Washington University, Arizona State University, and Stevens Institute of Technology in the US

148 Wil Lepkowski, "Appropriate Technology Prods Science Policy," 35.

149 See Stuart William Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993); Kelly Moore, *Disrupting Science: Social Movements, American Scientists, and the Politics of the Military, 1945–1975* (New Jersey: Princeton University Press, 2008); Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge: MIT Press, 2012); Sigrid Schmalzer, Daniel S. Chard and Alyssa Botelho, eds., *Science for the People: Documents from America's Movement of Radical Scientists* (Boston: University of Massachusetts Press, 2018).

1960s, "American campuses became theatres for anti-technocracy protest".[150] According to Matt Wisnioski, as the 1960s ended, "the engineering and scientific communities" were confronting "the intellectual and structural relationship of science and technology to society".[151] In this context, in the mid to late-1970s, AT seemed particularly well placed to counter concerns that technology was "feeding, and perhaps responsible for, many of the evils of society: urban crime, pollution, fear of a nuclear holocaust, economic deprivation, unemployment, etc."[152]

Beyond the U.S., other governments also began demonstrating an interest in AT; either supporting the establishment of national autonomous AT institutions or channeling funds for AT programs through existing AT groups.[153] In fact, during a series of congressional hearings on AT, Tom Fox, the executive director of VITA, stated that the U.S. was "not leading the way" in their treatment of AT. He suggested, "The Dutch are perhaps, for their size, as important as any—the British to a lesser extent".[154] In the Dutch context, the most prominent organization at the time was the TOOL foundation (Technische Ontwikkeling Ontwikkenlings Landen—or Technical Development for Developing Countries), which had been created by 8 student-staff groups in 1974.

TOOL was a non-profit national AT agency composed of universities, government agencies and a consulting engineering firm. The central servicing and networking role was provided by a professional full time secretariat based at the Royal Tropical Institute in Amsterdam and the rest of the TOOL staff worked across several university based interdisciplinary groups.[155] TOOL "promoted the concept and practice of a socially appropriate technology both to the general public and to current policymakers"; "engaged in

[150] Jon Agar, "What Happened in the Sixties?" *The British Journal for the History of Science* 41, no. 4 (2008): 582.
[151] Wisnioski, *Engineers for Change*, 314.
[152] William Ellis, George McRobie and Kenneth Darrow, *Appropriate Technology Development,* 4.
[153] For a detailed overview of these organizations see Richard Whitcombe and Marilyn Carr, *Appropriate Technology Institutions.*
[154] U.S. Congress, House, Committee, *Appropriate Technology,* 141.
[155] In 1980 the groups included: Agromisa, Wageningen University of Agriculture; the Centre for Appropriate Technology, Delft University of Technology; Development Action Group, Zwolle Technical College; Development Technology Workgroup, Twente University of Technology; Medical Development Workgroup, Nijmegen University; Microprojects Committee, Eindhoven University of Technology; Technical Development Workgroup, DHV, Consulting Engineers, Amersfoort; Tropical Agricultural Information, State College of Agriculture, Deventer.

providing support for a growing number of field projects in Africa, Asia, Latin American", and worked "with government and nongovernmental agencies alike on the application of SAT".[156] They also supported the organization of events, such as a 12 part lecture series on AT organized by the Committees for International Cooperation at the Technical Universities of Eindhoven and Twente—to which a number of speakers were drawn from ITDG.

As in the U.S., volunteer efforts into research and development soon formalized into dedicated AT units such as the Appropriate Technology Department at Eindhoven Technical University and the Center for Appropriate Technology (CAT) at Delft University of Technology. Created in 1978, the CAT initially focused its efforts, much like VITA and ITDG, on the practical implementation of AT in developing countries. By this time, there were some twenty AT units in operation throughout the developing world—most of which had close links with VITA and ITDG. For example, one or more AT groups existed in Botswana, Ethiopia, Ghana, Tanzania, Upper Volta (now Burkina Faso), Zambia, Bangladesh, India, Pakistan, and Sri Lanka. New centers were also in the pipeline in Indonesia, Papua New Guinea, Colombia, and Mexico.[157]

The CAT carried out both short and long-term projects, built cooperation agreements with regional and local institutions, and published an in house magazine that was sent to subscribers free of charge. CAT's projects included:

> a solar refrigeration unit for Botswana, a wood and bamboo water supply system for Tanzania, a portable winch for lumbermen in Cameroon and hydraulic rams in Rwanda… a low cost transportable dentist's chair for Malawi, small-scale sugar production in Colombia and a mechanized brick press for the Ivory Coast. [158]

In its first five years the CAT handled over 150 requests for assistance, "from ship-breaking in Bangladesh to dam design in Nicaragua, pedal power

[156] James E. Beverly, *Coordination of WASH Information Activities and Exchange with International Information Centers: Field Report*, USAID 32, no. 1 (1981): 31-33.

[157] George McRobie and E. F. Schumacher, "Report Prepared for the Third Inter-congress of the Pacific Science Association," unpublished, July 18-22, 1977, 2. Box 2, Folder 20, E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.

[158] TRANET, *Newsletter*, (Spring, 1985), 16. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.

technology in Brazil and the manufacture of shoe polish in India".[159] While its projects were similar to those undertaken by VITA or ITDG, the CAT, like other university AT units, was largely driven by the need to develop education and research simultaneously; the center's primary research aim was to develop a general theory of AT that would help to "mainstream" the concept.[160] The popularity of its courses meant that three AT modules soon turned into five. The center also regularly received requests to prepare seminars and teaching materials by other faculties across the university.[161]

In addition to supporting the creation of AT units at Dutch universities, TOOL also took the lead in establishing a comprehensive documentation bank for AT practitioners: the Socially Appropriate Technology Information System (SATIS).[162] In 1975, with the support of agencies in the UK, France, the U.S., and Canada, TOOL initiated discussions concerning the creation of an international network for the coordination of the development, dissemination, implementation and feedback of AT. In October 1976, a meeting was held in Paris with 18 AT organizations in order to discuss what form international cooperation might take. A multi-agency work plan was initiated, resulting in a survey of around 140 libraries containing AT-related material. During a series of subsequent meetings, in Amsterdam, Paris, Frankfurt, and St. Gallen, further details were ironed out and a series of pilots were designed.

SATIS focused specifically on supporting the exchange and dissemination of information and the publication of resource guides, in order to help reverse the trend whereby AT information was primarily collected and stored by institutions located in the Northern hemisphere. SATIS initially consisted of a series of AT catalogues containing the AT holdings of all of

[159] Ibid.
[160] This was done through a 3 part books series: Willem Riedijk, ed, *Appropriate Technology for Developing Countries* (Delft: Delft University Press, 1982); Willem Riedijk, ed, *Appropriate Technology for Liberation* (Delft: Delft University Press, 1986); and Willem Riedijk, ed, *Appropriate Technology in Industrialized Countries* (Delft: Delft University Press, 1989).
[161] Willem Riedijk, ed. *Appropriate Technology in Industrialized Countries*, xi.
[162] Plans for SATIS were several years in the making. Despite discussions beginning in 1975, the program was only officially launched during a meeting in Dakar in April 1982, by which time, 25 organizations had joined as member organizations. Nonetheless, a significant amount of work was carried out in order to develop the program between 1976 and 1982. SATIS activities were primarily funded through membership fees. Annual fees were US $100 for organizations and US $20 for individuals. In addition, all members were expected to make contributions to the network in terms of exchanging resources and helping to organize seminars. See James E. Beverly, *Coordination of WASH Information Activities.*

the participating organizations, but soon became a more sophisticated knowledge sharing system, developed in order to enable the registration, indexing, retrieval, exchange and storage of AT-related information. The system was designed so as "to enable a better flow of information to and between local AT centers in Africa, Asia and Latin America—but also from them"; as well as to provide access to a whole range of materials, beyond the information typically published by government agencies, universities, and inter-governmental organizations.[163] The main aim of the system was to foster open exchange relationships between its membership organizations based "upon equality, reciprocity and solidarity".[164]

As a bottom up organization, founded by Dutch universities, TOOL played a critical role in establishing the beginnings of an international infrastructure for AT. University based AT units, in general, helped to expand the movement's goals beyond providing technical assistance; to trying to map out a solid theoretical foundation for AT, as well as using AT as a means for broadening the education of technical professionals. Collaboration between universities also provided new institutional pathways for AT. The creation of SATIS brought together leading international agencies, allowing them to share the knowledge and experience they had gathered in a practical, action-oriented context.

Emerging in parallel with SATIS, and with remarkably similar goals in mind, was TRANET—the Transnational Network for Appropriate Technology. In the next section, I will briefly zoom in on the emergence and development of TRANET, before summarizing how and why I think AT's communities of intent made responsibility matter in ways that have since been taken up within the discourse surrounding R(R)I. As we will see, the activities and development trajectories of SATIS and TRANET provide us with some sense of the ways in which AT advocates continued shaping ideas about the *process* and *impacts* of technological change well into the 1980s and beyond.

[163] Ibid, 33. Designed for use in AT libraries and centers all over the world, the cards were designed to be adaptable to different purposes and local situations. The information recorded included written information, such as published books/reports, leaflets, brochures, and catalogues; unpublished reports, letters, and sketches; audio-visuals materials such as sound and/or vision tapes, video, films, and photographs; as well as biographical sketches of technologies, technologists and their organizations.
[164] Ibid.

Ongoing Synergies and Lasting Links

TRANET was also founded in 1976, by William Ellis, a no-nonsense former physicist who worked as a science policy consultant for over twenty years. In the early 1970s, he worked as an advisor on AT-related projects for the NSF, the OECD, and the World Bank.[165] While SATIS largely relied on the collaboration of universities and specialized AT agencies, the creation of TRANET was thanks to a chance meeting between Ellis and Schumacher at a conference on "Third World Technologies" in London in the 1960s. As a result of which, in 1976, at Schumacher's suggestion, Ellis was invited to set up a program and exhibit on AT during the UN Conference on Human Settlements in Vancouver.[166]

The AT program was part of "The Forum", which ran in parallel to the main conference and was an unofficial, informal event designed to allow an exchange of views and experiences between nongovernmental organizations (NGOs). Reports suggest that delegates from the main conference had neither the time nor the inclination to visit the Forum site. As a result, contact between those visiting the "caravanserai" at the Forum and the "grey-suited diplomats" at the "official conference" was minimal.[167] It probably didn't help that the Forum site was three World War II aircraft hangars at Jericho Beach, several miles from the downtown hotels of the main conference.

The Forum was described as something akin to a counterculture festival, offering a heady mix of meetings, seminars, exhibits, food stands, and demonstrations. But according to Nicholas von Hoffman of the *Washington Post*, while "there was lots of hair" and "lots of blue jeans and protests", "there was also a great deal more". He wrote

[165] Around the time Ellis started TRANET, a number of international agencies were also jumping on the AT bandwagon. For example, the Inter-American Development Bank created a Committee for the Application of Intermediate Technology in '76 and in '77, the World Health Organization established the Appropriate Technology for Health Program.
[166] For an overview of the organization and planning committee (which included the likes of Buckminster Fuller, Margaret mead, and Barbara Ward) see Athens Center of Ekistics, "At the Forum," *Ekistics* 42, no. 252 (1976): 281-284.
[167] Paul Goldberger, "Informal Forum that Parallels the Habitat Conference," *The New York Times*, June 9, 1976, 5. Proquest Historical Newspapers.

> If the official delegate's downtown, with their army-chauffeured cars, had their briefcases full of documents prepared for their foreign ministers, the citizen representatives in blue jeans had the expertise. They included scientists from the world's most prominent universities, planners and architects who had designed whole new cities, citizen leaders from Asia, Africa, and Latin America who in contrast to most bureaucrats and politicians downtown, had spent their lives with the problems under discussions… (It) is not to say that the confab at Jericho Beach will set the world on fire. But it made some sparks that illuminated important matters. The most important being the people are not the problem. They are the answer.[168]

The general ethos of the Forum clearly aligned with a more transformational vision of AT.

Ellis designed an AT program that included two large indoor exhibits inside a converted hangar, as well as numerous seminars and workshops. There was also an outdoor exhibition that demonstrated various types of "intermediate or appropriates technologies", such as solar water heating and composting toilets. However, over the course of the packed two-week program, discussions were largely dominated by the perceived need amongst participants for an "international mechanism for appropriate technology" (IMAT).

Over the next few months, the energy generated at the Forum appeared to be "too intense to die".[169] So while TOOL was looking into the feasibility of SATIS, Ellis organized and attended meetings in Vienna, Paris, and London, in order to talk about the possibilities for an IMAT. According to Ellis, participants from the developing countries were clear that they had no interest in the creation of a UN organization that would tell them what to do at a local level. Instead, what they wanted was an "informal mechanism" which they could "drop into or drop out of" as they wished.[170] According to Ellis, this was owing to the fear "that a centralized bureaucracy would override citizen participation".[171] After much discussion and back and forth, and while the non-governmental AT agencies were still working out the

[168] Cited in TRANET, *Newsletter and Annual Report*, (1985), 1. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[169] Ibid.
[170] William Ellis, "Flapping Butterfly Wings: A Retrospect of TRANET's First Twenty Years," Eighteenth Annual E. F. Schumacher Lectures, October 1998.
[171] Ibid.

details of SATIS, Ellis launched TRANET—a quarterly newsletter which would serve to collect, catalogue, and disseminate AT-related news and information.

First and foremost, Ellis wanted TRANET to provide a platform for anyone who felt an affiliation with the AT movement; from those who tinkered with technological devices in their garage, to those who were trying to reimagine the process of technological change. Subscribers to TRANET's 16-page typeset compendium of book reviews, abstracts and news grew quickly and included engineers and scientists, teachers, doctors, and bureaucrats. Within just a couple of years, TRANET had around 500 members paying dues and over 10,000 subscribers.

Connecting people was one of Ellis' main aims; he described TRANET's goals as "to stimulate exchanges among individuals, groups and networks in all parts of the world"; "to educate the public as to the concepts of AT"; "to promote dialogue towards a re-evaluation of the role of science and technology"; and "to promote the development, use and understanding of AT".[172] Ellis believed that networking could offer a grassroots led "second level of world governance"—a belief that was clearly shared by the folks over at the Apple Computer Company. In 1982, based on the rapid growth of TRANET, Apple gave Bill a 2E computer, a handful of five and a half inch disks, 600 BOD modems, and linked him up with the Farallones Institute in California, Volunteers in Asia at Stanford University, and the ecology department at the University of California, Davis, and told them all to learn how to network. As computer networking was still in its infancy at the time, there was little for the group to build on. Nevertheless, they created "Eco-Net", an ecology oriented network that connected over 10,000 groups across the U.S.

By the early 1980s however, the notion that AT could present a challenge to entrenched ideas about technological change and economic growth was beginning to wane. The arrival of Ronald Reagan in the White House put an end to many of the governmental initiatives introduced under Carter's administration. Reagan terminated the federal Community Services Administration, leaving NCAT without institutional or financial support; the

[172] TRANET, *Newsletter*, (Winter, 1980-81), 11. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.

California Office of Appropriate Technology was abolished; perhaps most symbolically, in 1982, during repairs to the White House roof, the solar panels installed by President Carter in 1979 were removed. As Pursell put it, "it was a symptomatic, but not a unique, rolling back of the progress Appropriate Technology had made over the decades".[173]

In Europe, TOOL and SATIS were also running out of steam. According to Willem Riedijk of the CAT at Delft, TOOL was "gradually losing its former leading role", partly due to "a lack of support by the Dutch government", but primarily for the reason that the "professionalizing and privatization of government controlled AT-groups" was taking place "at a slow rate".[174] The SATIS card system had also proved far more laborious than initially expected, with the processing of one card taking around 45 minutes. Even more time consuming was the compilation of a cumulative index that provided sufficiently detailed indexes of the processed cards in order that the information delivered to potential users would be adequate. Despite much talk about the possibility of digitalizing the process, this never came to fruition, largely due to a lack of resources.

The last meeting of the SATIS General Assembly was held from 29th November to 7th December 1985 in New Delhi, India. During the meeting, SATIS members evaluated the activities of the organization and recommended future directions. Great stress was laid on "assessing both the technical quality of information to ensure its reliability and the scope for application of this information, monitoring the latest developments in information technology, adapting methods of communication to the specific needs and resources of those using it, and encouraging participants to play an active part in the network".[175]

Whereas SATIS' networking function was oriented toward creating synergies between groups involved in trying to provide technical assistance—which was largely dependent upon governmental support and financial backing; TRANET served to connect a disparate but interrelated group of actors who still thought the AT movement's aims worthwhile, despite the shift in political climates. Unlike SATIS—and many other AT initiatives on both sides of the Atlantic—TRANET's existence was solely dependent on

173 Carroll Pursell, "The Rise and Fall," 633.
174 Willem Riedijk, ed, *Appropriate Technology in Industrialized Countries,* xiii.
175 James E. Beverly, *Coordination of WASH Information Activities,* 33-35.

the interest and support of its subscribers. This meant that despite the political tides turning away from AT, TRANET continued to go from strength to strength.

TRANET's activities soon included raising funds, conducting studies, arranging tours, holding real estate, providing advice to national and international agencies, and organizing seminars and conferences. For example, in 1984, TRANET organized a "summer institute" behind the red brick towers and battlements of Oak Grove-Coburn School a few minutes north of Augusta, Maine. TRANET hired a large log cabin off the shore of Rangeley Lake, where 20-25 AT activists and scholars could vacation together for a week or two. There was no fixed agenda, no scheduled talks or activities, the goal was simply "developing synergy" and creating "cooperative links" among AT advocates. Participants would be equally responsible for adopting the roles of "learner/teacher/cook/dishwasher".[176] Costs were shared at $250 a week for room and board and extra work would be made available for those couldn't afford the costs. [177] The result was a "strange and heady mixture of people"—

> European academics and Maine home-schoolers, organic farmers and economic theorists, an Iranian ex-minister of education and a Californian ex-student revolter, a young physicist seeking his way, an older journalist who had lost his… These ingredients were stirred and seasoned during talks and walks that went on from breakfast in the school's austere dining-room to midnight sessions around a beer or two in the same.[178]

The history of ideas and the future was the subject of a weeklong discussion; other topics included "what is the meaning of technology?"; "does the idea of 'economics' distort our true identities?"; and "would the world be different if 'energy' had not been created by man?" During the conference, the philosopher and social critic Ivan Illich asked TRANET to introduce a new page to its newsletter, one that would draw attention to newer trends of thought that questioned the assumptions common to large and small technologies. "The assumptions, for instance that 'information' should be

[176] TRANET, *Newsletter and Annual Report*, (1984), 1. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[177] Ibid.
[178] Ibid.

managed, be it for control or enablement. Or the assumption that the world constitutes a 'resource' to be managed, whether by the people themselves or by elites that dominate them".[179] In addition to the new column, other outcomes from the meeting included plans to publish a collection of essays and an ongoing regular "transnational retreat".[180]

In Europe meanwhile, despite the Dutch government's waning interest in TOOL and SATIS, through the course of the 1980s, the CAT at Delft had established a solid international reputation, supporting the establishment of several AT courses at other institutions. For example, between 1982 and 1987, the center helped develop a number of courses with the Interdisciplinary Project Group on Appropriate Technology at the Technical University of Berlin (TUB), alongside professors from various other departments including agricultural development, architecture, and informatics. The center was also in contact with other technical universities, such as in Munich and Darmstadt in Germany and Vienna in Austria, where CAT staff provided similar support, offering seminars in 1986, 1987 and helping to organize an international congress on AT in January, 1988.[181] In 1988-89, Riedijk conducted a tour of AT centers and universities across the US, which was widely publicized in the TRANET newsletter.[182]

TRANET continued to grow well into the 1980s. So much so, that in 1988 it absorbed RAIN magazine, one of the leading AT publications in the U.S. The 'Rain House' in Portland Oregon "had been the stop over point of activists from all ends of the spectrum of concerned citizens for over a decade".[183] In 14 years of publishing, more than 200 people had put in over 600,000 hours to keep RAIN going. But as its founders turned their attention to computer networking and their Center for Urban Development, a merger with TRANET—as "another bird of the same feather"—seemed a logical development.[184] It wasn't until 1997 that TRANET eventually closed its doors. Though the reasons for its demise are unclear, the fact that Bill and Margaret Ellis had stepped down one year earlier, having been at the helm for

[179] TRANET, *Newsletter*, (Fall, 1984), 15. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[180] TRANET, *Newsletter and Annual Report*, (1984), 1.
[181] Willem Riedijk, ed, *Appropriate Technology in Industrialized Countries*.
[182] TRANET, *Newsletter*, (Fall, 1988), 15. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[183] Ibid, 1.
[184] Ibid, 16.

more than twenty years, likely played a substantial role. Despite TRANET's closure however, the new editor wrote in the final issue that interest in AT "is still alive and well, as our large flow of mail attests".[185]

By the 1990s, only a smattering of what had once been a vibrant and dynamic AT landscape was still visible. The language of AT had also completely gone out of fashion. Yet VITA was still going strong, continuing to mobilize a roster of volunteers in responding to thousands of technical inquiries from around the world. ITDG also continued in a similar vein. In fact, today, ITDG—now Practical Action, NCAT, and a number of smaller AT centers continue to operate worldwide. As Stephen Macekura has shown, the role of AT stalwarts like VITA and ITDG on international development was undoubtedly both "indelible and impactful".[186] But AT potentially also left its mark elsewhere. I'll conclude by making clear how beyond concrete examples of AT's legacy—like Practical Action and NCAT—more subtle traces can also be found under the broad umbrella of R(R)I.

Conclusion

To this day, VITA and ITDG remain two of the best-known organizations of the AT movement. As we have seen, these pioneering organizations initially addressed the "knowledge gap" regarding technological choice. Collecting and documenting resources was a primary function of both groups; for which they relied on rosters of technically skilled volunteers, building up large documentation centers, as well as their own classification and retrieval systems. As instigators of AT's communities of intent, VITA and ITDG created projects, set up businesses, and got involved with education and research programs. Yet despite sharing similar strategies, they had different overarching goals.

VITA steered clear of more ideological discussions, sidestepping larger political questions surrounding the direction and impact of technological change drawing support and legitimacy for their work from members of the scientific elite like Harvey Brooks. They framed after hours tinkering as a way

[185] TRANET, Newsletter, (Summer, 1997), 1. E.F. Schumacher Archive. The Schumacher Center for a New Economics, Great Barrington, Massachusetts.
[186] Stephen Macekura, *Of Limits and Growth*.

of engaging with societal needs and the cumulative efforts of volunteers as a way of incrementally improving the status quo. ITDG's more overtly ideological approach on the other hand, was largely driven by its association with Schumacher. Though ITDG adopted a similar approach of supplying technical aid through building problem-based, interdisciplinary teams, they also supported a more transformational agenda. At ITDG, AT was a means of providing a critical reevaluation of technological change that foregrounded particular values such as small-scale, local, ecological, and sustainable.

AT attracted the support of people from a wide array of backgrounds, disciplines, political interests and philosophical views. Of course, social movements are typically heterogeneous entities; but with diversity can come disagreement, for a shared problem framing doesn't automatically translate into a shared vision of a movement's goals. As Willoughby points out, "this tension between consensus and diversity is typical of social movements, as opposed to dogmatic or tightly proscribed academic schools of thought".[187] As we have seen, with regards to AT's communities of intent, it helped that their message resonated with multiple different audiences, for example, VITA and ITDG's different visions of AT provided different ways and means of getting people on board. Engineers and scientists were drawn to AT as a way of applying their knowledge to societal problems, whereas philosophers and social critics were drawn to AT as an articulation of a broader critique about technological change. As a result of these different visions, the movement was able to make considerable inroads in the 1970s, being taken up at universities in the educational programs of engineers, as well as in the policies of national governments and development agencies.

Both VITA and ITDG helped generate considerable interest in AT within universities and governments on both sides of the Atlantic. But whereas formal arrangements orchestrated by national governments and development agencies were highly contingent upon prevailing policy trends, more informal arrangements such as TRANET relied on the commitment and dedication of its founders—as well as the contributions of like-minded individuals around the world. TRANET successfully connected the intentional communities and the communities of intent; the tinkerers and the transformers. Its success was largely contingent upon upholding a certain

[187] Kelvin Willoughby, *Technology Choice*, 139.

degree of ambivalence regarding exactly what AT was, or should be, instead opening up some sort of middle ground where all could come together, exchange, and share.

The ambiguity that remained inherent within AT means that we can trace AT's legacy as an intellectual movement in how terms of how it required "the simultaneous incorporation of technical-empirical, socio-political and ethical-personal factors in planning and decision making".[188] For example, at VITA and ITDG, providing technical aid meant engaging engineers with societal problems, through interdisciplinary exchange, requiring constant reflection on the relevant questions and stakeholders. This approach was successfully taken up at a number of universities, a good example of which was the CAT at Delft. As the language of AT began to fade in the 1980s, the CAT fused with the university's Bureau of Foreign Affairs, becoming the Center for International Cooperation and Appropriate Technology (CICAT). In keeping with the language of the times, the center later became the Center for Innovation & Impact and is now headed up by Paul Althuis, who worked at CICAT and was also previously involved with TOOL.

Today, Delft is a hub for R(R)I, which it defines as "pro-actively addressing relevant moral and social values already in the design phase of new technologies, products, services, spaces, systems, and institutions".[189] Delft offers educational programs in collaboration with other universities in the Netherlands, offering courses which, much like earlier efforts at the CAT, introduce students to "the technical, managerial and socio-economic principles that govern innovation" and provide students with the vocabulary to discuss the ethical conditions for "innovating responsibly".[190] Former members of the CAT, like Wim Ravenstijn, now coordinate R(R)I programs, hinting at the existence of ongoing synergies between AT in the 1970s and R(R)I today.

With regards to AT's broader critique of technological change, its legacy is also visible in a number of ideas which continue to be of central concern within R(R)I. For example, with regards to the emphasis it placed on

188 Ibid, 340.
189 TU Delft, "Design for Values," accessed March 23, 2022 https://www.delftdesignforvalues.nl/
190 TU Delft, "Responsible Innovation," accessed March 23, 2022 https://www.tudelft.nl/tbm/onderwijs/minoren/responsible-innovation-lde

the social and cultural aspects of technological change as a dynamic, interactive *process*; as well as the emphasis it placed on managing the *societal impacts* of technological change through a more democratic approach to technological choice. Though R(R)I reframes these issues under the banner of responsibility rather than appropriateness, these similarities still hint at a family resemblance between AT in and R(R)I. R(R)I's more transformational agenda shares with AT a critique which addresses "the basic values and operating rules of the system—from the profit motive to the primacy of economic efficiency, and from the ethics of growth to the belief in the universality of contemporary technology".[191]

Another parallel between AT and R(R)I is as scientific/intellectual movements they each demonstrate a similar internal tension between the goal of incremental reform, and the goal of broader transformation—with members often exhibiting a great deal of ambivalence between the two. According to Marco Guigni, reform movements often focus on the short-term goal of influencing policy, and are often successful in achieving short-lived gains. Revolutionary movements, on the other hand, typically target more long-term, institutional change. Whereas short-term policy outcomes can be measured relatively easily; institutional change is far more insidious—as Jéquier and Blanc put it, like the penetration of termites in a wooden building, this "can often go unnoticed for a number of years".[192]

In either case, identifying causality between social movements and outcomes is notoriously difficult. In that sense, my intention in this chapter was not to overstate the impact of AT. It did not spark a revolution, nor cause any major transformations—at least not in the way that many of its early adherents may have hoped. It was a movement that encompassed a broad spectrum of goals; successfully enrolled a range of diverse stakeholders; and reached a considerable degree of institutionalization. The ambiguity inherent to the movement meant that it appealed to different people for different reasons. In the end however, it seems as though ambivalence about whether AT should ultimately be about reform or transformation, resulted in AT being easily dismissed as a movement that failed to clearly articulate its main goals.

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[191] Nicolas Jéquier and Gérard Blanc, *The World of Appropriate Technology,* 164.
[192] Ibid.

Ultimately, understanding AT from a social movement perspective tells one story: a rise and fall narrative of a movement that grew rapidly, achieved a number of short-term gains, before rapidly fading into obscurity. Focusing on the communities of intent branch of AT, and treating that branch more specifically as an intellectual movement tells another story: one where AT's legacy leaves a much longer trail. It suggests that the organizations, friendships, and networks generated by AT continued to shape the landscape long after the slogans and labels once associated with it had become outdated or unnecessary. It demonstrates how the language, approaches, and tools of a scientific/intellectual movement do not disappear when fashions change, or funding fades. Instead, they are carried on through the people, practices, and places that remain. This seems to me as a particularly important lesson for R(R)I; as the R(R)I community reflects on a decade of effort and an uncertain future, the rippling effects of AT might serve as a cause for optimism.

Chapter 5

Imagining the Future through Revisiting the Past

On a typically grey British day in November 2018, I found myself driving down the motorway in the pouring rain to attend a conference co-organized by the Biochemical Society and BrisSynbio, one of six Synthetic Biology Centres in the UK, housed within the University of Bristol. Alongside the Synthetic Biology UK (SBUK2018) conference program, there was a separately run event which included two afternoons dedicated to the discussion of R(R)I; an evening event highlighting different social dimensions of synthetic biology (such as biosecurity, sustainability, language use, and art); as well as an evening on public engagement. The idea of hosting these two events in parallel was to provide space for a cohesive, vibrant, and multidisciplinary community to come together.

Somewhat symbolically however, the R(R)I "satellite" event took place in another building—a 5 minute walk away from the main event. As Sophie Stone comments in her review of the conference, "A Systemic Separation of Concerns", the spatial separation between the events was not only physical, but epistemological. Stone writes

> The distribution of event planning activities across multiple bodies itself is not unusual; different institutions are often better suited to organising different events. However, what particularly struck me was the positioning of these two

> programmes in relation to each other using words such as 'satellite' and 'aligned'. 'Satellite' imagery (no pun intended) invokes ideas of the social dimensions events as separate, 'tacked on' and only peripherally connected to SBUK2018's science programme. Whereas 'alignment' imagery invokes them as subordinate to the science programme. SBUK2018 was the place for discussing science, and the periphery was the place for discussing social science interests and public engagement.[1]

As I would come to realize over the coming weeks and months, as I attended more of these sorts of events, speaking to R(R)I theorists and practitioners, taking part in R(R)I projects and workshops, discussing R(R)I often seemed to take place at the *periphery*. It was often outside of, or at least adjacent to, more mainstream discourses surrounding research and innovation.

Some months before SBUK2018, I attended a social lab in Vienna as part of the NewHoRRIzon project.[2] The project used social labs to bring together multiple stakeholders (from research, business, policymaking, education, and civil society). Each of the 19 labs began with R(R)I knowledge sharing exercises, before a number of "pilot actions" were designed, implemented, and evaluated. The goal of the pilot actions was to introduce R(R)I to a wider audience as a part of the EC's "mainstreaming" initiative. The first social lab I participated in targeted beneficiaries of European Research Council (ERC) grants, bringing together ERC grantees, team members, and applicants, together with individuals from civil society and research funding organizations. During the morning session on the first day—after a short PowerPoint presentation introducing the concept of R(R)I—a "talking stick" was placed in the middle of the group and we were asked a series of questions. We were asked to describe what R(R)I meant within our own work, and the extent to which we thought it was a useful or important concept. One ERC grant holder from the natural sciences looked puzzled. Picking up the stick, they said, "Surely what we are talking about is just doing 'good' science?" As they explained, it wasn't at all clear to them

[1] Sophie Stone, "A Systemic Separation of Concerns," Engineering Life Blog, accessed April 27, 2022, https://blogs.sps.ed.ac.uk/engineering-life/2018/12/14/a-systemic-separation-of-concerns-reflections-on-synthetic-biology-uk-2018/

[2] The NewHoRRIzon project ran between 2017 and 2021 and its aim was to further integrate Responsible Research and Innovation (RRI) in the research and innovation systems on national and international levels. See "Project Description: NewHoRRIzon," NewHoRRIzon, accessed April 27, 2022, https://newhorrizon.eu/

what was new about R(R)I or how it differed to existing ideas about responsibility and *good* scientific practice.

These reflections nicely illustrate the ways in which different notions of responsibility—with seemingly different lineages—have played a role within discourses surrounding R(R)I. Much like the exchange between Simon, Newell, and Bellman in chapter 1, the quote from the scientist at the NewHoRRIzon social lab highlights the knottiness of "practical" versus "historical" pasts. As we have seen, this knottiness often engenders tensions, presenting hurdles to the sort of dialogue that R(R)I advocates try to cultivate. By tracing ideas about responsibility in and through the activities of previous intellectual movements, I have tried to contribute to R(R)I's historical past in a bid to illuminate, and perhaps even ameliorate, some of the knottiness that's evident in these examples of "satellites" and talking sticks. Approaching R(R)I as an intellectual movement, as a specific community of researchers and practitioners, I have provided the beginnings of a more textured historical past, moving beyond existing folk histories in order to examine how and why different ideas about responsibility have moved in and out of focus over time.

When I first started this project in late 2017, R(R)I was in the midst of a "golden age".[3] The movement was expanding rapidly covering an ever-wider range of topics and areas of application and continually enrolling new members. At the same time however, there was talk within the community about the "end of RRI".[4] The end of the EC's 2014-2020 R&D funding program was looming and with it the possible termination of the EC's program for R(R)I. As Erik Fisher wrote, the sizeable investment in R(R)I between 2014 and 2020—primarily by the EC—"strengthened national efforts, facilitated a wealth of engagement methods and case studies, and created a robust network of researchers".[5] All of which, he continued, promised to be "vital resources for moving responsible innovation forward"—whatever its fate turned out to be within the EC's next funding program.[6]

[3] Erik Fisher, "RRI Futures: Ends and Beginnings," *Journal of Responsible Innovation* 8, no. 2 (2021): 135.
[4] Erik Fisher, "Ends of Responsible Innovation," *Journal of Responsible Innovation* 5, no. 3 (2018): 253.
[5] Erik Fisher, "Responsible Innovation through a Multiplicity of Approaches," *Journal of Responsible Innovation* 8, no. 3 (2021): 339.
[6] Ibid.

By 2019, drafts for the next funding program began to circulate fueling rumors about the uncertainty of R(R)I's future. As soon became clear, the EC was set to drop R(R)I as a pivotal and organizing concept within Horizon Europe. So while initially the openness of the R(R)I concept appeared to have facilitated its political capture, it now appeared to have fallen victim to the ebb and flow of funding trends.[7] One session at a science engagement conference even had the title "R.I.P. R.R.I" and consisted of a "parody burial"—featuring a ceremony, a coffin, and a wake.[8] Elsewhere, the intentionally provocative phrase "RRI is dead. Long live RRI" became the starting point for a special issue of the *Journal of Responsible Innovation* (JRI). Within the issue, guest editors Michiel van Oudheusden and Clare Shelley-Egan summarized some of the pertinent questions the community now faced, namely "what have we achieved as scholars, practitioners, and policymakers? What is our legacy and impact? What have we learned about RRI in its varieties as both process and outcome? What are the future directions or prospects?"[9]

As I write in 2022, the community continues to reflect on what has been learned from roughly a decade of interest in R(R)I; taking stock, outlining future work, as well as thinking about how past, current, and future RRI-related work can remain relevant.[10] In a bid to engage in this ongoing moment of reflection, I published a discussion piece in JRI, together with Joshua Cohen, Shauna Stack, and Nicholas Surber.[11] In the piece we outline our observations as early career researchers working in and around R(R)I for a number of years. We describe 5 areas of "discomfort" we have each

[7] See Fisher, "Ends of Responsible Innovation", 253; and Arie Rip, "The Clothes of the Emperor. An Essay on RRI in and around Brussels," *Journal of Responsible Innovation* 3, no. 3 (2016): 290-304.
[8] "R.I.P R.R.I," Ecsite, accessed April 27, 2022, https://www.ecsite.eu/activities-and-services/ecsite-events/conferences/sessions/rip-rri
[9] Michiel Van Oudheusden and Clare Shelley-Egan, "RRI Futures: Learning from a Diversity of Voices and Visions," *Journal of Responsible Innovation* 8, no. 2 (2021): 139.
[10] Bernd Carsten Stahl, Simisola Akintoye, Lise Bitsch, Berit Bringedal, Damian Eke, Michele Farisco, Karin Grasenick, Manuel Guerrero, William Knight, Tonii Leach, Sven Nyholm, George Ogoh, Achim Rosemann, Arleen Salles, Julia Trattnig & Inga Ulnicane, "From Responsible Research and Innovation to Responsibility by Design," *Journal of Responsible Innovation* 8, no. 2 (2021): 175; see also (published as I was submitting this dissertation) Sally Randles, Elise Tancoigne, and Pierre-Benoît Joly, "Two Tribes or More? The Historical Emergence of Discourse Coalitions of Responsible Research and Innovation (rri) and Responsible Research and Innovation (RRI)," *Journal of Responsible Innovation* (2022): 1-27.
[11] Danielle Shanley, Joshua B. Cohen, Nicholas Surber, and Shauna Stack, "Looking beyond the 'Horizon' of RRI: Moving from Discomforts to Commitments as Early Career Researchers," *Journal of Responsible Innovation* (2022): 1-9.

encountered, before sharing a series of "commitments" we have made with and to each other.[12] We chose this set-up in an attempt to go beyond critique by pointing to a more pragmatic, activist, re-politicized, and collaborative program, while also choosing this framing explicitly to avoid our observations being construed as clear-cut problems with neatly packaged solutions.

As respondents to our piece pointed out, it is important not to reify R(R)I. It is also important to acknowledge as Stevienna de Saille notes, that "as a knowledge project aimed at institutional change" R(R)I's emergence is incomplete.[13] We must also recognize, as Jeroen van den Hoven states, that "it can take a discouragingly long time to mainstream a particular point of view or raise public awareness regarding matters of great public concern".[14] While broadly speaking I agree with these sentiments, what I have shown throughout this book is that efforts at making research and innovation more responsible *already have* long histories. It is only because movements like R(R)I and its predecessors have had a tendency to forget those histories that it is then possible for movement actors to say that what they need is more time. In this chapter I will argue that it is exactly in response to these sorts of points, regarding R(R)I's development and trajectory, as well as its longer term impacts and effects that more textured histories of R(R)I—which problematize its presumed novelty—might serve a role.

As such, in this final chapter, I will first ask in how far R(R)I has aged well, given the legacies of previous movements from the '60s and '70s. In so doing, I will revisit the main research question regarding how responsibility has been made to matter within discourses surrounding research and innovation. I'll then reflect further on these legacies, by examining the possible trajectories and outcomes of intellectual movements more broadly. Finally, I will close this chapter by taking up Cyrus Mody's call to develop a vocabulary of ambivalence. Drawing on insights from organizational studies, anthropology, sociology, and philosophy, I will make the case for ambivalence as a conceptual tool, methodological heuristic and intellectual virtue. I'll suggest that in contrast to seeing ambivalence as a problem that

[12] Ibid.
[13] Stevienna de Saille, "New Horizons, Old Friends: Taking an 'ARIA in Six Keys' Approach to the Future of R(R)I," *Journal of Responsible Innovation* (2022): 1.
[14] Jeroen van den Hoven, "Responsibility and Innovation," *Journal of Responsible Innovation* (2022): 1.

needs to be solved, within academic research, ambivalence itself could be seen as a way of making responsibility matter, as cultivating discomfort provides a means for "staying with the trouble".[15]

Well-Aged Wine?

In our JRI discussion piece we draw attention to R(R)I's contested novelty in a bid to raise awareness of the lack of historical reflexivity across the R(R)I community. In response, de Saille asks, "does it really matter that old wine is poured into new bottles, if the wine itself has aged well?"[16] Perhaps the answer here is no; but I would argue that providing a more textured historical account of longstanding traditions allows us to think more carefully about which parts have aged well and which parts have not. For example, as we have seen throughout, R(R)I is built upon the legacy of various intellectual movements that foregrounded understanding the processes of technological change as well as its outcomes. Contemplating the continuities between these movements and contemporary R(R)I provides a means through which to reflect on whether and in how far it is a well-aged wine, or not.

First of all, much like the protagonists of earlier chapters, R(R)I advocates often demonstrate highly ambivalent attitudes with regards to the movement's function and purpose. For example, Walter Valdivia and David Guston characterize R(R)I as an opportunity for incremental reform, building on prior developments in the governance of science and technology.[17] Richard Owen, René Von Schomberg, and Phil Macnaghten, on the other hand, chart a shift from early attitudes towards R(R)I, which encompassed broad, transformative visions for reimagining the relationship between science, innovation, and society towards attitudes and approaches that were underpinned by the more pragmatic and actionable six keys of the EC.[18] As suggested in chapter 1, this tension demonstrates the existence of both Langdon Winner's "theory of technological politics", and "ideology of

[15] Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016).
[16] Stevienna de Saille, "New Horizons, Old Friends," 2.
[17] Walter D. Valdivia and David H. Guston, "Responsible Innovation: A Primer for Policymakers," *The Brookings Institute* (Washington, DC: 2015).
[18] Michiel Van Oudheusden and Clare Shelley-Egan, "RRI Futures," 142.

technological change". In chapters 3 and 4 we saw that in contrast to the notion that AT belonged to the former and TA to the latter, much like R(R)I, these movements consisted of individuals whose attitudes appear to have reflected both categories *at the same time*.

In the case of R(R)I over the course of the last decade it has become increasingly difficult to discern in how far it is understood by its theorists and practitioners as a way of transforming the R&I system, or rather as a way of making modest improvements to the status quo. Just as was the case for Daddario (chapter 2) or Schumacher (chapter 3), R(R)I advocates today are often pulled in both directions as once, as they try to pursue broad ambitions and goals, while simultaneously having to stick to the rules of the game in order to acquire support and funding. Much like we saw in chapters 2 and 3, visions for making R&I more responsible as well as more socially responsive have often been successful at drawing the attention of investors and policy makers. However, as Owen, von Schomberg, and Macnaghten suggest with regards to R(R)I this often results in becoming "caught in the ties that bind".[19] As was the case with both TA and AT, the articulation of R(R)I within funding policies—primarily Horizon2020—failed to promote the goals initially envisioned by its early proponents. As Owen, von Schomberg, and Macnaghten explain, the uptake of R(R)I within funding policies had "the pragmatic advantage of being implementable (and measurable)"; making it "recognizable and intelligible to researcher community and less abstract"; and putting an "emphasis on action towards the meeting of issues". However, much like TA and AT, this resulted in the "more ambitious vision for RRI being lost".[20]

In addition to a number of deeply embedded tensions regarding the goals and purposes of the movement, what R(R)I also shares with its predecessors is that it is proactive rather than reactive. From proto-STS programs through to international programs for AT, what these movements all implied was a more constructive approach: looking for socially useful technologies, rather than solely resisting unattractive technologies. In the context of R(R)I, as Bernd Stahl and his colleagues write, a more proactive approach means that "the focus is not on accountability for potential

[19] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey? Reflections on a Decade of Responsible Research and Innovation," *Journal of Responsible Innovation* 8, no. 2 (2021): 224.
[20] Ibid.

unwanted outcomes", but instead on "shaping scientific practices by making practitioners commit to socially desirable goals". This, they continue, "entails that responsibility is not exhausted by legal compliance: it requires engagement with society and understanding of social goals. Responsibility is thus understood as the combination of a responsible process and desirable outcomes".[21] As we have seen, efforts to make research and innovation more responsible through drawing attention to both the processes and outcomes of technological change have deep roots in R(R)I's antecedent movements in the 1960s and 1970s.

In this sense, R(R)I also inherits and builds upon discussions about the distribution of responsibility, "*throughout* the innovation enterprise, locating it even at the level of scientific research practices".[22] According to Erik Fisher and Arie Rip, it is for this reason that R(R)I can be seen as a development over TA, which "was seen more as the responsibility of political processes than of scientific ones".[23] However, I would argue that by looking to the pre-history of TA prior to the creation of the OTA (chapter 3) we might say that R(R)I has breathed life into a conversation Daddario tried to initiate in his promotion of TA in the late 1960s. Though R(R)I undoubtedly extends that discussion, proposing a "richer concept intended to ensure the ethical sustainability and desirability of science and innovation outcomes", Daddario opened up the discussion regarding role-oriented approaches to responsibility questioning in how far scientists and politicians should be seen as responsible for difference parts of the research and innovation process.

R(R)I today does not only foster the distribution of responsibility throughout the research process, but also between various stakeholders. In opening up the notion of responsibility as a collective enterprise, it builds upon proto-STS programs, early TA panels, and AT project teams, as like these early initiatives, R(R)I is characterized by its emphasis on interdisciplinarity. Take the Columbia seminar (chapter 2), which brought together scientists, innovators, funders, and policy makers. Their discussions

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21 Bernd Carsten Stahl, Simisola Akintoye, Lise Bitsch, Berit Bringedal, Damian Eke, Michele Farisco, Karin Grasenick, Manuel Guerrero, William Knight, Tonii Leach, Sven Nyholm, George Ogoh, Achim Rosemann, Arleen Salles, Julia Trattnig & Inga Ulnicane, "From Responsible Research and Innovation to Responsibility by Design," 177.

22 Erik Fisher and Arie Rip, "Responsible Innovation: Multi-Level Dynamics and Soft Intervention Practices," in *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society,* eds. Richard Owen, John Bessant, and Maggy Heintz (Chichester: John Wiley & Sons Ltd., 2013), 165.

23 Ibid.

not only demonstrate the ways in which different stakeholders came together to discuss different understandings of responsibility in the 1960s, but also directly resulted in the creation of subsequent interdisciplinary programs. Perhaps the most important outcome of the T&SC seminar was the realization that what was needed was new areas of study, whose problem framing began with the technology-society interface. At Harvard, Cornell, and beyond these programs brought scholars together from across the natural sciences, social sciences, and humanities, providing an early model of what would soon become a well-trodden path.

Whereas R(R)I theorists today sometimes assume that scientists need to adopt new roles and responsibilities and embrace new ways of doing research, discussions at the T&SC seminar are also a good example of the long-standing willingness by members of the scientific community to discuss the possibility and feasibility of socially inclusive and anticipatory approaches. For example, scientists like Brooks and Wiesner articulated a clear disdain for the linear model of innovation, demonstrating a nuanced understanding of the complexity of innovation trajectories, asking how and in what ways societal needs could or should play a role. One might say that in so far as these scientists engaged in discussions regarding the relationship between technology and society they were pre-disposed towards this way of thinking. Yet sensitizing R(R)I's theorists and practitioners to the ways in which scientists have engaged with these issues before might enable them to make closer allies across the wider scientific community today. Historical exchanges, like those at Columbia, may also point to possible explanations for why inclusive, participatory approaches are considered problematic. For example, Rabi's insistence on a clear separation of role responsibilities highlights some of the tensions that underscore a commitment to a particular image of what *doing science* looks like and the type of scientific identity which that image upholds.

So far I have shown that much of the discussion surrounding R(R)I has been built upon the ways in which previous movements made responsibility matter in terms of their reformist/transformative ambitions; proactive approaches; and collaborative, interdisciplinary practices. In relation to such legacies, it would seem fair to suggest that R(R)I does indeed expand upon earlier efforts meaning that so far, the wine does seem to be aging fairly well. However, turning my attention now to the ways in which the concept of responsibility became coupled with the concept of innovation, suggests that for some, the aftertaste might be at least a little less palatable.

Innovation beyond Growth

As Godin writes, beginning in the 1960s "every discipline embraced the concept of innovation", so much so that from the 1980s onward innovation became a "panacea for every socio-economic problem".[24] He suggests that whereas much innovation-speak today focuses on supply; "contestations of the industrial form: social innovation, responsible innovation, sustainable innovation, inclusive innovation, common innovation, and so on" rely on the notion of *social needs*—a concept inherited from the 1960s.[25] According to Godin, Brooks' OECD report "is a perfect synthesis of the rhetoric of the time".[26] As we saw in chapter 2, the report implores governments of Member States to go "beyond exclusively economic considerations"; to focus on "socially oriented technologies; which are capable of contributing to "collective needs".[27] Insofar as the report is concerned with changing the character of technological innovation—so as to make it more responsible—rather than replacing it with different kinds of innovation, the rationale of the report is in many ways similar to that of R(R)I today. Godin even suggests that constructions like R(R)I are merely "a re-articulation of the contestations of technological innovation of the 1960s-70s".[28]

That is not to say that the dimensions of innovation considered today are not broader than they were in the Brooks report. Though interestingly Godin points to "sustainability" and the "the anticipation of impacts, or 'technology assessment' as it was called in the 1970s" as major characteristics of contemporary R(R)I—topics which, as we have seen, Brooks also engaged with in the '60s and '70s.[29] As Godin points out, recent constructions like R(R)I typically focus on process; emphasizing inclusion and early engagement in order to foster more social, ethical, and environmental outcomes. But

[24] Benoît Godin, *The Invention of Technological Innovation, 228.*
[25] Ibid.
[26] Ibid, 232.
[27] Cited in Godin, 232.
[28] Ibid, 233.
[29] Ibid.

essentially they "have the same function as does technological innovation" in that they are "prescriptive and programmatic".[30] Ultimately, "innovation is an imperative".[31] Innovation is "the *a priori* solution".[32]

R(R)I was originally envisaged as a means through which to challenge the technology–market dyad which framed innovation policies since the Second World War.[33] Yet, despite purporting to challenge the "pro-innovation bias" and questioning the extent to which innovation is "the engine of choice to foster economic growth, productivity, and prosperity" policy framings of R(R)I have continued to couple the concept with the objective of increasing economic growth.[34] For example, consider von Schomberg's focus on "marketable products" in his oft-cited definition.[35] Yet, as von Schomberg and Hankins note, the market is not designed to maximize societal benefit over profit. But as discussions at the Columbia seminar (chapter 2) and in relation to TA (chapter 3) during the '60s and '70s demonstrate, trying to couple research and innovation with societal needs instead—or in today's parlance, Grand Societal Challenges—doesn't necessarily shift innovation away from "competition, individualism, and carelessness", towards "collaboration, empathy, humility, and care".[36]

As Kelvin Albertson and his colleagues remind us, when R(R)I was first discussed at the EC in the early 2010s, "stewardship of the future" and "commitment to care" were key ambitions which subsequently failed to be integrated in EC policies.[37] For those who saw R(R)I as an opportunity to promote transformational systemic change and question the "innovate or die mania" which seems to preoccupy the modern world, AT would appear to be an important forebear. According to Mario Pansera and Mariano Fressoli, this mantra "underpins assumptions—such as technological determinism and productivism—that neglect the socially constructed character of

[30] Ibid, 227.
[31] Ibid.
[32] Ibid, 228.
[33] Sebastian M. Pfotenhauer and Joakim Juhl, "Innovation and the Political State: Beyond the Myth of Technologies and Markets," in *Critical Studies of Innovation*, eds. Benoît Godin and Dominique Vink (Cheltenham: Elgar, 2017), 68-94.
[34] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey?" 222.
[35] René von Schomberg, "A Vision of Responsible Innovation," in *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, eds. Richard Owen, Maggy Heintz, and John R. Bessant (Chichester: John Wiley & Sons, 2013), 39.
[36] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey?" 228.
[37] Michiel Van Oudheusden and Clare Shelley-Egan, "RRI Futures," 143.

technological development, its politics and its capacity to enable (or disable) just and equitable societies".[38] Yet it is only fairly recently that concepts like "post-growth", "de-growth", and "responsible stagnation" have started to receive attention within R(R)I.[39]

As management and innovation scholars have increasingly turned their attention towards the topics of development and poverty, a whole series of concepts have emerged, including: "grassroots innovation", "frugal innovation", "reverse innovation", "Jugaad innovation", "bottom of the pyramid innovation (BOP)", "Gandhian innovation", "empathetic innovation", "below the radar innovation", and "inclusive innovation".[40] In contrast to concepts like post-growth or de-growth which look to uncouple innovation from economic growth, these concepts typically share the consensus that the capacity for innovation must be enhanced if developing countries are to flourish. Admittedly, they also typically "present an outwardly apolitical conceptualization of innovation, tending to overlook the importance of cultural and social contexts and, above all, the politics of innovation."[41]

Given that these discourses share similar aims with R(R)I with regards to fostering participation and making research and innovation more inclusive, there would appear to be great potential in better, more sustained engagement between them. Looking at AT as an important legacy for R(R)I could also help to bring these sorts of discourses closer together. For example, notions such as inclusive growth and responsible stagnation reconsider innovation along relational terms, "including care, stewardship, and social welfare rather than aligning it to the logic of the market".[42] As we saw in chapter 4, regardless of the extent to which AT succeeded or failed as a movement, through its various networks and experiments it did develop an

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[38] Mario Pansera and Mariano Fressoli, "Innovation without Growth: Frameworks for Understanding Technological Change in a Post-growth Era," *Organization* 28, no. 3 (2021): 380. See also Lee Vinsel and Andrew L. Russell, *The Innovation Delusion: How our Obsession with the New has disrupted the Work that Matters Most*, Sydney: Currency, 2020.

[39] See e.g. Stevienna de Saille and Fabien Medvecky, eds. *Responsibility beyond Growth: A Case for Responsible Stagnation* (Bristol: Policy Press, 2020).

[40] This list is closely based on the one which appears in Richard Owen and Mario Pansera, "Responsible Innovation: Process and Politics," 43.

[41] Ibid.

[42] Michiel Van Oudheusden and Clare Shelley-Egan, "RRI Futures," 143.

alternative vocabulary for talking about technological development, one that foregrounded humanistic principles.

The other chapters also provide examples of why it is important to move beyond the language of success and failure. For example, in chapter 2, we saw that despite proto-STS programs at Harvard and Columbia meeting an early demise and efforts to professionalize the field through the 1970s turning away from concerns with technology and social change, those concerns returned in the 1980s with ideas about the social construction of technology which in turn fueled the creation of constructive technology assessment. Similarly in chapter 3, the collapse of the ISTA not long after the creation of OTA is perhaps indicative of the fact that well into the 1980s there was the sense that TA was what was done at OTA. Yet, by the time OTA closed its doors in the mid-1990s, it left behind it a strong movement on both sides of the Atlantic.

Instances of demise or closure often provide moments for reflection. For example at Columbia in 1972, T&SC seminar Chairman Granville Sewell outlined a shift in policy precipitated both by the seminar's 10th anniversary, as well as the discontinuation of the programs at Columbia and Harvard—as programs "closely identified with the Seminar's early development".[43] Sewell asserts that while their closure might reflect a move "away from broad, interdisciplinary efforts to narrower, more specialized studies", the seminar would proceed by inviting scholars that are more active, expanding its membership, and broadening the seminar's scope.[44] A similar moment of reflection can be found in a special issue of *Technological Forecasting and Social Change*. Marking OTA's closure in 1995, contributors to the issue asked with OTA gone, what the future held in store for TA. Bruce Bimber and David Guston suggested, "In a world where definitions can have tremendous stakes for the ownership of issues, the loss of OTA leaves technology assessment apparently mired in uncertainty—if not threatened with extinction".[45] "The

[43] Granville Sewell, "Seminar Minutes: Some Reflections on Science-Technology-Society Studies in the Seminar's Tenth Year," Columbia University Seminar on Technology and Social Change, October 10, 1963. The University Seminars Digital Archive.
[44] Ibid.
[45] Bruce Bimber and David H. Guston, "Introduction: The End of OTA and the Future of Technology Assessment," *Technological Forecasting and Social Change* 54, no. 2-3 (1997): 125.

closure of OTA" they wrote, provided "just the sort of historical juncture in intellectual movements at which stock-taking… is appropriate".[46]

With the shift from Horizon2020 to Horizon Europe, R(R)I now finds itself on similar ground. De Saille suggests that even if the community agrees that it "has not yet achieved its goal of institutionalization, this does not mean that it has failed".[47] In order to assess the success of R(R)I as an intellectual movement, Brundage and Guston take up the conditions initially laid out by Scott Frickel and Neil Gross. Yet, as discussed in the previous chapter, social movement theory has largely shifted away from evaluating a movement's success or failure towards a focus on its outcomes and consequences. Making this shift in the context of R(R)I allows us to think differently about the trajectories of previous movements, highlighting the non-linearity of responsibility-related concerns in relation to research and innovation. Focusing on the legacies of previous movements instead allows us to see R(R)I as part of a constellation of efforts to make responsibility matter in ways that have come in and out of focus over time.

Moment or Movement?

In thinking about the non-linear trajectories of intellectual movements, de Saille's response to our discussion piece once again provides a good starting point. For she asks, "So is RRI, to borrow a phrase from the musical Hamilton, a moment or a movement?"[48] Owen, von Schomberg, and Macnaghten seem to think that it constitutes the former, describing R(R)I as "being part of a broader conversation that has a past, present and future, as a moment on a journey that is far from over".[49] I followed the lead of Miles Brundage and David Guston, in approaching R(R)I as an intellectual movement. As such, I have mainly drawn upon Frickel and Gross' theory of SIMs in charting the emergence of antecedent movements.

As we have seen, intellectual movements rely on the support of high-status actors—like Brooks, Daddario, and Schumacher, for example. As

[46] Ibid.
[47] Stevienna de Saille, "New Horizons, Old Friends," 2.
[48] Stevienna de Saille, "New Horizons, Old Friends," 3.
[49] Richard Owen, René von Schomberg, and Phil Macnaghten, "An Unfinished Journey?" 229.

Frickel and Gross explain, intellectual movements are generally reliant upon the resources these actors provide access to; think, for example about how Daddario commissioned reports from various sources on the different aspects of TA (chapter 3), or Brooks' solicitation efforts on behalf of VITA (chapter 4). Intellectual movements also require opportunity structures to open up, through organizational resources such as journals and scholarly networks—think of ISTA (chapter 3) or TRANET (chapter 4), which both provided important channels of communication and coordination while simultaneously supplying linkages between different sorts of institutions. Micromobilization contexts—such as conferences, retreats, programs, and projects—also provided opportunities to disseminate and exchange ideas about both the processes and outcomes of technological change. We have seen time and again how movements preceding R(R)I had broad framings, coming together around "buzzwords, concepts, and catchphrases", providing a motivational frame which allowed actors to "cohere behind not just a slogan but a program of action".[50] Though these movements provided some sort of collective intellectual identity, they typically remained interpretively flexible so as to ensure that their message resonated with as broad an audience as possible.

Brundage and Guston argue that R(R)I similarly fulfills Frickel and Gross' conditions for success in terms of its reliance upon the support and promotion of elite actors; the access to key resources which those actors facilitate; the creation of opportunity structures and mobilization contexts; as well as its broad framing and diverse audiences. But as Brundage and Guston point out, the case of R(R)I also poses questions regarding the suitability of these conditions for ascertaining success *beyond* the emergence and consolidation of a SIM. For example, they ask, as a movement that crosses disciplinary boundaries, whether its conditions for success might look different from a movement with a narrower focus. They also ask whether the conditions for success might be different for a movement like R(R)I which has ambitions for change both *within* and *beyond* the academy. Finally, they propose that as a diverse intellectual movement, encompassing a broad array

[50] Larry Au, "Recent Scientific/Intellectual Movements in Biomedicine," *Social Science & Medicine* 278 (2021): 2.

of practices and approaches—as both a focus of inquiry *and* a normative project—R(R)I might require additional criteria in order to measure different types and levels of success.

While Brundage and Guston's questions imply the need to open up Frickel and Gross' conditions for success, they fail to go beyond an understanding of the two main outcomes of an intellectual movement as either success or failure. Following traditional thinking within social movement theory, Frickel and Gross write that in that intellectual movements are "episodic creatures", they "eventually and inevitably disappear, either through failure and disintegration, or through success and institutional stabilization".[51] In his analysis of recent intellectual movements within biomedicine, Larry Au suggests that they have three conceivable outcomes; incorporation (where the movement is so successful that its slogans and labels become unnecessary as the movement's aims become part of taken for granted reality); balkanization (where the movement collapses through the creation of new breakaway fields); and rejection (where the movement receives backlash from fellow researchers/funders causing failure, loss of momentum, and the movement's slogans to then disappear from the published scientific record entirely).[52] While Au gives a slightly more textured account of what an intellectual movement's outcomes might look like, each one is still largely oriented around the notion that movements either succeed or fail.[53]

As Marc Schneiberg and Michael Lounsbury have pointed out, recent work at the interface of social movement studies and institutional analysis "directs analytical attention to how historical legacies of prior social action become embedded in existing fields, providing bases for sequences of mobilization, and the construction of new paths from the elements or ruins of old or forgotten orders".[54] This suggests that instead of reconfiguring the conditions for an intellectual movement's success, or thinking about different

[51] Scott Frickel and Neil Gross, "A General Theory of Scientific/Intellectual Movements," 225.
[52] Larry Au, "Recent Scientific/Intellectual Movements in Biomedicine," 2.
[53] In their conclusion, Frickel and Gross briefly acknowledge outcomes beyond success and failure. They highlight the possibility of "stealth SIMs" which pursue "change while emphasizing continuity"; and "cooptation, in which the language of the movement is folded into mainstream discourse without affecting real change". Scott Frickel and Neil Gross, "A General Theory of Scientific/Intellectual Movements," 229.
[54] Marc Schneiberg and Michael Lounsbury, "Social Movements and the Dynamics of Institutions and Organizations," 266.

types of success or failure, we might think instead about how movements "can create cultural and theoretical foundations for new activities, forms, and fields".[55] As discussed in chapter 1, given that intellectual movements typically mobilize less contentious strategies than traditional social movements and are often intra-institutional forces, insights drawn from the interface of "institutional phenomena and collective action processes" might prove useful when thinking about the outcomes and consequences of intellectual movements.

Schneiberg and Lounsbury suggest that the "parallels between institutionalist imageries of path creation as waves of layering, on the one hand, and movement research on cycles of mobilization and protest, on the other, suggest that linking the two can provide new insights for future research on path creation and change".[56] For example, Moore's analysis of public science organizations demonstrates that when movements operate within mainstream institutions, they often de-emphasize "confrontational tactics in favor of their role as mobilizers of multiple logics and as agents or vehicles for *recombination, assembly, translation, and diffusion*".[57] However, whereas in Moore's case scientist-activists tried to resolve the tension between science and politics by creating new, hybrid forms of organization like the Union for Concerned Scientists, intellectual movements typically try to open up space for the creation of broad, new intellectual programs, as we saw within each of the preceding chapters.

Given that within intellectual movements like R(R)I there is often a "subtle blurring of boundaries between collective action that is normative and that which is quietly transformative", opening up discussion regarding the outcomes and consequences of intellectual movements beyond success or failure would seem like a good way to go.[58] For even when movements seemingly collapse, they still leave behind organizational, cultural, and institutional legacies—"bits and pieces of the paths they had pursued, including theories of order, regulatory fragments, local movement chapters,

[55] Marc Schneiberg and Michael Lounsbury, "Social Movements and Institutional Analysis," in *The Handbook of Organizational Institutionalism,* eds. Royston Greenwood, Christine Oliver, Roy Suddaby, Kerstin Sahlin-Andersson (London: Sage, 2008), 656.
[56] Ibid, 664.
[57] Ibid, 656.
[58] Marc Schneiberg and Michael Lounsbury, "Social Movements and the Dynamics of Institutions and Organizations," 226.

and alternative systems of enterprise in key industries".[59] Consider the CAT at Delft for example, which morphed over time given shifts in the Dutch policy climate. Or TRANET, which continued to bring together AT actors around the world, providing a platform for intellectual exchange far beyond the AT movement's supposed demise. As we have seen, various factors condition an intellectual movement's dynamics and outcomes. Legacies of prior policies, such as the TA act of 1972, provided subsequent methods and theories designed to make research and innovation more responsible providing a benchmark to which they could respond; and receptive institutional authorities, such as Harvard and IBM, provided proto-STS programs with the opportunities and resources required to get new areas of study off the ground.

The legacies of R(R)I's antecedent intellectual movements therefore served as legitimating structures, providing platforms and infrastructures within which subsequent collective mobilizations could continue to build. The creation of proto-STS programs provided institutional footholds for the emerging field of STS and TA activities that extended beyond the establishment of OTA helped create a community that would start to reinvent TA in the decades that followed. Other legacies of these earlier movements also include the establishment of "creative contexts" and new identities.[60] For example, early STS scholars positioned themselves as "bridge builders"; while Thomas Knight described TA advocates at the ISTA conference as "professional half-breeds" or, "marginal men", "change-agents, on the periphery trying either to change their profession or organization or, in more 'radical' cases, set up new ones".[61]

According to Schneiberg and Lounsbury, distinguishing between movements that operate outside and inside institutional fields raises important questions regarding their "different enabling conditions, trajectories, or effects".[62] As insider groups, for example, intellectual movements do not only pursue different tactics and different forms of

[59] Marc Schneiberg and Michael Lounsbury, "Social Movements and Institutional Analysis," 665.
[60] Armstrong, Elizabeth A., "Crisis, Collective Creativity, and the Generation of New Organizational Forms: The Transformation of Lesbian/Gay Organizations in San Francisco," in *Social Structure and Organizations Revisited*, eds. Michael Lounsbury and Marc J. Ventresca (Bingley: Emerald Group Publishing Limited, 2002), 361-395.
[61] Thomas J. Knight *Technology's Future*, 163.
[62] Marc Schneiberg and Michael Lounsbury, "Social Movements and Institutional Analysis," 658.

mobilization, but also "frame problems and solutions differently, and differently negotiate or exploit structures, networks and institutional frames provided by established fields".[63] They may also be "more likely to err on the conservative side".[64]

Regardless of whether movement members are bottom-up carriers of change or intellectual elites, new ways of doing things are rarely the product of a specific moment. As Schneiberg and Lounsbury put it, they are "not created in one fell swoop, through one wave of diffusion or comprehensive settlements".[65] Rather, "paths may emerge through multiple waves, over time, via sequences or successive stages of translation, layering, theorization and assembly that elaborate and innovate on previous, partial accomplishments".[66] Drawing upon R(R)I's longer histories demonstrates the extent to which contemporary efforts to make research and innovation more responsible builds on the outcomes and consequences of previous movements. This suggests that a likely consequence of R(R)I might very well be a successor movement with a different acronym, but similar—ambivalent—goals.

Building a Vocabulary of Ambivalence

> We are the Ambivalents. Unable not to see both sides of the argument, frozen in the no-man's land between armies of true believers. We cannot speak our name, because there is no respectable way to confess that you believe two opposing propositions, no ballot that allows you to vote for competing candidates, no questionnaire in which you can tick the box, 'I agree with *both* of these conflicting views'. So the Ambivalents avoid the question, or check "I don't know," or grit their teeth and pick a side… Consequently, our ambivalence doesn't leave a trace. But that doesn't mean it doesn't exist.[67]

As we have seen, ambivalence has long been a common response to technological change: from widespread public ambivalence across much of the U.S. and Western Europe in the late 1960s and early 1970s to specific

[63] Ibid.
[64] Ibid.
[65] Ibid, 664.
[66] Ibid.
[67] Ian Leslie, "Ambivalence is Awesome."

articulations of ambivalence at the Columbia seminar (chapter 2) or in Daddario's calls for TA (chapter 3). Yet, as Ian Leslie insinuates in the passage cited above, despite its apparent persistence, ambivalence often doesn't seem to leave much of a trace. Mody suggests that this is because histories of science and technology—perhaps even most histories in general—tend to forget about the role that was played by the "excluded middle" or the "politically ambivalent".[68] This is perhaps a little surprising given that when we present our own views *in the moment*, they are often indistinct or muddled. As Amélie Rorty writes

> We are ambivalent—multi-valent—about most of the salient and important features of our lives, our relatives and colleagues, our occupations and projects, even about our hopes and ambitions. Our motives and emotions are overdetermined; our maxims are ambiguous; their priorities are indeterminate; and we often take dim views of our ideals.[69]

Given that ambivalence is such a prevalent feature of day-to-day life, yet routinely goes unrecognized or unaccounted for in historical accounts, this implies, as Mody suggests, that what we need is a better vocabulary for talking about ambivalence. For as Rorty puts it, "we might as well attempt to find its benefits and attempt to cultivate the skills that best address its inevitability".[70] In order to draw out some of the different ways in which we might think with and through the concept of ambivalence, I'll briefly describe how I have come to think of it as a conceptual tool, a methodological heuristic, and an intellectual virtue.

Organizational scholars Blake Ashforth and colleagues provide an analytical approach to ambivalence within organizations.[71] First, they outline different sources of ambivalence. These include "hybrid identities" (think of the contradictory goals and role conflicts Daddario described as par for the course when scientists engage with politics, or politicians engage with science—chapter 3); "dualities" (think, for example, of the underlying tension within these intellectual movements regarding whether they're oriented

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[68] Mody, *The Squares.*
[69] Amélie Rorty, "A Plea for Ambivalence," in *The Oxford Handbook of Philosophy of Emotion*, ed. Peter Goldie (Oxford: Oxford Handbooks Online) 2.
[70] Ibid, 17.
[71] Blake E. Ashforth, Kristie M. Rogers, Michael G. Pratt, and Camille Pradies, "Ambivalence in Organizations: A Multilevel Approach," *Organization Science* 25, no. 5 (2014): 1453-1478.

towards continuity or change; evolution or revolution); "multifaceted objects" (technological change clearly being a multifaceted and complex issue, as was clear right from the beginning of the Columbia seminar—chapter 2); and "temporal factors" (given the dynamism of organizational contexts, be that universities, governments, or civil society organizations; change, inconsistency, and ambiguity are recurring features which often generate opposition).[72]

From the perspective of intellectual movements, as collective mobilizations within which groups construct meaning through individual interactions, the way in which ambivalence moves between the individual and collective levels is worth thinking about. Ashforth and colleagues identify diffusion mechanisms in terms of their bottom-up "emergent effects" and their top-down "cascade effects".[73] As we have seen, because intellectual movements are often embedded in organizational contexts and dependent on the high-status of individual actors, it is not uncommon for movement intellectuals to shape the way that individuals interpret and think about the problem at hand. Movement intellectuals can sow ambivalence intentionally or unintentionally, conveying "mixed or at least equivocal messages" as a means of "stimulating change", or as a way of provoking "actors into thinking more dialectically and acting more wisely".[74] For example, in chapter 4, we saw how VITA and ITDG, as members of AT's communities of intent, articulated their goals differently so as to attract endorsement from different groups; and in chapter 3, how Daddario framed TA broadly in order to enroll the support of congressmen, the scientific community, and industrialists alike.

As Alberto Metucci writes, within social movements, individuals and groups "construct their action, laboriously adjusting the different orientations that express multiple and contrasting requirements of a collective field".[75] He suggests that within social movements "ideology and framing processes are therefore necessarily ambivalent because on the one hand they express the actual meaning and goals of collective action, but on the other they cover and hide the plurality of orientations and tensions corresponding to the different

[72] Ibid, 1455-1458.
[73] Ibid, 1458.
[74] Ibid, 1459.
[75] Alberto Metucci, "Challenging Codes: Framing and Ambivalence in the Ideology of Social Movements," *Thesis Eleven* 31, no. 1 (1992): 137.

components of the movement".[76] I would argue that the same holds true for intellectual movements. Yet while traditional social movements are highly dependent on the packaging and dissemination of "collective action frames", Frickel and Gross suggest that within intellectual movements, intellectual identity formation is also crucial in that it shapes movement framing in terms of the "rhetorical constructions of the movement's collective identity, its historical construction, and its relationship to various competitor movements".[77] Movement analysis might therefore draw upon the concept of ambivalence, particularly with regards to its emergent or cascading effects, in order to trace the ways in which the meaning and goals of movements are constructed in concrete exchanges between movement members.

In contrast to Ashforth and colleagues who map the major responses to ambivalence as "avoidance", "domination", "compromise", and "holism", I have tried to ascertain the ways in which ambivalence can have different outcomes or effects over time.[78] For example, in chapter 2, we saw the effect of ambivalent attitudes towards technological change was to open up different courses of action where ambivalence seemed to facilitate different approaches to the study of technology and social change. In chapter 3, we saw how Daddario's ambivalence allowed him to successfully win over TA's critics and enroll a broad base of support for the OTA, even if that meant sacrificing some of the broader aspirations he once held. Finally in chapter 4, in the case of AT's communities of intent, we saw how their ambivalence came to be interpreted as irrelevance as over time their role seems to have been subject to a considerable degree of amnesia. These outcomes would appear to suggest that in the short-term ambivalence within intellectual movements might be desirable, whereas longer-term its effects might become detrimental.

Looking at the sources, diffusion mechanisms, and outcomes of ambivalence helps to make sense of contested framing strategies and non-linear movement trajectories. But ambivalence is not only useful analytically when it comes to making sense of R(R)I's emergence as an intellectual movement. Following Ciara Kierans and Kirsten Bell, I would argue that

[76] Ibid.
[77] Scott Frickel and Neil Gross, "A General Theory of Scientific/Intellectual Movements," 222.
[78] Blake E. Ashforth, Kristie M. Rogers, Michael G. Pratt, and Camille Pradies, "Ambivalence in Organizations," 1460-1467.

ambivalence might also be adopted *within* intellectual movements like R(R)I as a methodological heuristic. As Kierans and Bell write, "Ambivalence arises as a product of taking stances. It is at the heart of attempts at position taking".[79] It therefore makes sense that the movements discussed appear to have produced ambivalence.

The analysis of social action often relies on distinctions and classifications, ordering the world into neat binaries. Kierans and Bell suggest however "the more we steer toward polarized understandings, the easier it is to lose sight of the everyday ambivalences which underlie our ways of making sense of the world and acting upon it".[80] As Bernhard Giesen writes, a sociology of ambivalence draws attention to the "extraordinary space in between the opposites".[81] Recasting ambivalence as a methodological heuristic therefore draws our attention to what is going on between the poles and the "conditions within which polarized descriptions are made meaningful".[82]

Throughout this book, polarized positions have been commonplace—from optimists to pessimists; technocrats to utopians. Highlighting ambivalence necessarily foregrounds polarized positions. Instead of taking these positions as a given, cultivating ambivalence as a methodological orientation requires us to become "more conscious and critical of our own moral presuppositions".[83] Or, as Kierans and Bell put it, ambivalence "destabilizes the very categories it is premised upon".[84] It involves stepping forward "into the murk and indeterminacy that polemics conventionally mask" in order to ask, "What is going on?"

In my case, methodological ambivalence has meant looking at concrete exchanges *in the moment*. In so doing, I have discovered something about the conditions within which different ideas about responsible research and innovation came to be and about how people came to take up variable, often ambivalent positions. As suggested in chapter 1, despite reflexivity being held

[79] Ciara Kierans and Kirsten Bell, "Cultivating Ambivalence: Some Methodological Considerations for Anthropology," *HAU: Journal of Ethnographic Theory* 7, no. 2 (2017): 35.
[80] Ibid.
[81] Bernhard Giesen, "Inbetweenness and Ambivalence," in *Breaking Boundaries: Varieties of Liminality,* eds. Agnes Horvath, Bjørn Thomassen, and Harald Wydra (Oxford: Berghahn Books, 2015): 61.
[82] Ciara Kierans and Kirsten Bell, "Cultivating Ambivalence," 36.
[83] Ibid.
[84] Ibid, 39.

up as a core pillar of R(R)I, community members have typically failed to be reflexive about how they arrived at their own views and positions. Yet in order for R(R)I to meet the requirement of reflexivity, the R(R)I community needs to acknowledge the various histories of the field, not only the ones that are told but also the ones that could be told.[85]

Crucially, methodological ambivalence does not imply that actors should avoid taking stances but rather, as Kierans and Bell write, "that these stances ought to be the outcome of analytical work and not precursors to it".[86] As Rorty argues

> The best policy in the face of ambivalence involves a persistent, imaginative, and responsible attempt to understand and evaluate its sources and grounds. If it is discovered to be appropriate and justified, the best strategy involves a fertile and epistemically responsible use of the imagination to find ways of preserving the terms of both commitments.[87]

It is in this sense that despite being uncomfortable or unsettling, "there are some forms of ambivalence that are appropriate and responsible".[88] Insofar as cultivating ambivalence requires imaginative skills and strategies—such as "compartmentalizing, compromising, reframing, and embedding"—I would argue that in addition to being a conceptual tool and methodological heuristic, ambivalence might also be considered an intellectual virtue.[89]

Understanding ambivalence as an intellectual virtue suggests that rather than treating it as a negative; as a psychological problem that needs to be solved, ambivalence might instead be understood as a praiseworthy quality, like open-mindedness or intellectual humility. It might indeed be something that, as scholars, we should seek to cultivate and nurture. As Rorty suggests, ambivalence is an expression "of our attempts to preserve long-standing, well-tested habits while also responding to novel situations that elicit radically different—and sometimes incompatible— attitudes".[90] According to Rorty, we often have good reason to "retain entrenched patterns of salient responses"; while at the same time, "we have good reason to adopt radically

[85] See also Danielle Shanley, "Imagining the Future through Revisiting the Past."
[86] Ciara Kierans and Kirsten Bell, "Cultivating Ambivalence," 39.
[87] Amélie Rorty, "The Ethics of Collaborative Ambivalence," *The Journal of Ethics* 18, no. 4 (2014): 394.
[88] Ibid, 392.
[89] Amélie Rorty, "A Plea for Ambivalence," 12.
[90] Ibid, 3.

innovative attitudes".[91] Essentially, ambivalence can be uncomfortable and confusing, "but honest confusion may be preferable to righteous but self-deceptive closure".[92]

Limitations, Impact, and Final Thoughts

A pile of rocks might seem like a strange cover for a book about efforts directed towards making research and innovation more responsible. Yet, in an attempt to avoid clichéd images of lightbulbs, test tubes, and cogs set against blue and silver backgrounds I found myself drawn to rock cairns as an apt metaphor for some of the themes I have dealt with in this book. Initially, I was drawn to them as a means of representing balance. As we have seen, making responsibility matter within research and innovation often means attempting to strike a balance between opportunity and need, evolution and revolution, continuity and change. Balancing acts necessarily produce tensions. Yet in this chapter, I have tried to argue that instead of seeking resolution, we might actually cultivate ambivalence as a means of *staying with the trouble*.

Rock cairns also seemed a particularly appropriate symbol for a historical project. For though their meanings are multiple, they are often interpreted as navigational aids effectively connecting the past with the present, while at the same time providing a signpost to the future. In this sense they nicely reflect some of the broader ambitions of this book such as showing the ways in which R(R)I could have been otherwise and making the case for R(R)I's histories as a valuable resource when thinking about the future. Like the practice of building rock cairns, ideas about responsibility have roots across the globe stretching back far longer than the '60s and '70s. However, as indicated in chapter 1, conducting research means making choices. And based on what I learned doing historical ethnography, I made the decision to focus on the ideas and activities of intellectual movements during this period.

While I have referred to the histories contained herein as "alternative", it is important to acknowledge that I have largely focused on the global

[91] Ibid.
[92] Ibid.

north, and that throughout the preceding chapters much of my attention has been on the activities of white, male, middle-class professionals. As Mody notes in *The Squares*, in recent years historians have increasingly—and necessarily—emphasized the agency of "those whom previous generations of historians regarded as lacking agency: women, people of color, proletarians, subalterns in colonial regimes, and increasingly non-human organisms and machines".[93] Like Mody however, the histories I have examined come from "the other side of the fence".[94] As I too have focused largely on "the type of people whose agency is often taken for granted".[95] But that is not to say that histories of R(R)I should not be made more representative and inclusive, as well as more global. In fact, quite the opposite. There have been encouraging signs that the field is beginning to move in this direction, particularly in recent issues of JRI which have highlighted the importance of multiple visions (e.g. multiple pasts, presents, and futures); multiple voices (e.g. bridging, connecting, boundary spanning, and community building); and institutional change (e.g. as both an object of study within R(R)I as well as a core ambition).[96] This book is but a modest step towards opening up what I have called R(R)I's folk history, to include a broader menu of neglected, forgotten, or ignored narratives. Further work is still required to extend these histories further both temporally and geographically. To this end, quantitative analysis using methods such as scientometrics can also be enlightening, as demonstrated by Sally Randles, Elise Tancoigne, and Pierre-Benoît Joly in a piece published in JRI as I was completing this conclusion.[97] Approaching R(R)I as a constellation of discourse coalitions, they open up further avenues through which R(R)I's histories could be expanded, extended, and explored.

At a time when the future of the R(R)I community remains uncertain, these histories point towards alternative ways of envisaging what might come next. As we have seen, intellectual movements do not only succeed or fail; they leave important legacies and evidence of paths not taken. Throughout this project I have tried to promote critical reflection on R(R)I's possible

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[93] Mody, *The Squares*, 17.
[94] Ibid.
[95] Ibid.
[96] I borrow this observation from Sally Randles who used these three themes when she acted as discussant on the Special Issue on RRI's Futures at a special event in Leuven, Belgium in June, 2022.
[97] Sally Randles, Elise Tancoigne, and Pierre-Benoît Joly, "Two Tribes or More?"

histories, engaging with the R(R)I community through established outlets such as the *Journal of Responsible Innovation*. I have presented my work at scientific conferences, workshops, seminars discussing my findings with historians, STS scholars, scientists, engineers, and policy makers in a bid to demonstrate how different ideas about responsibility were made to matter at different times for different reasons. I have organized this chapter so as to highlight the specific relevant contribution for 1) R(R)I theorists and practitioners; 2) social movement theorists; and 3) researchers more generally. My findings have also informed how I approach teaching, where I have designed course curricula and assignment texts that reflect shifting attitudes towards research and innovation, lecturing students from multiple disciplines on how and why different ideas about responsibility have moved in and out of focus over time.

Ultimately, what I have tried to demonstrate with the histories contained in these pages is that R(R)I is part of a longer project that existed long before it was enshrined by the EC and will continue long after the funding initiatives that supported its recent growth have disappeared. Like rock cairns, ideas about making responsibility matter have withstood political storms and changing policy winds before. While some ideas about responsibility may have eroded and faded away, others have merely changed shape, poised to reemerge under the right conditions—say when proactive groups mobilize around alternative ideas about the future or when technological change catalyzes public concern (such as is the case—at the time of writing—with re-emerging debates surrounding "sentient AI"). At a time when our world is confronted by numerous inescapable societal and environmental challenges, many of which are seen as the indirect consequences of scientific and technological developments, we must continue thinking about the different ways in which responsibility matters be that under the guise of R(R)I, or by any other name.

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Interview Participants

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Brian Martin, Professor Emeritus of Social Sciences, 2019 (online)

David Richards, Former Director at Appropriate Technology International, 2018 (online)

Diana Page, Former Staffer at Appropriate Technology International, 2018 (telephone)

Frances Stewart, Professor Emeritus of Development Economics, 2018 (telephone)

Gerald Epstein, Former OTA staffer and Defense Expert, 2019 (online)

Jeroen van den Hoeven, Professor of Ethics and Technology at Delft University, 2018 (Delft, Netherlands)

Joel Goldhar, Professor of Operations and Technology Management at Illinois Institute of Technology, 2020 (online)

John Alic, Former OTA Staffer; Adjunct Faculty, Arizona State University's School for the Future of Innovation, 2019 (online)

Ken Taylor, Research Associate in Synthetic Biology and Responsible Innovation at Newcastle University, 2018 (Bristol, UK)

Linda Garcia, Former OTA Staffer; Director of the Communication Culture and Technology Program, Georgetown University, 2018 (online)

Neelke Doorn, Professor of Ethics of Water Engineering at Delft University, 2018 (Delft, Netherlands)

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Paul Althuis, Director of the Innovation & Impact Centre at Delft University, 2019 (Delft, Netherlands)

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Ralf Lindner, Head of the Competence Center Policy and Society, Fraunhofer Institute for Systems and Innovation Research, 2018 (online)

René von Schomberg, Senior Research Fellow at RWTH Aachen University, 2018 (Brussels, Belgium)

Richard Owen, Professor in Innovation Management at Bristol University, 2018 (Bristol, UK)

Robert Gianni, Research Fellow for Ethics and Responsible Research and Innovation at the BISS institute, Maastricht University (online)

Robert Leonard, Professor of Economics at Université du Québec à Montréal, 2020 (online)

Ron Stegall, Former Director at Appropriate Technology International, 2019 (online)

Rosina Malgrida, Head of the Living Lab for Health at IrsiCaixa, 2018 (online)

Stevienna de Saille, Lecturer in Sociology at the University of Sheffield, 2018 (Brussels, Belgium)

Susan Molyneux-Hodgson, Professor of Sociology at University of Exeter, 2018 (Bristol, UK)

Susan Witt, Executive Director of the Schumacher Center for a New Economics, 2019 (Great Barrington, U.S.)

Tsjalling Swierstra, Professor of Philosophy at Maastricht University, 2018 (Maastricht, Netherlands)

Viv Shelanski, Former Editor of Science, Technology, and Human Values; Mediator and Arbitrator, 2020 (telephone)

Wim Ravesteijn, Associate Professor of Responsible and Sustainable Innovation, 2018 (Delft, Netherlands)

Samenvatting

Dit proefschrift gaat over hoe de processen rondom technologische verandering, van onderzoek tot innovatie, ons ertoe aanzetten om opnieuw te evalueren wat het betekent om nieuwe technologieën op een *verantwoorde manier* te ontwikkelen. Ideeën over 'Responsible Research and Innovation' (RRI), vandaag de dag populair in zowel academische als beleidskringen, komen niet uit het niets. Ze maken deel uit van een lange geschiedenis van nadenken over verantwoordelijkheid waarin verschillende actoren, verschillende historische momenten en verschillende doeleinden met elkaar verweven zijn. Vroegtijdige waarschuwingen, onbedoelde gevolgen en controle zijn slechts enkele van de manieren waarop verantwoordelijkheid *belangrijk is gemaakt* als het gaat om het praten over onderzoek en innovatie. Ideeën rond RRI zijn bijvoorbeeld gebaseerd op het idee dat als we proberen te anticiperen op de effecten van onderzoek en innovatie, we vroegtijdig kunnen waarschuwen voor mogelijke onbedoelde gevolgen. Dat betekent dat we kunnen proberen controlemechanismen in te stellen, zoals nieuw beleid en wetgeving. De vraag die ik in dit proefschrift stel is dan ook: *hoe zijn verschillende ideeën over verantwoordelijkheid belangrijk gemaakt binnen gesprekken/discussies over onderzoek en innovatie?*

Tegenwoordig wordt veel nagedacht over de vraag hoe sterk verantwoordelijkheid van belang is met betrekking tot zowel de processen als de maatschappelijke gevolgen van technologische verandering. Binnen de onderzoeksector zijn gedragscodes en ethische commissies gemeengoed geworden. Dat geldt ook voor verschillende criteria voor de financiering van onderzoek. Zo wordt van onderzoekers regelmatig verlangd dat zij een interdisciplinair perspectief in hun probleemstelling opnemen; dat zij de verwachte impact van hun onderzoek aantonen; dat zij diverse belanghebbenden bij het gehele onderzoeks- en ontwikkelingsproces betrekken; en dat zij een of andere vorm van ethische goedkeuring verkrijgen. De financiering van onderzoek wordt ook vaak georganiseerd rond bepaalde thema's of aandachtsgebieden, zoals bijvoorbeeld de 'Sustainable Development Goals' (doelstellingen voor duurzame ontwikkelingen) van de Verenigde Naties. Tegenwoordig vallen al deze inspanningen onder de brede noemer van 'Responsible Innovation' (RI, verantwoorde innovatie).

Sinds ongeveer 2010 zijn RI en RRI zowel voor academici als beleidsmakers populaire manieren geworden om kwesties omtrent verantwoordelijkheid in te kaderen.[1] Internationaal is de aandacht voor deze discoursen in de laatste tien jaar sterk toegenomen. Onderzoeksraden in Nederland, het Verenigd Koninkrijk en Noorwegen hebben bijvoorbeeld hun eigen RI-programma's en beleid geïmplementeerd of uitgebreid. In de Verenigde Staten heeft de National Science Foundation financiering verstrekt voor een wereldwijd virtueel instituut voor RI, dat in 2013 is opgericht. Daarnaast is in 2014 het Journal in Responsible Innovation gelanceerd. Dit heeft geleid tot verschillende bijeenkomsten, onderzoeksgroepen, projecten en netwerken omtrent de conceptualisering en institutionalisering van R(R)I. Hoewel de R(R)I-gemeenschap de afgelopen jaren is blijven groeien, is ook de bezorgdheid over de teloorgang van R(R)I binnen het Europese financieringsbeleid toegenomen. Deze bezorgdheid weerspiegelt de groeiende onzekerheid binnen de R(R)I-gemeenschap, die is ontstaan door het verlies van R(R)I als een

[1] Zoals besproken in hoofdstuk 1, gebruik ik het acroniem R(R)I om naar beide discoursen tegelijk te verwijzen, hoewel ik erken dat er een belangrijk onderscheid moet worden gemaakt.

horizontale pijler van het Europese kaderprogramma Horizon2020, dat in zijn huidige versie, Horizon Europe, de focus heeft verlegd naar 'Open Science' en 'Open Innovation'. Gezien de onzekerheid over de toekomst van R(R)I biedt het huidige moment een geschikte gelegenheid voor de gemeenschap om na te denken over hoe het nu verder moet met R(R)I. Zoals ik in dit proefschrift echter duidelijk maak, is het belangrijk te erkennen dat R(R)I, als een manier om verantwoordelijkheid te zien, niet altijd al een belangrijke zaak was voor academici en beleidsmakers. Integendeel, R(R)I is ontstaan als een historisch gesitueerd proces dat door meerdere voorgangers werd gevormd. Als gevolg daarvan is er niet één enkele oorsprongsgeschiedenis van R(R)I. In plaats daarvan is de geschiedenis van R(R)I een verzameling van mensen, plaatsen en praktijken waarmee ideeën over verantwoordelijkheid in de loop der tijd zijn gevormd. Door aandacht te schenken aan de manier waarop verschillende visies op verantwoordelijkheid—op verschillende momenten en op verschillende plaatsen—hun betekenis hebben gekregen, worden we eraan herinnerd dat R(R)I *ook anders had kunnen zijn.*

Zoals ik in hoofdstuk 1 bespreek, legt R(R)I vaak de nadruk op het belang van reflexiviteit. Toch is er weinig reflectie geweest op hoe actoren in het veld tot hun eigen opvattingen en posities zijn gekomen. Uiteindelijk is dit echter een noodzakelijke stap om aan de eis van reflexiviteit te voldoen. Dit soort reflexiviteit houdt in dat de *meerdere versies* van de geschiedenis van het veld worden erkend, niet alleen die *al verteld worden*, maar ook die *mogelijk* verteld zouden kunnen worden. Dit alles wil zeggen dat er een belangrijke maar *tot nu toe* verwaarloosde rol is weggelegd voor historische analyses als het gaat om het nadenken over de toekomst van R(R)I. De geschiedenis is daarom een belangrijke lens waardoor we kunnen proberen te begrijpen hoe en waarom bepaalde visies op verantwoordelijkheid in de loop van de tijd op verschillende manieren in het publieke en academische debat zijn verschenen en weer verdwenen. Dit vereist om verder te gaan dan de directe ervaring en kennis van de leden van de R(R)I-gemeenschap zelf om te begrijpen hoe R(R)I is ontstaan. Er moeten namelijk ook vragen worden gesteld over dominante verhalen, en over hoe die op verschillende momenten relevant werden gemaakt en werden gemobiliseerd voor verschillende doeleinden.

Ik beschouw R(R)I als een wetenschappelijke/intellectuele beweging ('scientific/intellectual movement'—SIM). Volgens Scott Frickel en Neil Gross (2005) hebben zulke bewegingen over het algemeen een soort samenhangend intellectueel programma; weerspiegelen ze een zekere mate van verdeeldheid; zijn ze inherent politiek; vereisen ze collectieve actie; zijn ze episodisch; en kunnen ze in intellectueel bereik variëren van ambitieus tot bescheiden en van progressief tot reactionair.[2] Tot op heden concentreert het meeste werk over intellectuele bewegingen zich op hoe ze ontstaan, hoe ze zich consolideren en hoe ze zich ontwikkelen. Door R(R)I als een intellectuele beweging te beschouwen, kan ik inzoomen op voorafgaande bewegingen en de aandacht vestigen op de acties van intellectuelen van de beweging, het bestaan van geschikte structurele voorwaarden, de creatie van micro-mobilisatie omgevingen, evenals de 'framing' van de ideeën van de beweging. Met betrekking tot de overkoepelende vraag van dit proefschrift, over hoe verschillende opvattingen van verantwoordelijkheid belangrijk zijn gemaakt, ben ik echter niet alleen geïnteresseerd in hoe de antecedenten van R(R)I zijn ontstaan en zich hebben ontwikkeld, maar ook in hun gevolgen of effecten in de loop van de tijd. Dat wil zeggen: in hoeverre kunnen we zeggen dat antecedenten

[2] 2 Scott Frickel and Neil Gross, "A General Theory of Scientific/Intellectual Movements," *American Sociological Review* 70, no. 2 (2005): 204-232.

van R(R)I zijn getransformeerd tot stabielere, meer geïnstitutionaliseerde vormen? Ik stel dat het begrijpen van R(R)I als een intellectuele beweging uitnodigt tot een andere manier van kijken naar de geschiedenis ervan. Het helpt onze aandacht te vestigen op de lange termijn impact en effecten die verschillende bewegingen kunnen hebben.

Op basis van archiefonderzoek en kwalitatieve interviews zoom ik, in de hoofdstukken 2, 3 en 4, in op de activiteiten van de bewegingen in de jaren '60 en '70. Ik richt me in het bijzonder op de vorming van programma's in 'Science and Technology Studies' (STS), de oprichting en ontwikkeling van 'Technology Assessment' (TA), en een bredere verschuiving in de publieke opinie naar de waarde van meer participatieve vormen van betrokkenheid, zoals die bijvoorbeeld tot uiting komt in de 'Appropriate Technology' (AT). Ik stel dat we binnen elk van deze bewegingen ideeën kunnen traceren die sindsdien centraal zijn komen te staan op de agenda van R(R)I vandaag de dag.

Met betrekking tot het ordenen van dit proefschrift heb ik ervoor gekozen om de opzet te volgen van Al Teich's Technology and the Future, voor het eerst gepubliceerd in 1972. In het derde deel ordent Teich een aantal canonieke lezingen uit de jaren 1960 en 1970 in 3 delen: Deel 1, 'Thinking about Technology'; deel 2 'Forecasting, Assessing, and Controlling Technology', en deel 3 'Reshaping Technology'.[3] Hoewel ik STS, TA en AT identificeer als behorend tot elk van deze drie categorieën afzonderlijk, laat ik zien hoe de convergenties tussen deze categorieën lijken te zijn vergemakkelijkt door een netwerk van mensen die vaak en min of meer vloeiend tussen deze categorieën heen en weer liepen. Vanuit het oogpunt van vandaag zou het kunnen lijken alsof de mensen achter deze inspanningen heel uitgesproken opvattingen hadden over de relatie tussen technologie en politiek, en deze ideeën op heel verschillende manieren in praktijk brachten. Deze zienswijze sluit nauw aan bij de historiografie van wetenschap en technologie in de jaren zeventig, die zich heeft geconcentreerd op individuen en groepen met uitgesproken opvattingen. Door een microhistorische lens te hanteren en in te zoomen op de beginjaren, rond 1970 en daarvoor, laat ik echter zien dat de kruisbestuivingen tussen deze groepen mogelijk werden gemaakt door de katalyserende aanwezigheid van individuen met zeer ambivalente opvattingen. Daarom kom ik in alle drie de hoofdstukken herhaaldelijk terug op het begrip ambivalentie, en onderzoek ik de verschillende rollen die het kan spelen bij het ontstaan, de ontwikkeling en de impact van intellectuele bewegingen.

In navolging van Teich traceer ik in hoofdstuk 2 de opkomst van een intellectuele beweging die zich bezighield met 'het denken over technologie', waarbij ik kijk naar proto-STS programma's in de jaren zestig - in het bijzonder het Columbia Seminar on Technology and Social Change (T&SC) - en vraag me af: *wat voor soort kwesties hebben proto-STS programma's op de agenda helpen zetten?* Zoals ik in hoofdstuk 1 bespreek, is de geschiedenis van R(R)I onlosmakelijk verbonden met de geschiedenis van STS, en STS-geleerden maken nog steeds een belangrijk deel uit van de R(R)I-gemeenschap. Van het onderzoeken van technisch-wetenschappelijke processen als dynamische sociale praktijken tot het anticiperen op onbedoelde of ongewenste gevolgen: STS-wetenschappers hebben ruwweg vijftig jaar lang geprobeerd om verantwoordelijkheid binnen onderzoek en innovatie een rol te laten spelen. Mijn belangstelling voor het T&SC-seminar is dan ook drieledig. Ten eerste is het T&SC-seminar een vroeg en tot nu toe over het hoofd gezien onderdeel van de geschiedenis van STS. Het is een voorbeeld van een interdisciplinair, probleemgeoriënteerd forum dat dialoog en interactie mogelijk wilde maken

[3] Albert H. Teich, *Technology and Man's Future* (New York: St. Martin's Press, 1981).

over de relatie tussen technologie en sociale verandering—allemaal nog steeds cruciale kenmerken van hedendaagse R(R)I. Ten tweede, in tegenstelling tot de oorsprongsverhalen over STS en R(R)I waarin hun ontwikkeling vaak wordt voorgesteld als een enigszins radicale afwijking van bestaande posities en praktijken, biedt het netwerk dat het T&SC-seminar hielp creëren een inkijkje in een alternatief narratief over STS en R(R)I, wat vaak over het hoofd werd gezien. De focus op het T&SC-seminar brengt de rol van meer ambivalente actoren—of *bruggenbouwers*—op de voorgrond. Deze bruggenbouwers stapten ofwel zelf uit STS, ofwel werden gedwongen uit STS te stappen toen het een steeds meer geprofessionaliseerd academisch veld werd. Ten derde leidt het beschouwen van het T&SC-seminar als een intellectuele beweging ertoe dat er meer aandacht is voor het seminar als voorbeeld van een collectieve inspanning die in de jaren zestig in de VS met succes de relaties tussen technologie en samenleving op de agenda heeft gezet, waardoor verantwoordelijkheid een rol ging spelen op een manier die in de loop van de jaren zeventig en tachtig internationaal door STS-programma's zou worden opgepakt.

In hoofdstuk 3 richt ik mijn aandacht op de opkomst van TA als een intellectuele stroming die zich bezighoudt met het 'voorspellen, beoordelen en controleren van technologie'. In dit geval richt ik mij met name op het decennium dat voorafging aan de oprichting van het 'Office of Technology Assessment (OTA)' in de VS in 1972 en het soort discussies en debatten dat plaatsvond over wat TA zou kunnen of moeten zijn. De belangrijkste vraag in dit hoofdstuk is dan ook: *wat was TA vóór de OTA?* In dit hoofdstuk onderzoek ik daarom in de eerste plaats de ideeën over TA toen deze nog in ontwikkeling was. Echter, in plaats van me uitsluitend te richten op de ontwikkeling van de TA-wetgeving—die uiteindelijk resulteerde in de oprichting van de OTA—onderzoek ik ook de manieren waarop TA in bredere zin werd gezien als een manier om technologische verandering meer verantwoord te maken. Ten tweede, in tegenstelling tot de verschillende versies van de geschiedenis van TA en R(R)I die typisch uitgaan van de veronderstelling dat 'klassieke TA' top-down en conceptueel beperkt was, toon ik aan hoe meervoudige, soms tegenstrijdige, idealen en visies wel degelijk gemeengoed waren in de jaren vóór de OTA. Hier, anders dan de rol van ambivalentie in de mogelijkheden voor actie (hoofdstuk 2), stel ik dat ambivalente opvattingen gediend lijken te hebben als een succesvolle 'framing'—strategie die het mogelijk maakte steun te verwerven van een verscheidenheid aan verschillende belanghebbenden. Door TA te benaderen als een intellectuele beweging denk ik tenslotte ook na over de relatie tussen intellectuele bewegingen en institutionele verandering. Daarbij tracht ik aan te tonen hoe de totstandkoming van de OTA in 1972 afhankelijk was van jaren van institutioneel werk door mensen als Emilio Daddario, lid van het Huis van Afgevaardigden namens de Democratische Partij, alsook van de opkomst van een bredere TA-beweging die zowel vormgaf aan als gevormd werd door de succesvolle institutionalisering van TA bij de OTA.

In hoofdstuk 4 concentreer ik me op de AT beweging als een intellectuele beweging die zich toelegde op het 'opnieuw vormgeven van technologie', waarbij ik onderzoek hoe verschillende benaderingen werden gekozen door verschillende groepen binnen de beweging. Ik laat zien dat waar sommigen probeerden kleine hervormingen door te voeren door internationale technische ondersteuning te bieden aan hen die hulp nodig hadden, anderen AT zagen als een manier waarop men technologische verandering kon heruitvinden met prioriteit voor maatschappelijke behoeften en menselijke waarden. Van de drie bewegingen is AT de enige die tot op heden niet aan bod komt in de vertelde versies van de geschiedenis van R(R)I. Daarom vraag ik me in dit hoofdstuk af: *als we AT beschouwen vanuit een perspectief dat zich uitstrekt voor en na de* *gebruikelijke eindpunten van de beweging (waarmee de meeste beschouwers werken), wat kunnen we daaruit leren?* Ik begin met te kijken naar de activiteiten van twee van de pioniersorganisaties van AT, de Volunteers for Technical Assistance (VITA) en de Intermediate Technology Development Group (ITDG) en stel dat drie strategieën de kern van hun succes bepaalden. Ten eerste, aangezien hun voornaamste doel het verlenen van technische bijstand aan mensen in nood was, zagen beide groepen al snel in dat de steun van interdisciplinaire teams nodig was om adequaat te reageren op problemen. Ten tweede vertrouwden beide groepen sterk op de steun van mensen met een hoge status. Deze mensen maakten deel uit van sterke communicatienetwerken die met elkaar verbonden waren via overlappende organisatie-eenheden, vriendschappen, vergaderingen en conferenties. Ten derde waren beide groepen actief betrokken bij universiteiten. Ze droegen zo bij aan de verspreiding van onderzoek naar en onderwijsprojecten gebaseerd op AT. Zoals ik laat zien in de rest van het hoofdstuk, maakte het succes van deze drie strategieën uiteindelijk de oprichting van internationale infrastructuren voor AT mogelijk. Waar ik in de voorgaande twee hoofdstukken benadruk hoe ambivalente opvattingen mogelijkheden bieden voor actie, en het mogelijk maakt om brede steun te verwerven, stel ik in hoofdstuk 4 dat ambivalentie ook verkeerd kan worden geïnterpreteerd als irrelevantie, omdat ambivalentie vaak niet gemeten en derhalve niet gedetecteerd wordt. Het gevolg hiervan is dat historische vertellingen veelal diegenen te bevoordelen die duidelijke en uitgesproken standpunten hadden. Ik stel dat in het geval van AT het soort ambivalentie dat inherent lijkt te zijn geweest aan de beweging misschien een verklaring is voor het feit dat ze nog steeds niet serieus wordt beschouwd als een relevant onderdeel van de geschiedenis van R(R)I. Dit ondanks het feit dat AT belangrijke bijdragen heeft geleverd om verantwoordelijkheid belangrijk te maken in het denken over zowel het *proces* als de *gevolgen* van technologische verandering.

Alle drie de hoofdstukken volgen een gelijksoortige verhaallijn. Ik begin met het schetsen van de context en het stellen van de specifieke onderzoeksvraag met betrekking tot respectievelijk STS, TA en AT. Daarna ga ik kort in op de geschiedschrijving van elke ontwikkeling, alvorens in te zoomen op individuen, gemeenschappen en gebeurtenissen om te laten zien hoe verantwoordelijkheid op verschillende manieren en op verschillende plaatsen belangrijk werd gemaakt. Ik eindig elk hoofdstuk met een terugblik. Hierin beschrijf ik hoe wat op de ene plaats belangrijk werd gevonden mogelijk vorm heeft gegeven aan wat elders belangrijk werd gevonden. Ook beschrijf ik hoe 'het belangrijke' zich verspreidde en wel of niet werd opgepikt in verschillende contexten. In het laatste hoofdstuk kom ik terug bij de hoofdvraag van het onderzoek, en reflecteer ik op wat de voorafgaande intellectuele bewegingen van R(R)I ons vertellen over de trajecten van intellectuele bewegingen. Ik pleit er hier ook voor om ambivalentie te beschouwen als een conceptueel hulpmiddel, een methodologische heuristiek en een intellectuele deugd.

Hoewel STS, TA en AT fundamenteel verschillende benaderingen waren, kwamen ze allemaal naar voren als antwoorden op de veranderende relatie tussen technologie en de samenleving in de jaren '60 en '70. Door dit proefschrift heen beargumenteer ik daarom dat het opnieuw bekijken van de geschiedenis van R(R)I de aandacht vestigt op verwaarloosde of over het hoofd geziene ontwikkelingen die ook een belangrijk onderdeel vormen van de verhalen die algemeen worden beschouwd als centraal in de evolutie van R(R)I—waarbinnen reflectie een vereiste is. Ik betoog ook dat R(R)I kan worden gezien als een erfenis van verschillende intellectuele bewegingen die in de jaren zestig opkwamen. Deze bewegingen omvatten zowel wat wordt beschouwd als de meer expliciet politieke en responsieve tak van STS (betreffende de meer expliciete normatieve betrokkenheid) als zijn relatie tot beleidsvorming, onderwijs en de burgermaatschappij. Zij omvatten ook de TA-beweging, die, zoals ik laat zien, veel verder reikte dan de eenvoudige notie van 'klassieke TA' of het aanvankelijke bereik van OTA. Binnen de TA-beweging werd op congressen en in workshops uitvoerig gediscussieerd en onderhandeld over de doelstellingen van TA, en over de voor- en nadelen van publieksparticipatie. Hoewel AT van de drie misschien het meest wordt beschouwd als een traditionele sociale beweging, was AT toch verre van traditioneel in die zin dat AT, in tegenstelling tot bewegingen tegen de atoomoorlog of de aantasting van het milieu (die ook vroege STS-geleerden beïnvloedden), zelden boycots of marsen organiseerde. In plaats daarvan spiegelde AT zich aan organisaties als VITA en ITDG, die kennis en expertise deelden door het publiceren van pamfletten, informatiebladen en 'hoe moet het' instructies, en deze zo wijd mogelijk beschikbaar maakten door het creëren van uitgebreide informele netwerken.

De bewegingen die ik in dit proefschrift heb samengebracht, zijn vaak ruwweg gekarakteriseerd als groepen technocraten en 'tech-fixers' aan de ene kant en idealisten en 'hippies' aan de andere kant. Mijn analyse toont echter aan dat veel (zo niet de meeste) van de betrokken actoren ergens in het midden zaten - niet anders dan velen die vandaag binnen R(R)I werken. Inderdaad, zoals ik aantoon, maakten vele van de betrokkenen deel uit van meerdere bewegingen, wat aantoont dat bewegingen die verschillend lijken, in feite vaak diep verstrengeld waren. Dit doet de vraag rijzen of hetzelfde gezegd kan worden van R(R)I vandaag; zijn er verbanden tussen R(R)I en andere bewegingen die zich op vergelijkbare wijze richten op het transformeren van de analyse, evaluatie en praktijken van technologische verandering? Zo ja, hoe kunnen de praktijken en strategieën van deze bewegingen de R(R)I gemeenschap inspireren als het gaat om het verbeelden van de toekomst?

Het is belangrijk voor de R(R)I gemeenschap om zich kritisch bezig te houden met dergelijke vragen, vooral zolang de toekomst onzeker blijft. Uiteindelijk probeer ik in dit proefschrift de aandacht te vestigen op de impact van technologiebewegingen in de jaren '60 en '70 die vandaag nog steeds doorklinken binnen R(R)I. Ik stel dat meer aandacht voor het soort verwaarloosde versies van de geschiedenis dat ik bespreek een verrijking voor R(R)I zou kunnen zijn, een dieper begrip mogelijk zou maken van hoe en waarom R(R)I is ontstaan, en ons zou kunnen aanzetten om na te denken over de manieren waarop ons denken over mogelijke toekomstige werelden wordt beperkt of mogelijk gemaakt door de manieren waarop verschillende versies van de geschiedenis worden verteld. Door minder bekende versies van de geschiedenis van R(R)I op de voorgrond te plaatsen beargumenteer ik dat de interpretatieve rijkdom die een empirische historische analyse biedt waardevolle inzichten kan en moet verschaffen nu we beginnen na te denken over waar R(R)I nu naartoe gaat. In die zin kan de verkenning van de verbanden tussen R(R)I en technologiebewegingen uit de jaren '60 en '70 helpen om R(R)I op een creatieve manier te herdefiniëren nu het tijd is om zorgvuldig na te denken over zijn mogelijke toekomst(en).

About the Author

Dani Shanley (Guildford, 1988) studied a BA in Arts & Culture (cum laude) at Maastricht University (the Netherlands). Staying in Maastricht, she conducted her MSc in Cultures of Art, Science, and Technology (cum laude), during which she carried out a research internship at Stellenbosh University (South Africa) and acted as the program's student representative. Between 2015 and 2017 she was employed by the philosophy department at the Faculty of Arts and Social Sciences at Maastricht University as a teaching fellow, before starting her PhD trajectory in the history department. As part of her PhD work, she was enrolled in the graduate training program of the Netherlands Graduate School of Science, Technology, and Modern Culture (WTMC). Between 2018 and 2020, Dani also served as the PhD representative of the faculty. During the course of her PhD, she was a member of the Centre for Ethics & Politics of Emerging Technology (EPET) as well as the Sociey for the History of Technology (SHOT) and the Society for Social Studies of Science (4S). In 2022 she has taken up a post-doctoral position back in the philosophy department at the Faculty of Arts & Social Sciences at Maastricht University, where she is exploring ethical issues that emerge within immersive virtual envrionments.

Around the turn of the millennium, as responsibility became an increasingly important concept in relation to research and innovation within both policy and academic discourse, responsibility was largely framed as a new and emerging matter of concern. 'Responsible Innovation' and 'Responsible Research and Innovation' quickly became popular ways of talking about responsibility-related issues for policy-makers and academics alike. Yet clearly, responsibility has meant different things to different people for a very long time and contemporary ideas surrounding responsibility within research and innovation did not emerge out of nowhere; rather, they are part of a long history within which different ways of understanding responsibility have been made to matter.

This book treats 'Responsible Innovation' as an intellectual movement. It zooms in on the emergence, development, outcomes and consequences of antecedent movements in order to show how making responsibility matter within research and innovation often means attempting to strike a balance between opportunity and need, evolution and revolution, continuity and change. It argues that at a time when our world is confronted by numerous inescapable societal and environmental challenges, many of which are seen as the indirect consequences of scientific and technological developments, it is essential that we continue thinking about the different ways in which responsibility matters.