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Making & Doing

Activating STS through Knowledge Expression and Travel

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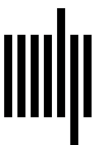
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INTRODUCTION

Activating STS through STS Sensibilities

Gary Lee Downey and Teun Zuiderent-Jerak

Scholarship in Science and Technology Studies (STS) has frequently built on critiques of the linear model of creation, diffusion, and utilization. Developing alternate accounts, STS researchers have shown that sciences and technologies always develop in specific settings and that myriad agents and agencies participate in their production, expression, and travel. With repeated studies showing how the development, materialization, and utilization of the facts and artifacts under examination were entwined right from the start, it is no surprise that many STS scholars have cultivated practices to turn STS lessons about nonlinearity onto their own work.

The most visible practices have involved research. Some concentrate attention on the academic paper or book, exploring how STS publications might respond to unforeseen uses and reactions beyond the boundaries of the field or be framed to produce desirable outcomes.¹ Other practices open up the taken-for-granted relation between knowledge production and publication of the academic paper or book to call attention to emerging and potential configurations of *knowledge expression* (Bowker 2011) that extend beyond them. Along with early experiments with alternative literary forms for performing STS knowledge (Ashmore 1989; Ashmore, Myers, and Potter 1995), interrogating relations between knowledge expression and knowledge production has expanded to include collaborating with practices in design, digital studies, and indigenous art (Calvert and Schyfter 2017; Vertesi et al. 2019; Watson-Verran, the Yolngu Community at Yirrkala, and Chambers 1989) and experimenting with a range of material enactments in both performing and producing STS knowledges (Latour and Weibel 2005; Law and Urry 2004; Lezaun, Narres, and Tironi 2017; Lury and Wakeford 2012; Marres, Guggenheim, and Wilkie 2018; Zuiderent-Jerak 2015). Via findings about the nonlinearity of knowledge development and the materiality of scholarly practices, STS research has increasingly embraced challenges to explore how its own forms of knowledge have been and might be expressed.

Alongside research, STS has also long provided intellectual and institutional space for scholarly projects that explore novel practices for achieving *knowledge travel* into empirical fields in consequential ways. Such projects often have not made their way into publications or other scholarly venues that traditionally express STS research.² Yet by insisting in STS-informed terms that the explicitly nonlinear work in making knowledge travel is scholarship, too, they challenge and expand the boundary around the notion and practices of STS scholarship itself (Downey 2009; Zuiderent-Jerak 2015). The number, contents, and scope of such projects have expanded as STS scholars increasingly extended their investigative and experimental work to include the trajectories of STS knowledge flows beyond the boundaries of the field. Calling heightened attention to relations between knowledge expression and knowledge travel, they complement and, sometimes, overlap with research initiatives that elaborate relations between knowledge production and knowledge expression.

One outcome of these scholarly interests in turning STS lessons onto STS work has been the rise of *STS making & doing* as a collective label for projects that expand STS scholarship by adding attention to both knowledge expression and knowledge travel alongside dominant commitments to knowledge production (Downey and Zuiderent-Jerak 2017; Wylie, Shapiro, and Liboiron 2017).³ Initially, interest in promoting any and all scholarly projects that extend beyond the academic article or book justified piloting a program of STS Making & Doing at annual meetings of the Society for Social Studies of Science (4S). Energetic participation in the first program, combined with the multiplication of related initiatives across STS and STS-affiliated organizations, expanded scholarly attention from making visible nonlinear scholarly projects to critically examining how STS scholarship of all sorts grapples with issues of knowledge expression and knowledge travel beyond the boundaries of the field. After all, the expression and travel of STS knowledge even through academic texts involves practices of making & doing that exceed simple diffusion and utilization (Guggenheim 2015). This volume extends the STS Making & Doing program by experimenting with narrative demonstrations and interpretive accounts of individual projects, examining and reflecting on what happens when STS scholarship actively entwines knowledge expression and travel with knowledge production.⁴

The purpose of this book is to explore how STS making & doing projects contribute to and advance STS scholarship. In ten *demo accounts*, contributors both present and critically assess how their projects express STS knowledge and seek to effect its travel into empirical arenas beyond the boundaries of the field, as they understand it. In the process, these demo accounts attend simultaneously to the engagement of actors and practices in fields of STS work and to reflexive learning from those actors and practices. Contributing authors generously accepted a difficult challenge to critically account for both what happens when their projects seek to inflect understandings and actions in empirical arenas through STS learning and how they themselves learn from their interlocutors and the settings in which they do and share their STS

work. The resulting collection thus adds to ongoing initiatives that turn STS lessons onto STS work by exploring and documenting how diverse, and sometimes divergent, STS projects express and enact two-way, or multiple-way, flows of STS knowledge. Together, these demo accounts show that STS making & doing projects contribute to and advance STS scholarship precisely by expanding it to include practices of knowledge expression and knowledge travel.

CURATING OPENNESS, FOLLOWING OVERLAPS

How might differently positioned scholars write their projects in STS making & doing? We were uncertain at the outset. We had previously observed that scholarly initiatives in STS making & doing appear as multiple as STS is as a whole (Downey and Zuiderent-Jerak 2017). It was clearly incumbent on us not to try to capture these projects in some holistic way, claiming and attempting to cage in advance a multiplicity that we actually want to document, highlight, and further stimulate.

We did know that we wanted the demo accounts to be grounded in empirical cases so that readers could experience and recognize the terms and complexities of a given project in STS making & doing, including its passions, commitments, struggles, and pathways of travel. At the same time, we resisted the notion that narratives of STS making & doing have to include rhetorical techniques or literary forms that are as experimental as the projects they present. We did not want to presume that existing modes of scholarly writing and analysis are not adequate to both demonstrate and account for practices that perform the scholarship of STS making & doing. Decisions about narrative elements and structure had to be made by contributors themselves.

We did anticipate, correctly as it turned out, that contributors would find it important to write in the first person. Nonlinear projects in STS making & doing tend to position specific scholars in specific empirical fields. When one is demoing and reporting on relations between knowledge expression and travel, it rarely makes sense to imagine and construct an anonymous maker and doer, and it can be problematic to do so. It can risk stripping the project of specificities in the practices of knowledge expression and travel that may prove crucial to the scholarly import of those practices.⁵

At the same time, we did expect that the challenges involved in producing first-person versions and accounts could prove discomfiting to authors, including ourselves. In particular, every demo account confronts what emerged as a recurring issue: how might first-person STS demo accounts critically examine relations between knowledge expression and knowledge travel without degenerating into self-promoting autobiography that falls outside of STS scholarship entirely? Not an easy task. We asked contributors to include their dilemmas, frustrations, and failures, especially when these generated new practices that might not have occurred had their work not taken the form of making & doing scholarship.

We started the project by soliciting interest and an “abstract/summary/outline” from self-identified STS scholars whose work spanned a range of topics and territories and appeared to intersect with the threefold aim of “making STS knowledge and expertise travel to new areas, . . . producing and expressing STS knowledge and expertise in novel ways, and . . . reflexively furthering learning and theory development within STS.”⁶ The invitations included the terms “expression” and “travel” but without definition or elaboration. We had previously used these terms as signposts at 4S conferences, a joint conference of EASST (European Association for the Study of Science and Technology) and 4S, and in a chapter of the *Handbook of Science and Technology Studies* (Downey and Zuiderent-Jerak 2017) to call attention to flows of STS knowledge beyond the boundaries of the field (see also Downey 2014, 2015; Downey and Zuiderent-Jerak 2016). In addition, without defining STS, we did look for relatively developed projects that address simultaneously the knowledge, or technical, dimensions of issues involving science, technology, and medicine and the social, or nontechnical, dimensions, as these are conventionally understood.⁷ Asking contributors to work through empirical case material “to a maximum extent,” our guidelines for draft manuscripts emphasized attending to flows of learning, “including (or even especially) learning by the STS scholars involved.”

Contributors directly encountered one another’s projects by reviewing two other demo accounts and, sometimes, sharing manuscripts. We designed an iterative internal review process to enable contributors to take stock of the scholarly trajectories in other projects while articulating their own. The review process was necessarily open (i.e., not anonymized). We asked contributors to imagine themselves in conversation with an author or authors who could not respond.⁸ Their first charge was to articulate how a project “construe[s] and enact[s]” scholarly practices of STS making & doing, focusing in particular on what makes the project “especially compelling.” Contributors then had to explain limitations or outstanding issues by “taking care to include specific suggestions about how to address them.” By effectively transforming each contributor into a coauthor of two other demo accounts, this step helped all to reflect on the framing and positioning of their own. It also invited them into the editorial process of balancing the acknowledgment and presentation of divergent multiplicity with analysis of parallels and overlaps.

A realization that the relationship between knowledge expression and knowledge travel could serve as more than a signpost for scholarly contributions in STS making & doing emerged indirectly, but clearly, while we curated the initial draft demo accounts and subsequent review process. In the first place, we were surprised to see contributors almost invariably position their projects outside of and, at times, in opposition to an assumed mainstream of STS scholarship. Although mostly unspecified, this mainstream of “safe” scholarship consists of empirical inquiry, formal theorizing, and publication in academic journals and books.

To us and, ultimately, to contributors, this outside was but another inside of STS scholarship. Perhaps the shared sense of exclusion or marginalization was actually instructive. In reviews, contributors encouraged one another and, seemingly, themselves to trust that their “unsafe” projects are indeed making and doing STS scholarship and to accept the challenge of demonstrating and specifying how. The issues they identified in one another’s work took a significant step past guideposts. In particular, they included repeated suggestions to elaborate empirical interactions in the field, to clarify flows of STS knowledge, to position the STS scholar more explicitly in relation to the field, and to document learning both in the empirical field and by the STS scholar(s).

Drawing on the reviews, our requests for revisions challenged each contributor or team of contributors to elaborate the practices through which their project expresses STS knowledge and effects its travel into its empirical arena and to account for the sorts of practices that emerged as a result. As the ten final versions arrived, we inquired more specifically into how the specific practices enacted in each project (1) express STS knowledge for other audiences and settings, (2) produce travel for STS knowledge into and across the empirical field, (3) make the scholar visible in the scholarly practices, and (4) facilitate learning on the part of the STS scholar. As we reviewed answers to these questions, it became clear that each raises a distinct set of scholarly issues, addressed differently by different projects. At the same time, our commitment to curating openness and multiplicity also produced something of a surprise. We found all the projects to include practices that express STS knowledge through “STS sensibilities” and attach those sensibilities to practices in empirical fields.

1. EXPRESSING KNOWLEDGE THROUGH STS SENSIBILITIES

In introducing STS making & doing through our chapter in the 2017 *Handbook of Science and Technology Studies* (Downey and Zuiderent-Jerak 2017, 227), we identified “Techniques, Devices, and Infrastructures” as elements of STS engagement that respond to *frictions* (Kember 2003) encountered in the field and perform alternate images through STS knowledge and identities. As we watched the manuscripts in this volume emerge, we were so struck by the recurring appearance and critical performance of STS-inspired techniques, devices, and infrastructures that we began to call them STS practices themselves. They are what STS scholars make and do as they express STS knowledge for other audiences and settings.

Every project in this collection identifies in STS terms one or more frictions to which it responds. These frictions are places and practices where dominant images of science and technology lose their smoothness and become multiple. A courtroom encloses science solely in the figure of the expert witness, excluding victims.

Self-trackers lack ways to question and reflect critically on the data they produce. Bureaucratic procedures that create the academic migrant as a statistical category leave out asylum seekers. Market-oriented governmental policies in science and technology tend to omit the users of research results. Public debates on technoscientific issues take place on a large scale in social media but get left out of governance procedures. Fish laboratories focus narrowly on some obligations while ignoring many others. Hospital evaluation and improvement practices emphasize innovation through external consultants who miss important knowledge on-site. Initiatives to decarbonize the electrical grid actually leave in place hydrocarbon infrastructures and supporting knowledge infrastructures. Evidence-based medicine is not attached exclusively to the randomized controlled trial. Learning engineering challenges students to divide their worlds into two parts, right and wrong.

Developing making & doing projects in the midst of frictions positions those frictions as pivot points between conventional STS knowledge production and initiatives that activate STS by including knowledge expression and travel. The questions and potential practices multiply as they gain directionality. Could this friction be about boundaries, subordination, demarcation, presupposition, invisibility, multiplicity, obligation, some combination of the above, something else, or what? Might a friction be stable or shifting? How does the way one approaches it open up or close down potentials to engage with its actors and practices? How might a potential project construe a friction, localize it, benefit from it, or alter it? By seeking to add STS knowledge, does a project aim to smooth, interrupt, displace, replace, introduce, reframe, keep open, or maximize a friction, or perhaps just get a localized setting to recognize a friction in the first place?

With some exceptions, these contributions include relatively few theoretical concepts or citations of research findings, making their connection to STS theory as it appears in academic articles and books seem relatively loose. Even the contribution by Michael Guggenheim, Judith Kröll, and Bernd Kräftner (demo account 3) which takes pains to position itself intellectually in relation to other ongoing work, describes its incubations as “allowing the logic of the project to destabilize STS methods and media so much that they are no longer recognizable as social research.” It would be difficult to describe these STS demo accounts as applying or otherwise prioritizing formal theory from STS research through the practices they make, do, and provoke. Yet at the same time, it is equally clear that every project conveys STS knowledge. This knowledge appears in the techniques, devices, infrastructures, and versions of themselves and others that the scholars make and do in confronting the frictions they identify.

As STS practices, the techniques, devices, infrastructures, and selves in these projects express STS knowledge through forms designed to fit into or attach to the empirical fields to which they are added and become traceable. The demo accounts are filled with examples. Workers who become visible participants in a courtroom rather

than invisible observers. A software infrastructure that tries to stabilize the figure of a general end user who explores data. A public office in a shipping container that moves academic asylum seekers from marginal spaces to a central square. Local management desks in remote rural settings that enact sociotechnical alliances around water. Visualizations of data on public debates that travel fast when wrapped up as facts. A laboratory protocol that sees fish as food, political citizens, and grandmothers. A hospital infrastructure focused inward on existing strengths. Imaginative space that extends beyond detoxification. A working group that explores methods for appraising and including different knowledges in medical guidelines. An elective course shared via a teleconference.

We came to see these practices as enacting *STS sensibilities*, by which we mean observable instances of knowledge expression that enact STS knowledge contents but without necessary reference to their formal linguistic formulations. This is different from existing uses of the term “STS sensibility,” which tend to focus attention on the relations between STS knowledge expression and production (i.e., the practices and outcomes of research). John Law and Vicky Singleton suggest, for example, that ANT (Actor Network Theory) is “probably best understood as a sensibility,” which to them refers to “a set of empirical inferences in the world, a worldly practice, or a lively craft that . . . is created, recreated, explored, and tinkered within particular research practices” (2013, 485). When produced in research, or “knowledge-making” as the program committee for the 4S 2017 conference put it, STS sensibilities tend to become capabilities located in persons. The committee framed the conference theme “STS (In)Sensibilities” by positioning sensibility as “the ability to grasp and to respond” that is achieved, or not achieved, by “STS scholars, teachers, and activists” (Suchman et al. 2017, 5).

Quite differently, as these demo accounts repeatedly indicate, the scholarship of STS making & doing opens the aperture on STS sensibilities to direct attention to their prospective and actual material lives and trajectories beyond the boundaries of the field. Relevant scholarly questions expand to include exploring how practices that express STS sensibilities may or may not be responding to frictions encountered in the field. They also include following how those practices actually attach to ongoing knowledge practices in the empirical arena, or not. The analytic spotlight opens up to focus on those things and people inhabiting the empirical arena that take on challenges to integrate STS sensibilities with existing knowledge practices.

2. PRODUCING TRAVEL BY ATTACHING STS SENSIBILITIES

Our *Handbook* chapter, “Making and Doing: Engagement and Reflexive Learning in Science and Technology Studies,” describes the ecological dimensions of making & doing as consisting of audiences for STS learning—which may include partners, engaged practitioners, and those enacting STS sensibilities in the field—as well as

reflexive STS learning through feedback and reframing. Consider the early STS finding that knowledge developments in science and technology do not simply follow an internal technoscientific logic but are shaped by all kinds of dynamics and are thus nonlinear in their emergence and effects. This bit of STS knowledge joins settings beyond the boundaries of the field as an STS sensibility to the extent that the practices that carry it begin to interrupt appeals to linearity and introduce alternate dynamics. As nonlinear movement, expressing STS knowledge as STS sensibilities for other audiences quickly becomes quite complex, posing significant theoretical challenges. How does a scholar of STS making & doing frame this, or some other, knowledge claim via practices that may be admissible or taken for granted at gatherings of STS scholars but perhaps not easily elsewhere?⁹

Expressed through techniques, devices, infrastructures, and selves, the practices of STS making & doing *attach* STS sensibilities in empirical arenas. In this volume, the ten projects attach STS sensibilities to interrupt a knowledge hierarchy, elevate subordinated knowledge, reframe assumptions, make visible hidden knowledge, emphasize the obligations of the person in the scholar, highlight the social in technical materiality, perform the multiplicity in technical visions, make visible hidden knowers, recast calculation as sociotechnical infrastructure, and blur a boundary around certified knowledge. As one moves from project to project, it quickly becomes clear that each draws on a distinctive intellectual trajectory to frame and attach STS sensibilities.

Unless attached STS sensibilities are simply ignored, practices of STS making & doing provoke interactions and add relations that become sites and vehicles for extending STS learning. It is just that such learning often appears implicitly in subsequent actions, presupposing or performing STS sensibilities without reference to their academic origins. Some examples: surprised judges convert a cafeteria to an extension courtroom in which STS commentators flourish. The software infrastructure generates a miniature social arena that engineers are not equipped to organize. Academic asylum seekers agree that they should themselves serve as the carers of their module. The social development ministry and agricultural technology institute agree to form a public-public consortium to support a lab that enacts both. Politicians, municipal leaders, and union officials learn that teachers in one municipality are not united in their critique of the school reform. The university grants permission to dispose of fish guts as food rather than as hazardous waste. The surgeons and pathologists jointly develop a written template to describe the orientation of the specimen in the patient's breast. Leaders of the aerosolar balloon project withdraw the assignment to identify scientific payloads specifically for environmental justice advocates. The board of an international guidelines association founds a working group to appraise and include a wider set of knowledges than evidence from randomized controlled trials. Advocates of active learning for engineers make a move to locate culture within the technical practices of engineering.

The attachment of STS sensibilities thus produces travel for STS knowledge. The metaphor of travel for the flow of sensibilities and, hence, learning appeals because it suggests diverse trajectories with multiple starting points rather than emanations from a privileged scholarly core. It calls attention to movements with different temporalities and spatialities. It comes with companions, some of which you may end up liking more than you thought—or less. Better than “diffusion,” which imagines passive spread and appears to aim for uniform concentrations, “travel” calls attention to active transport through practices that are both distinct and traceable. Better than “impact,” which imagines an external force producing collision, “travel” can involve multiple agencies with multidirectional trajectories. The analysis of knowledge travel opens up generative questions of origin and destination, propulsion and resistance, with a call for specificity. Overall, the notion of knowledge travel helps make nonlinear modes of knowledge expression something to follow and trace with interest and critical attention.

At the same time, actually following attachments of STS sensibilities in empirical arenas adds complexities to the practices of STS scholarship by generating as many questions about the contents and implications of such attachments as there are trajectories of contact and flow. What do STS attachments add to an empirical setting? Subtract? Through what configurations of practices and relationships? What are key entry points for a given STS sensibility? How do STS sensibilities encounter and interact with other sensibilities that may be active in the setting or also seek activation? Through what relations does a project actually attach the scholar to the setting? With what implications for the project and the person? Do other attachment arenas appear open to these STS sensibilities?

These demo accounts illustrate how the travels of scholarly projects in STS making & doing can be uncertain and unpredictable, inviting research into their contingencies and possible alternate formations. We also see that practices of STS making & doing regularly attach to one another, inviting similar research into their relationships and possible alternate configurations. The directionalities of scholarly practices in STS making & doing matter because their specific movements make STS knowledge claims and insights become situated in distinctive and variable ways. We see in these demo accounts scholars repeatedly confronting variations of the questions “Where is the STS sensibility in this practice now, and what does it become in relation to what?” And “What other techniques, devices, infrastructures and selves might we/I try adding? And what do these practices mean for me, or us?”

3. ACCEPTING THE SCHOLAR'S VISIBILITY IN ATTACHING SENSIBILITIES

Adding a program with projects in STS making & doing to the annual meeting of the 4S generated a great deal of enthusiasm among presenters and attendees alike.

What could account for that? But wait: is even asking such a question, inquiring into the contents of scholarly enthusiasm, a violation of proper scholarly judgment and assessment? While reading the STS demo accounts in this book, you might find yourself coming away with an elevated sense of appreciation for STS scholars who have been working long and hard to devise and experiment with ways of expressing STS knowledge that have a chance of attaching to empirical arenas beyond the boundaries of the field. To us, enthusiasm for projects in STS making & doing feels quite similar to the excitement we can feel when encountering research literatures in STS that enable us to explore an issue in new ways and propel us to conduct research that might speak or contribute to those literatures. Yet there is a difference.

As a mode of scholarship, STS making & doing involves attending not only to what the scholar makes and does but also to how the scholar and the scholarship get made and done in the process. Most academic infrastructures endeavor to make scholars invisible (e.g., anonymous peer review). They do so incompletely. Expanding the notion and purview of STS scholarship to explicitly include STS scholars as persons calls attention to how they themselves embody and become vehicles for the travel of STS sensibilities. Relations between scholarly and other identities of the person become salient, along with the practices that perform them.¹⁰ Feminist studies have long undone the problematic split between scholar and person in the production of sciences and technologies (Faulkner 2007; Haraway 1991; Harding 1991; Keller 1993; Wajcman 1991). Growing commitments to care in STS research are undoing the masculinist treatment of objects of study and concern and calling new attention to relations between the figure of the knower and that of the known (Jerak-Zuiderent 2020; Martin, Myers, and Viseu 2015; Puig de la Bellacasa 2011, 2017; Russell and Vinsel 2016). STS making & doing adds to these scholarly moves by putting the body of the scholar directly on the line as that body endeavors to express and attach STS sensibilities.

Demonstrating and accounting for the visible presence of the scholar in the scholarship becomes one of the most vexing issues in STS making & doing. Beyond the situated positioning of standpoint, which has gained increased acceptance in scholarly writing, adding ourselves as persons to our demo accounts may risk undermining the intellectual value of the practices and learning they seek to offer. Blurring the boundary around one's scholar identity to acknowledge the presence and participation of other identities raises the fearsome prospect that the scholarship will dissipate and decline into personal opinion, idiosyncratic experience, or other non-STS practice. It might become *ad hominem* or *ad feminam*, about us rather than our object of study, producing the loss of both scholarship and scholars from a recently emerged field with still-vulnerable infrastructures. Even as we, as authors, want our work to be connected to our names, especially if this leads to acknowledgment through citations, we routinely strive to keep invisible our bodies and selves.¹¹ This boundary becomes porous in STS making & doing and, hence, in STS demo accounts. Indeed, those very

moments in which demo accounts reveal or perform commitment or aspiration, making them feel transgressive or otherwise unsafe, may also be providing insights into a key dimension of their scholarly import as practices of knowledge expression and travel.

The attachment or nonattachment of STS sensibilities in empirical arenas marks experiences infused with affective contents. Such contents provide significant indicators of meaning, indexing what STS sensibilities are or could be contributing to empirical arenas through the complexities of knowledge expression and travel. Affective contents indicate intensities of welcome or resistance, obstruction or encouragement. They reveal specificities in relations established or spurned and distance covered or remaining. Every demo account in this volume draws attention to some kind of affective content as they report building and rebuilding practices of knowledge expression and travel. In STS demo accounts, commitments—even or especially when speculative—are not extraneous, marginal, or otherwise supplemental to the scholarly contents of the work. They are core, constitutive, and central.

Consider Hsin-Hsing Chen yelling “Score!” as a commentator in the extended courtroom, or Yi-Ping Lin exclaiming excitedly that she had caught a foul ball (in demo account 1). Both moments call attention to inconsistencies in a court case that was designed to keep workers invisible. One way these scholars knew they were attaching STS sensibilities in the courtroom was that it felt good and, as such, worth the enormous personal investments involved. Their demo account makes clear that they judge themselves to be both authorized and compelled to report such experiences in an account of STS making & doing.

Dawn Nafus (demo account 2) asserts at the outset that she wanted to work hands on with code because “helping people work with data on their own terms mattered to me.” Adding herself to her text as person did not diminish the account by making it about her. Rather, it articulated the meaning of this initiative in STS knowledge expression and travel, helping us map and assess how and why she adopted the strategies she did, with what hopes, expectations, and consequences. Michael Guggenheim, Judith Kröll, and Bernd Kräftner (demo account 3) describe how the “humiliation” that academic asylum seekers experienced when marginalized on the job market is evidenced by certificates that are designed to perform visual officialdom but have become worthless. What does it mean, they ask reflexively, for a project whose practical logic is to make such asylum seekers visible, if that logic also has the effect of affirming the invisibility of those without certificates? Time and time again, Hernán Thomas, Lucas Becerra, and Paula Juarez (demo account 4) found their work proposal and action plans “fall outside the rationales of existing public institutions” that relied on linear or determinist thinking. It took five years of frustrating negotiations with all parties to get unanimous support. The authors compress into two words the bodily commitments and practices that, for them, transformed the meaning of research and identity of the researcher: “we persisted.”

Torben Jensen, Andreas Birkbak, Anders Madsen, and Anders Munk (demo account 5) share their uncertainty about ethical responsibility as they watch powerful stakeholders carry away their digital maps and devices and use them to mobilize against other actors. The anxiety they experience calls attention to a contingency in knowledge expression and travel that confronts all projects in STS making & doing and for which their project attempts to take account. Following commitments in STS making & doing calls attention to the importance of iterating STS sensibilities while critically highlighting the challenges of iteration. Max Liboiron, Emily Simmonds, Edward Allen, Emily Wells, Jessica Melvin, Alex Zahara, Charles Mather, and All Our Teachers (demo account 6) call attention to power relations and ethical obligations in a different way when they admit that they are still “working on” their own assumption of access to fish guts and recognition that their “access precludes other access, uses, and relations.” Jessica Mesman and Katherine Carroll (demo account 7) explicitly work to make visible the hidden knowledge in the everyday work of health care professionals in order “to make a difference.” They challenge themselves to recognize and analyze who is becoming what, because doing video reflexivity adds on STS sensibilities. Attaching STS sensibilities in empirical fields produces encounters with other sensibilities that require much scholarly work to sort out. Navigating those encounters is necessarily part of our scholarship.

Nick Shapiro (demo account 8) repeatedly evades assignment on the aerosolar project to serve as spokesperson for environmental justice advocates by “discern[ing] what scientific payloads would be most useful” to them. He worries that the assignment would limit his project to pluralizing authoritative claims about the environment rather than challenging a presupposition shared across otherwise competing positions. Teun Zuiderent-Jerak (demo account 9) is surprised to find his coinitiative to appraise and include different knowledges in guideline development lead not to collaborative work rebuilding knowledge infrastructures but to philosophical writing on styles of reasoning. What must he and his project become now, he asks, as the members of the working group he founded are more interested in epistemology than in knowledge infrastructures, and he finds himself largely agreeing with them? Gary Downey (demo account 10) watched his interlocutors express enthusiasm about positioning culture within engineering as a step toward promoting active learning. He could not share the enthusiasm, however, because they were reinscribing a demarcation between technical and social. He realized that his project needs a new entry point.

In every case, affective content is also STS content, a performance of STS knowledge. By expressing knowledge through STS sensibilities that make STS travel, these projects act on behalf of some version of the field, albeit for other audiences. Each time we STS scholars step into empirical arenas and offer ourselves as embodiments of STS knowledge, we also challenge ourselves to articulate once again what counts as STS, how it may look different in a new setting, and what it means to do STS work. The issue is nontrivial, about much more than strategy and tactics in downstream

diffusion and utilization. The first STS Making & Doing program generated great enthusiasm in part because it authorized the performance and sharing of joy, angst, and pretty much everything in between. The affective contents of presented projects became available for colleagues to experience and interpret because the scholarship of STS making & doing requires its scholar-practitioners to be visible.

The experimental demo accounts in this volume take steps to reveal the person in the project, documenting the flows of learning that such presence helps to produce, as well as what sensibilities and knowledge might be gained reflexively in the process. Likely all the authors would acknowledge that such documentation and associated analysis remains emergent and incomplete, and, for many, more than a little bit uncomfortable. We assert that these STS demo accounts stand out by making the effort in the first place.¹²

4. REFLEXIVE LEARNING THROUGH STS SENSIBILITIES

Attaching STS sensibilities in empirical arenas often provokes reflexive learning on the part of the STS scholars involved. Just as travel is not about diffusion from a scholarly core, so reflexive learning is not measured by its relation to knowledge production alone. Practices of reflexive learning may head in different directions. They may indeed turn to inflect the results of research, including modes of STS theory. They may also walk back to reassess and reconsider a motivating friction. Carrying new questions about the self in the scholar, they may proceed to interrogate relations among scholar and nonscholar identities. They may set out to initiate further iterations of knowledge expression and travel, perhaps with different itineraries.

Practices of reflexive learning in these demo accounts tend to point toward another round of sensibilities and attachments. Since court procedures did not formally change to admit workers as bearers of knowledge, perhaps a documentary might help others to gain such permission. Difficulties stabilizing the general self-tracker shifts the software's focus to nonprofit groups that already offer stable figures. A training scheme to pair asylum seekers with academic organizations does not work out, motivating founding a new organization to integrate them. A local management desk risks distraction from the water project and makes house fumigation its first collective action, combating the Chagas disease that afflicts the entire population. An ethical commitment to multiplicity leads to an insistence that all formulated visions, including ones that weaken the teachers' union, remain publicly available online. A scientific lab that recognizes its relations and tries to fulfill its obligations finds itself making many compromises. New clinicians take the initiative to carry on by themselves, both documenting how they do safety and figuring out how to do it better. The pursuit of radical alterity necessarily includes incrementalism even though it risks dissolving into reformism. Workgroup members challenge the focus on more diverse knowledge appraisal infrastructures by giving priority to retheorizing styles

of reasoning in evidence-based medicine. Infrastructuring culture into engineering education might better begin with the student's entry into the curriculum rather than through an elective addition.

Note how demo accounting for reflexive learning in an STS making & doing project tends to direct attention beyond the boundaries of the narrative. Highlighting the temporality and spatiality of the project, the demo account names itself as an episode, acknowledging its own incompleteness. Something came before, and something different will likely come after as project episodes overlap with career practices and trajectories. And once again, questions multiply. What sorts of specific practices produce acceptance and adoption of STS sensibilities? Does the learning that occurs in empirical fields speak in any way to the STS scholar's initial apprehension of a friction? What has become of that friction by virtue of the project? And what of the attachments of the STS scholar? Does achievement of learning in empirical settings motivate new STS research? How about another making & doing project, or phase of the current project, to further extend the reach of its sensibilities and learning?

Each demo account in this book thus calls for its own extension. It is a call that, in principle, knows no limitation. The trajectories of projects in STS making & doing are coterminous with the field, as the project construes it. As their practices perform the field, they also extend its reach. To date, the temporal and spatial limitations of scholarly careers have likely contributed to the relative devaluation of STS scholarship in making & doing. Projects that appear not to be scholarship have too often emerged, prospered, and expired with the scholars who initiated them, including when the projects did not mimic scholarly conventions closely enough to support an academic career. The project that is this book maintains that producing and sharing demo accounts can enable STS as a whole to extend itself through the reflexive learning they provide.

TEN DEMO ACCOUNTS OF STS MAKING & DOING

Dissecting these demo accounts through four analytic questions has disaggregated them. It divided them up. Something got lost in the process. Disaggregating projects in the way we have thus far has stripped them of the flows of STS sensibilities that constitute them and call attention to what is especially compelling about each. It is precisely the demo quality that attracts great interest during the STS Making & Doing program, where one can walk from project to project and begin to understand what is at stake in each. By gaining the opportunity to examine and review dozens of demo accounts of such projects, might one be able to gain a better handle on just how active that STS scholarship has been, is now, and could become?¹³ The text that follows assembles the disaggregated analyses into summary introductions that isolate specificities in how the project expresses STS knowledge for other audiences and settings, producing travel for STS sensibilities into and across the empirical field,

making the scholar visible in the scholarly practices, and facilitating learning on the part of the STS scholar. We know there are many such projects. Here are ten.

DEMO ACCOUNT 1: ADDING WORKERS TO THE COURTROOM (YI-PING LIN AND HSIN-HSING CHEN)

“Score!” The court had opened an extension courtroom in the cafeteria, and STS scholars created and staffed the new position of “commentator.” The commentator explained to the crowd what was happening on the televised screen when an attorney cornered a defense witness using questions that commentators and others had designed weeks earlier. Akin to a baseball game, scoring happened infrequently and usually only after a long buildup that often included another STS scholar texting back and forth between attorneys in the courtroom and researchers on campus. The high court in Taiwan had been unprepared to accommodate the hundreds of former Radio Corporation of America (RCA) workers and their families who campaigned to be present for the court sessions. They were violating the ontological status assigned to them. Yi-Ping Lin and Hsin-Hsing Chen show what they and other STS scholars did and had to do to help workers become and stay visible as holders of knowledge.

Parties to a civil lawsuit typically attend only the initial session, final oral summations, and announcement of the verdict. Otherwise, attorneys introduce them through witnesses and documents. The parties gain legal embodiment as the judge dictates to the clerk a written record of testimony, painstakingly negotiating details with the attorneys and witnesses. The RCA workers and families, representing more than five hundred former employees, wanted to attend and be seen because they were the victims. Their complaint, the first collective lawsuit in Taiwan, claimed that RCA had knowingly exposed its workers to hazardous chemicals that had caused miscarriages, lupus, and fifty-six types of cancer. Their very presence was a knowledge claim.

At one point, the Chinese-language academic journal *STM (Taiwanese Journal for Studies of Science, Technology and Society)* appeared on the attorneys’ table. In that issue, Chen (2011, 45–46) had shown how Japanese courts had expanded notions of causation from “scientific certainty” to “reasonable medical certainty,” with clear implications for this case. Lin (2011, 61–112) had shown that existing epidemiological knowledge about worker exposures had omitted a crucial category of worker: young women who had worked for relatively short periods of time. This STS knowledge about gender bias in clinical studies later proved crucial when RCA lawyers pointed to epidemiological studies linking one chemical to kidney and liver cancer but not to breast and cervical cancer. They were unaware that such studies were “mainly done on populations of male workers.” Recognizing this omission in a courtroom exchange that felt like a baseball game, Yi-Ping Lin emerged exclaiming, “I’ve caught a foul ball!”

The *STM* issue had added STS scholarship and scholars to a case that was calling public attention to environmental and health costs from Taiwan’s rapid industrial

expansion through collaborations with, especially, US-based companies seeking low-cost labor. It had made the scholars visible to the workers as knowledgeable advisers who could move back and forth between the factual medical and environmental claims and the evolving state of the court case in both local and international terms. By appearing on the attorneys' table, the journal attached to the courtroom itself not only STS sensibilities but also formalized STS knowledge.

Had STS scholars not joined the case, it is likely that the workers would have remained largely bystanders. Apart from the few who would have provided sharply constrained testimony as witnesses, they would have been effectively invisible, observers of their own legal diagnoses. By accepting and enacting the identities of backstage commentator and attorney support, as well as advisory group member, documentary film maker, and so on, STS scholars helped enable them to become and remain visibly present, even as silent interlocutors. The multitude of contributions that STS scholars made to the case expanded the category of plaintiff in a civil lawsuit to include bodies in the courtroom. Alongside work that makes STS knowledge on the status of evidence present in court (Cole 2009; Lynch and Cole 2005), this STS sensibility extended the courtroom itself, connecting the courtroom to public controversy. The scale and persistence of the scholarly efforts also helped STS gain status and visibility as an academic field in Taiwan and helped Taiwanese STS scholars make contributions well beyond the country.

DEMO ACCOUNT 2: INSERTING A THIRD FIGURE BETWEEN SOFTWARE AND USER? (DAWN NAFUS)

"In the course of these encounters," writes Dawn Nafus, "my participants got better at seeing what I saw and came to anticipate what needed doing and doing it." Working as a senior researcher at Intel, Nafus was testing an early-stage software design she had codeveloped that would help users learn things about themselves by juxtaposing different kinds of data and looking for patterns. One test user found it revealing, for example, to examine not only the average number of steps she was taking each day to keep fit but also the actual total numbers. She discovered that too much exercise was triggering her autoimmune disease. A group of family caregivers collected data from a device that tracked their sleep patterns, looking for insight about their own levels of stress. A community group examining the effects of air quality on health correlated their heart rate and blood oxygen levels with data from local sensors of pollutants. Nafus helped test users decide on what data to collect and input and how to experiment with different correlations, and she watched as they offered interpretations and speculated on what other sorts of analyses might be done with additional data. Nafus and her engineering team members started off building a tool that could do exploratory analyses of different types of data and that was based on earlier research that identified possible uses. The tool instead emerged as a sociotechnical

infrastructure called Data Sense. In the process of building it, team members had to become themselves the new kind of figure they were trying to produce.

Software engineers use the distinction between visible “figure” and invisible “ground” to focus their work. Software highlights the visible pathways it offers users via its features while hiding the stacked layers of computations on which the pursuit of those pathways depends. In the Data Sense project, Nafus bore primary responsibility for figure—user desires and specifications—while engineers ruminated over the computational layers of ground. Such is the engineer’s image of an STS scholar, preserving the technical-social dualism they take for granted by assigning the social to her. But Nafus brought with her another image of figure, that of the “cultural figure.” It is an agent who operates in cultural and social formations, such as the “wildly heterogeneous . . . data culture” of the present. Software engineers appear in this framing initially as “data wranglers.” As they worked together to build a new kind of web-based software system, both Nafus and the engineers crossed the boundaries they initially saw as separating them.

Nafus and her teammates want to help “self-trackers,” an emergent category of person; they “work with data on their own terms.” In one way or another, anyone who engages with software has become a self-tracker, devoting increasing amounts of time to collecting, organizing, cleansing, and analyzing data (Dumit 2018). Nafus finds it “intellectually interesting” and “socially beneficial” to help people ask new questions about data that pertain to them and reflect critically on “the circumstances in which the data was collected.” It turned out that the software engineers did, too.

Team members learned how difficult it is to build software that departs significantly from the narrow image of a tool serving a single purpose or pursuing a small set of goals (i.e., software with a stable figure in both senses). In particular, how can one system process heterogeneous streams of data whose characteristics cannot be specified in advance? They found that one correlation in Data Sense might require the ground to process five streams of data, another twenty-five. The first might require the visible figure to parse the data by time of day, the other by smoothing data across variable time periods. Adding the ability to count steps per hour makes sense, but counting heart beats per hour does not. Also, users whose identities tilted toward that of the data wrangler found it easier to use Data Sense to ask new questions than those with little knowledge of coding. Such users could easily become overwhelmed if Data Sense presented them with too many options to organize and manipulate data.

The team developed a system of ground and figure for “onboarding” users, helping them learn enough computational concepts and practices to upload data and begin to manipulate it. But Nafus found over and over again that “the figure of the end user who explores data” could not be attached and stabilized in general terms. As a company, Intel is known for producing semiconductor chips for a wide range of applications, or figures. Its niche in computing is the general. Data Sense emerged as a software product that produced a “miniature social arena” when Nafus herself

was present with users to have a “dialogue in data,” and she was “making meaning together” with them.

In the terms we’re using here, Data Sense performed an STS sensibility by requiring a continued collaboration with the STS scholar in order to produce the third figure in a reliable way.¹⁴ Building the computer engineers’ technical figure for a new kind of software also required building and attaching a new kind of cultural figure. Nafus learned that Intel was not positioned to facilitate the interpersonal engagements and socially sanctioned moments necessary for people to “sit down with data” and discover things about themselves through Data Sense. But perhaps some groups are? Nafus was able to ask what sorts of alliances needed to form. In doing so, Nafus helped Intel shift Data Sense away from a software analog of the general microchip to begin negotiating with nonprofit groups that could use Data Sense to produce third figures in locally meaningful ways. Data Sense could not race to the end, helping the self-tracker emerge as a uniform general category. Instead, it is helping localized self-trackers to continue emerging a little at a time.

DEMO ACCOUNT 3: INCUBATING THE ACADEMIC ASYLUM SEEKER (MICHAEL GUGGENHEIM, JUDITH KRÖLL, AND BERND KRÄFTNER)

One member brought a white doctor’s coat to the office as a sign that she could not use it anymore; another brought a dictionary of medical terms connecting Somali to German and compiled to help other refugees; a third suggested putting up maps of home countries. All had accepted invitations to join an exhibition project designed to make visible the “situation of scientists that became asylum seekers” in Austria. The office was in a shipping container placed on a central square in Vienna between the Charles Church and the Technical University. Participants used the office to converse with passersby about their lives and experiences during six weeks in summer. The conversations about academic asylum seekers made up one of twelve interactive modules in an exhibition visited by some fifteen thousand people. Each module had “module carers,” project members who were trained to interact with visitors through the objects and controversies on display. In this module, the asylum seekers served as the module carers themselves.

The exhibition is an “incubation,” which the authors define as “a socio-technical device that uses situational, social and time-based pressure to invent the social and represent it with a wide variety of media” (Guggenheim, Kräftner, and Kröll 2018, 65). The demo of their incubation accounts for the sequential development of the project, focusing on shifts that could not be anticipated in advance. The project started with the goal of highlighting how academic migrants get made through bureaucratic procedures and statistics as they cross borders through student exchange programs, fellowships, and visiting professorships. But encounters with an academic asylum seeker led the organizers to focus more specifically on how the tag “asylum seeker”

silences everything that makes up the person's biography as an academic. What qualities of academic asylum seekers are invisible to the state or actively made invisible by the state? And how might such qualities be made visible in public settings? How should they be represented?

Over the course of a year, the project organizers learned to recognize representation as "chimera" (i.e., as a weird and distant appropriation that belied its own goals). The organizers became curators of the exhibition they describe, and they decided with the asylum seekers who joined the project that the latter must speak for themselves. They had fled to Austria from Sudan, Côte d'Ivoire, Chechnya, Ukraine, Georgia, Libya, Palestine, Kyrgyzstan, Somalia, the Democratic Republic of the Congo, Afghanistan, Iraq, and Iran. They lived in refugee shelters, together.

The curators offered participants office space in an unused café as long as their grant could cover the rent. There the participants could develop their own projects away from the shelters and "outside the pressures of the incubation," which held regular meetings. As it became clear that academic asylum seekers should represent themselves in the exhibition, it also became clear that fixing the location for the module would make it more visible than having it move. Locating it in the city center would grant it maximum visibility. The central location itself also called attention to the more hidden refugee shelters. Participants wanted to post their BA, MA, and PhD certificates on the walls. The certificates visibly named the knowledge and skills that participants were sacrificing by seeking asylum in a country that did not recognize them.

The incubation evolved past the multitude of conversations at the exhibition. Recognizing that the state made invisible the knowledge and skills of persons tagged asylum seeker, the curators had set up a kind of exchange and training scheme that worked to pair refugees with relevant academic organizations. They hoped that the exhibition might also make publicly visible and document the workings of this new training scheme. When they encountered difficulties in pairing, the curators and participants founded a new organization, called Researchers without Borders. The purpose of the organization was to help asylum seekers make the case that they had integrated themselves into Austrian society: they were integrated by becoming members of a professional organization called Researchers without Borders. Through the exhibition and the new organization, project participants effectively created and attached the category of "integrated academic asylum seeker," persons with professional knowledge and status that made them worthy of state certification and legal standing as "refugees."

By following an experimental and procedural logic in the incubation, the STS scholars had become interviewees in articles about the exhibition, documenters of integrated asylum seekers, and founders of Researchers without Borders. To make these shifts, they needed to move away from "the logic of written STS," along with its media commitments. They then returned to those logics to produce this demo account as a "second, separate act."

DEMO ACCOUNT 4: BUILDING SOCIOTECHNICAL ALLIANCES FOR INCLUSIVE DEVELOPMENT (HERNÁN THOMAS, LUCAS BECERRA, AND PAULA JUAREZ)

Residents in the remote rural community came to the “local management desk” to discuss how to build on the fumigation project to produce a more permanent mechanism for accessing water that was not contaminated with arsenic. Attendees included local families, teachers from the school, officials from a national technology institute, and the STS researchers. The group had previously decided to make its decisions through a lottery-like system. Groups in four other rural areas of the province of Chaco included in the project had chosen raised hands, elected a representative, or appealed to ancestral criteria.

Hernán Thomas, Lucas Becerra, Paula Juarez, and other STS scholars from the National University of Quilmes, Argentina, had borrowed the concept of the local management desk from a government agency. But by reapplying it outside of urban settings as part of the DAPED (Right to Access to Goods: Water for Development) project, they added distinctive sociotechnical content to its organization and practices. The Quilmes team was seeking to generate “actual dynamics of local development” in especially poor regions to the north and to build a lab for the national “public-public consortium” that the STS scholars had worked for years to establish. The local management desk was one “sociotechnical alliance” among several the team had created.

Five years earlier, the relatively new national Ministry of Science, Technology, and Productive Innovation approached some of the Quilmes scholars for help developing “technological solutions” for “chief social issues.” These included lack of access to drinking water, housing, and energy, as well as the high costs of medications and the prevalence of regional diseases that had no cure. Since completing a degree in science and technology policy, Thomas had been critical not only of linear images of technological determinism but also of such alternatives as appropriate technology, alternative technology, grassroots innovation, bottom of the pyramid, and social innovations. Although technological determinism ignored social dimensions, the relatively fixed social commitments in other theoretical models tended to produce short-term responses, aftereffects that might be worse than the initial problem, and problems in the planning of devices and systems to realize them.

The evolving Quilmes team accepted the invitation from the ministry as a challenge to shift its scholarship from the orthodox, safe exploration of “topics” to the targeted, risky investigation of “problems.” Embracing problems did not mean directly seeking solutions, however. To do so would be to continue the long-established focus of supply-side, market-oriented governmental policies in science and technology. Rather, embracing problems meant moving beyond publishing critical analyses and informed discourse for academic audiences and working with “other social groups (e.g., policy makers, policy practitioners, social movement activists, and civil society

entities)." It meant collaborating with such groups to figure out who would be the expected users of research results, and developing mechanisms to include them in both defining and addressing social and environmental problems. Building "technologies for social inclusion" thus required not only theorizing technological systems as sociotechnical in content but also adding new sociotechnical alliances to include expected users.

Can STS knowledge be "applicable," yet not "applied" (Kreimer and Thomas 2004; Thomas and Kreimer 2002)? How, asked the Quilmes team, can STS knowledge be taken up in actual deliberations involving science and technology? Thomas's theory of social technological systems adroitly positions the word "social" to achieve applicability. It means inclusive. That is, the technological systems it describes seek inclusivity. Non-STS listeners who encounter the theory experience no challenge to view all technological systems as sociotechnical in content all the time. For members of the Ministry of Science and Technology and National Institute of Agricultural Technology who tend to define technology in purely technical terms, the adjective "social" simply points them to develop technologies whose benefits include inclusivity. For the STS scholars and officials in the Ministry of Social Development involved in the water project, adding the adjective authorized their focus on the organizations and actors that must be created and added to enable a given water technology to come into being and serve its users.

Establishing the water project took five years because it required that much time to create the necessary sociotechnical alliance to fund and carry it out. The Quilmes team proposed that the science and technology ministry fund a public-public consortium co-organized by the social development ministry and the agricultural technology institute. But the S&T ministry had no authority to fund "social development" and the state bureaucracy lacked procedures for intragovernmental articulation. The water project ultimately came into being in significant part because a previously established sociotechnical alliance provided a "collaborative platform" for it. The Network of Technologies for Social Inclusion brought together public and private institutions committed to "strengthening and improving the capabilities of innovation and technological development for social inclusion." After filling a gap between the private and public sectors, the network persuaded the government to fill a gap within the public sector.

Thomas's theory of social technological systems came to serve as a "lighthouse" for the Quilmes Institute of Science and Technology Studies, leading researchers to expand their scholarship. New research projects included contributing to the development of public policies, which in turn reconfigured the masters and doctoral research of scholars in training. Also, the institute expanded its publication strategy beyond academic outlets, and it formulated and enacted a communications strategy "aimed at challenging political and social agents." In the process, both research and researchers experienced a "dynamic transformation." Not only did the "problem

agenda, knowledge generation, and researcher concerns and activities” change, but so did “the very notion of what a researcher is.” In our terms, by producing and sustaining sociotechnical alliances, Quilmes team members relocated their theoretical commitments to their making & doing work.

DEMO ACCOUNT 5: ADDING ISSUE PUBLICS (TORBEN JENSEN, ANDREAS BIRKBAK, ANDERS MADSEN, AND ANDERS MUNK)

Starting with the recognition that there is no such thing as a purely automated analysis, Torben Jensen, Andreas Birkbak, Anders Madsen, and Anders Munk work with “issue experts” to produce alternative visualizations of the data they analyze together. The group of differing, even opposed, “stakeholders” whom project organizers had identified and invited to participate may decide to delimit the view to a shorter period or to filter out actors who are relatively unconnected to other actors. The STS scholars are on the “constant lookout” for techniques to iterate quickly from one way of visualizing the data to another. Yet they have found through a range of individual empirical “experiments” that they cannot define themselves out of the process. Producing the next data visualization may take them minutes or hours, and they may even have to leave the room to generate a new poster-sized printout. Experiencing iterations of empowerment and loss of control strengthens their commitment to produce a “kind of ontological inquiry that works against universalistic and too-quick assumptions about the world.” Yet they see danger in possibly becoming “merchants of multiplicity.”

The authors harvest massive quantities of data from Twitter, Facebook, scientific articles, and other databases to help people involved in a debate, controversy, or future planning to identify what’s at stake in an issue at hand, and for whom. The Danish Board of Technology had long organized citizen hearings on technoscientific issues, enrolling “trusted experts” to help produce the detailed handouts that initiate and guide discussions. The STS scholars harvested four hundred thousand tweets related to the Zika virus and then analyzed them through network graphs to identify the “issue publics” (Marres 2005) that had emerged through debates on Twitter. Results appeared on the handouts. Likewise, the scholars harvested Facebook data to help the local Aalborg municipality identify nine hundred different visions of possible school reform and the Royal Danish Theater to identify different ways of construing “authenticity” in self-defined cultural enterprises and productions. Another project drew data from scientific journal databases and food-related Instagram posts to demonstrate a “surprisingly fragmented discursive landscape” in research about obesity.

Collaborating with diverse participants in debates or controversies provides the scholars with a surprising sense of empowerment qua STS researchers. Their collaborators attribute significant power to the digital maps, once they understand how to interpret them. They tend to describe the visualizations as the “actual, databased facts”

about the field as opposed to their own representations as participants within the field. Such judgments persist even as the STS experimenters stress “their constructed nature, the uncertainty of data, and the dangers of reading too much into them.” They maintain that the visualizations shape questions, not answers. Yet the visual products tend to “travel much faster to other settings when wrapped up as facts.”

The recognition of empowerment iterates with a sense of loss of control. Producing maps positions the STS scholars as a kind of mediator. They cannot claim to be knowledge authorities on the field in question. Producing maps that get to become actual or factual also entails detaching the scholars who figured out how to work with the software to extract persuasive visualizations from mass quantities of data. And then the external partners further distance themselves from the experimenters by carrying the products away to use on their own. The STS scholars get left behind.

A key example is the politicians and municipal leaders whose vision of school reform faced opposition from the teachers’ union. The union was arguing that the reform would negatively affect teachers and their work. When the visualization “suggested that not all teachers were united in their critique,” the leaders used it to destabilize the opposition by showing discord within its ranks. Indeed, the authors report that they “constantly” encounter potential collaborators who have a stake in “producing particular kinds of multiplicity.”

What ethical responsibilities are borne by STS scholars whose products leave them behind and travel sufficiently to become true or real in the field of study and participation? These scholars argue that their products come with ethical commitments. The collection of practices that add up to “participatory data design” carries with them a commitment to multiplicity. Accordingly, they are reluctant to seek contracts from powerful stakeholders who want them to perform a “targeted deconstruction operation” on a particular issue public, making multiplicity visible in order to subordinate others. To ensure that the municipal leaders would not easily stabilize one of nine hundred visions via the specific visualization they supported, the experimenters insisted that all the formulated visions remain publicly accessible online. Their commitment is to the multiplicity. They do STS by “setting in motion processes that collectively engage more actors with datafication as a means for ontological inquiry and building new things.”

DEMO ACCOUNT 6: ADDING ACCOUNTABILITY TO THE COD (MAX LIBOIRON, EMILY SIMMONDS, EDWARD ALLEN, EMILY WELLS, JESSICA MELVIN, ALEX ZAHARA, CHARLES MATHER, AND ALL OUR TEACHERS)

The revised draft of this demo account left the fish off the list of authors. At a meeting to discuss putting the fish as first authors, lab members recounted cases in which assigning authorship had or would have the effect of committing violence against someone. At a previous meeting, they had identified the labor that went into the

manuscript and the laborers who had contributed. All had agreed that the fish had contributed, by dying. But including fish as authors would ignore the uneven social locations and histories of contributors. There can be no parity between parties when one has died. Also, even if still alive, the fish would not acquire an obligation to the submitted manuscript that human lab members gain. Max Liboiron, Emily Simmonds, Edward Allen, Emily Wells, Jessica Melvin, Alex Zahara, and Charles Mather appear as authors because they chose to follow the “norms of science in which only humans are considered authors.” The cod, hake, and char gain authorial credit as part of the larger heterogenous category of “All our teachers.”

Contributors to the Civic Laboratory for Environmental Action Research (CLEAR) position themselves as marine scientists “committed to Western science and its ways of knowing.” But they equally resist values that “undergird and reproduce the dominance of science over other forms of knowledge.” Scientists, they maintain, always work within relations. Relations produce obligations, and obligations constitute ethics. And vice versa. Members of CLEAR commit to recognizing their “obligations to emplaced relations” by “enacting equity, reciprocity, or humility” in their research practices.

Lab members agree with other scientists that marine animals and humans are at risk from chemicals that are concentrated in plastics. These chemicals accumulate in the tissues of fish that ingest them and biomagnify through the food web. CLEAR stands out among research labs in a university setting by attending to obligations that accrue to their location in Newfoundland and Labrador, where “marine mammals, birds, and fish are a mainstay of diets for rural and Indigenous communities.”

Because obligations “come from where we are from,” lab members draw on their identities as feminists and anticolonialists and on their “Métis, Kabanangajuk, local settler, and come-from-away settler positions.” The work of CLEAR seeks to expand “how fish are known in a university setting.” Fish and their guts certainly serve as samples. They also contribute as “food, political citizens, and grandmothers.”

Drawing on feminist STS helps lab members see how realities are constituted by relations and dispose themselves to seek accountability within “nonmasterful, enmeshed relations” that frame the laboratory work. Drawing on Indigenous thought adds the crucial insight that, by means of constituting realities, relations also constitute obligations. In the process of producing realities, a scientific laboratory also fulfills obligations or not. To make and do marine science via a feminist, anticolonialist scientific laboratory significantly expands the scope of the myriad obligations to which the lab must attend.

Members of CLEAR attend to such obligations through scripted protocols. The scripts range from sharing fish guts with a woman on the wharf, to gaining permission to dispose of guts as food rather than hazardous waste, to figuring out author order and citation strategies. Foregrounding obligation keeps lab members focused on local scales and specific actions because relations are “never in the abstract.”

At the same time, obligations are “sometimes at odds with one another.” A scientific lab that recognizes its relations and seeks to fulfill its obligations must necessarily make compromises. Lab members dedicated to expanding how fish are known must “pick [their] way through the less-than-ideal landscape.” Making compromises makes clear that relations, obligations, and ethics are “best enacted as synonymous.” They merge epistemology with ontology, axiology, and standpoint. Research practices in CLEAR work out all simultaneously.

DEMO ACCOUNT 7: A CLINALYST INFRASTRUCTURE (JESSICA MESMAN AND KATHERINE CARROLL)

The breast surgeons found out that their workflows “were much more entangled” with those of the surgical pathologists in the lab “than they had realized before.” As the surgeons analyzed video clips of pathologists evaluating specimens taken during surgical procedures while also managing multiple other specimens coming and going, they were amazed that “we do as well as we do” in collaborating to produce diagnoses of diseases such as breast cancer. The two groups participated in “video-reflexivity” sessions designed to make visible their strengths and identify pathways for improvement. In this case, the surgeons and pathologists developed a written template to better describe the orientation of the specimen in the patient’s breast, something both needed. They also modified such other procedures as “developing a script for call-back, and requesting both the pathology and surgery staff [to give] verbal confirmation and verification of reports.” In so doing, report STS scholars Jessica Mesman and Katherine Carroll, the two groups of physicians expanded their definition of team success by adding interprofessional communication to outputs from laboratory instruments. And they joined the STS scholars as “clinalysts” who catalyze insider knowledge by asking outsider questions and maintaining “a constant tension between critique, interpretation, analysis, questioning, and concluding.” The changes happen fast, implemented within months.

Mesman and Carroll describe video-reflexive ethnography as a collaborative visual method to “understand, interpret, and optimize professionals’ work practices.” The camera serves as a key, central device. But only in relation to others. The STS scholars gain the permission of hospital practitioners to video them in agreed-on settings and situations. The scholars produce clips that isolate informal mundane routines and make them literally visible. They then facilitate the discussions that transform the routines into remarkable achievements of everyday work. As nurses, doctors, and other staff members watch the delivery of complex, dynamic practices, they see Grand Central Station, a “well-orchestrated symphony,” or simply “value” in their own work and the work of others around them.

The dominant image of hospital evaluation and improvement emphasizes innovation. External consultants contract with hospital administration to deliver advice and

models for change. Mesman and Carroll start off with such an external identity and role. But before the camera ever enters the hospital setting, the STS scholars meet and work with every potentially affected group to construct a new infrastructure that includes everyone. Typically, an internal advocate facilitates introductions and initial meetings. Tacit approval by all, including hospital administrators, leads to a formal internal research proposal and procedures for protecting the rights of human subjects. Everyone becomes a clinalyst in this added infrastructure, essential to its performance—STS scholars, observed workers, camera, and so on. Mesman and Carroll call the preparatory work both “foundational” and, following John Law, “deeply messy.”

In the new infrastructure, the STS scholars neither remain outsiders nor become insiders. They become “alongsiders,” a role that confronts challenging issues of accountability and professional vulnerability. In a study of how an emergency department hands off urgent cases to surgery, the STS scholars don blue surgery scrubs so they do not need to seek permission every time they want to cross the threshold between the two departments. The scrubs made patients “think we belonged to the hospital staff” and sometimes made others in scrubs visibly wonder if the STS scholar was “one of us” or not. And the scholars themselves felt “angst” over not having enough time to form genuine relationships with people to begin to be considered as insiders,” despite their seemingly moving from outside to inside. Also, their frequent presence “on location” meant that the scholars had made themselves available not only for “praise” and “advice” from participants but also “direct criticism.” What responsibilities do they acquire in the unstable identity of alongsider? In building the clinalyst infrastructure, they join with hospital staff to produce the “shared framework” that pursues “collaboration and quality and safety in health care.” But what comes along with their “affective enrollment”? When, they ask, does “giving in and being flexible” in responding to requests and challenges “become a threat to one’s ambitions” as an STS scholar?

The emergent clinalyst infrastructure can persist. It can become robust. During a study of patient safety in neonatal intensive care, Mesman could not be present for reflexivity meetings. At first, the meetings were canceled. Then other members of the video team took it on themselves to continue. They selected the footage, organized and chaired the meetings, and taped the discussion. The new clinalysts were able to carry on documenting how they go about “doing safety” and identifying what new steps they might take to do safety better. The STS scholars learned that they could design their own exit into the clinalyst infrastructure to the extent that other participants would be willing and able to “maintain a constant tension between critique, interpretation, analysis, questioning, and concluding.” In this way, their approach to empiricizing as alongsiders what it meant to improve quality and safety in health care also resulted in a situation where clinalysts equally became alongsiders of STS scholarly practices, helping all figure out how STS infrastructures can remain alive at a larger distance from STS scholars.

DEMO ACCOUNT 8: ATTACHING RADICAL ALTERITY (NICHOLAS SHAPIRO)

One of the first people lifted by the balloon was an environmental activist who lived beside a sprawling petrochemical plant outside of Buenos Aires. Elsewhere, environmental justice advocates invoke the “well-publicized quasi-plausible future that the project advocates” by tethering solar balloons at their protests as rallying points. The Aerocene serves as a platform for social movement action that calls attention to and resists chemical violence. But its ethical doings go beyond documenting harms and demanding policy changes. To Nick Shapiro, a project collaborator, the aerosolar balloon materially cultivates not just incremental reforms but an immaterial alternate, the “ethos, altered subjectivity, and desires” of a radical alterity.

Shapiro accepted an invitation to join a collaborative project aimed at realizing aerosolar balloon travel—that is, travel in hot air balloons filled with normal air and gaining loft through the heat of the sun—as a viable means of global mobility. Meteorologist collaborators built a web platform for plotting when to fly and which winds at which altitudes to catch in order to reach a particular destination. The idea is to make visible a “transit infrastructure” that is latent in everyday ecologies. The Aerocene engages that infrastructure without expecting to master or control the “extra-human environment” that constitutes and animates it. Quite the contrary. To its organizers, the Aerocene is about “calculated submission” to that environment.

Contributors are making and doing different things as they design the balloon, build circuit boards for the positioning and data relay system, experiment with infrasound sensors, model the elemental variables of flight, calculate soar flux, encourage public participation, and so on. Indeed, with the project led by an artist, the work of “developing infrastructure, technology, and community” can take “second seat” to representations in art installations. In other words, tensions arise in partially competing visions of how to simultaneously build and imagine the world differently. Shapiro has led balloon launches in Antarctica and Idaho, supplied and advised on the suspension of air quality sensors from the balloon, codeveloped a lending library and data-sharing protocol, guided open licensing decisions, and written short pieces about the project. But he “wriggle[s]” out of a charge to “discern what scientific payloads would be most useful to environmental justice advocates” because his contributions to the project aim at something other than civic technoscience.

Shapiro joins other scholars in critiquing the “hydrocarbon and intellectual property infrastructures that envelop our world.” Yet rather than endorse reformists’ efforts to decarbonize the grid and spawn a world of batteries and short-lived solar panels, he insists on grappling with the “assumptions, imaginaries, extractive logics, asymmetrical financial benefits, regimes of consumption, and traditions of ecological mastery” that emerged with hydrocarbon engineering. That is to say, his critical analysis motivates intervention into the “presuppositions” that frame the problem to be solved. What does it take, he asks, to “mak[e] harms *unnecessary*”?

In this framing, the Aerocene is no more “escapist fantasy” than believing that technocratic reformism that accepts dominant assumptions about current infrastructures will also somehow change them. The Aerocene he is involved in is a “paradigm-shifting” project with “serious environmental justice chops.” Accordingly, Shapiro judges his most important contributions to be speaking publicly about the project, to show how it differs from dominant approaches to detoxification. To him, the Aerocene “carve[s] out imaginative space” in a way that cannot be achieved by “polishing the status quo.”

Wriggling out of the charge to produce data aimed at environmental justice also produced important learning. The pursuit of radical alterity necessarily includes incrementalism. “Neither is superior.” When standing alone, incrementalism certainly risks dissolving into reformism that accepts the enclosures of the present. So, to Shapiro, the ethical doings in the Aerocene project become challenges to build “productive friction” between its incremental moves and its alter-engineering subjectivity, to ensure that incrementalism remains attached to radical alterity. He sees in the project opportunities to help effect “syncretic methods of environmental change,” thereby positioning his practices of STS scholarship right at the intersection of the imaginative and the messy.

DEMO ACCOUNT 9: ANIMATING THE THIRD SPACE OF AID KNOWLEDGE (TEUN ZUIDERENT-JERAK)

A group of guideline developers, the Working Group on Appraising and Including Different (AID) Knowledge, has come together at an international conference to discuss how best to appraise and include knowledge in guideline recommendations that does not come from randomized controlled trials (RCTs). Zuiderent-Jerak is chairing as cofounder of the group. He tries to focus their work on the development of appraisal methods for knowledges in the plural, having been convinced that challenging the epistemological shortcomings of evidence-based medicine (EBM) just repeats stale, stereotypical accounts of epidemiology. Epidemiologists, he maintains, were never as epistemologically naïve as their critics depict them. Did not the founders of EBM themselves indicate, contrary to sociological accusations, that their project was *not* about the absolute supremacy of the RCT? Are knowledge infrastructures, then, not a desirable locus for changing the politics of knowledge in EBM? Could focusing on them perhaps provide a passage that bypasses tired yet sticky debates that position epidemiology and the so-called human sciences on opposite epistemological shores with nothing but thick layers of ice between them?

Zuiderent-Jerak borrows the metaphor, with the help of Steve Brown (2002), from Michel Serres (1983), who proposes that traveling between the shores of the so-called natural and human sciences compares to “traveling the Northwest Passage.” Traveling between the “messy coastlines in northern Canada that connect the Atlantic and Pacific Oceans,” which are variable, fractal, and “an adventure to be had,” compares

to navigating between the shores of sociology and EBM. Traveling requires occupying a “third space”—a space of transformation that lies between. When traveling this third space to *found* AID Knowledge together with leading guideline developers, it proved crucial to undo the critique of the epistemological narrowness of EBM. That passage had been frozen for too long. Now that AID Knowledge has itself become a third space between EBM and the human sciences, Zuiderent-Jerak argues in the working group, the focus on knowledge appraisal infrastructures rather than epistemology should remain. It is a nice try, but the guideline developers are not convinced.

One of them suggests that it will be crucial to nominate important alternatives for what Ian Hacking calls “frequentist reasoning.” Without challenging the dominance of the “epistemological assumption that the more we observe a (controlled) phenomenon, the better the knowledge of it we have,” all appraisal methods for other knowledges will, the working group member fears, leave them looking second best. The politics of knowledge infrastructures cannot be disentangled from epistemology. Providing a sense of alternative “styles of reasoning” becomes a crucial next step. Otherwise “appraisal infrastructures for all other knowledges will . . . continue to look inherently less reliable and knowledge inclusion will be on unequal terms, because other knowledges will have the wrong frequentist measures applied to them.” Zuiderent-Jerak learns that, what looked like a passage to him, others in AID Knowledge see as a “dead end” that would leave them “stranded at the shore of current EBM and its frequentist reasoning.” Better to test how thick the epistemological ice is. They jointly author an article on how different knowledges require different styles of reasoning (Wieringa et al. 2018). It makes most of them, including Zuiderent-Jerak, read up on philosophy of science.

STS insights about decentering epistemology had been crucial when founding this working group as a third space within an international association for guideline development. Yet once that version of the STS insight had done its work, it found itself challenged within this third space. The reminder “of the entwined nature of ontology and epistemology” shows how STS knowledges became part of the “perpetual translation” that comes with traveling the Northwest Passage and occupying “spaces of transformation,” as Serres puts it. To explore this “oscillation between the shores” STS may be particularly well placed. The “nomadic nature and elasticity of STS” with its scholars “inhabiting an overwhelming range of academic departments” is sometimes seen as a risk to the future of the field. The myriad of interlocutors it produces, however, may be a main source of vitality.

DEMO ACCOUNT 10: INFLECTING DOMINANT KNOWLEDGE PRACTICES WITH OTHERS (GARY DOWNEY)

The tangible outcome of the teleconference was but three sentences in a 750-word position statement promoting active learning in engineering education. Gary Downey

edited them to critically engage and help retheorize a pervasive distinction in engineering that demarcates technical knowledge from social knowledge. His demo account explores what is at stake when expressions of STS knowledge confront a dominant knowledge form in technoscience. Following the travel of STS knowledge flips its framing and priorities, he says, prompting its examination from “outside [the field] in as well as from the inside out.” Downey elaborates practices of “critical participation,” defined as “developing, expressing, and attaching sociotechnical practices to engage and inflect a dominant knowledge form in science and technology without necessarily dismantling or wholly replacing it, . . . produc[ing] flows of sociotechnical learning and reflexive sociotechnical learning.” Going into the teleconference, he was interested in learning if the experiment might add a new pathway to inflect core practices of engineering calculation. Afterward, he found it important to reframe the heart of his own project.

Downey had been contacted by advocates of active learning who were frustrated with the resistance they had encountered from engineering faculty. Concluding that engineering education has a cultural problem, they wanted to know how they could go about changing the culture. Downey’s critical STS accounts had found limitations in educational practices that claim to produce engineers with technical knowledge only. But while the activist educators pictured a cultural problem surrounding engineering, Downey located a problem precisely within the knowledge core of the engineering curriculum.

He draws on this interaction to examine three scholarly issues that critical participation in dominant knowledge practices must confront. The first is to theorize the production and persistence of knowledge dominance in ways that open it to engagement from traveling practices of sociotechnical knowledge. By theorizing culture as “dominant images,” Downey frames the demarcation between technical and social in engineering as a valuation built into the relations that produce curricular infrastructures and connect them to one another over time. The second involves following dominant attachments of knowledge to personhood, where the category of persons can extend to nonhumans, and problems of personhood emerge as relations within an entity. Downey briefly explores how engineers encounter and respond to challenges of personhood they experience in the engineering demarcation between technical and social. The third involves translating sociotechnical findings into sociotechnical techniques, devices, infrastructures, and selves, and attaching them to the field, often as gifts. To the extent they express STS knowledge in ways that inflect, or interrupt persistence in, dominant knowledge practices, he describes them as “STS practitioners.” In the teleconference, Downey adapted a longer-term pedagogical project in infrastructuring and selving: a course designed to activate STS findings about engineering knowledge and personhood into an expanded image of engineering practice and persons that positions culture within both.

Downey suggested that the educators engage resistance by first trying to understand it. Dominant images of engineers and engineering have certainly changed

and will change again, but that doesn't make it easy to effect change. Might they recruit faculty and students to join them in reflecting on the knowledge, identities, and commitments they gained through existing learning techniques and then explore how active learning might challenge or reframe those outcomes? At stake in their project, he said, are core questions about what counts as engineering knowledge, what it means to an engineer, and what engineers seek to accomplish through engineering. The educators expressed enthusiasm about positioning culture within engineering as a step to promote active learning. The draft statement that arrived, however, reinscribed the demarcation between technical and social, presenting the "content" of engineering as located "within an established culture." Downey saw in the draft statement a potential entry point through the concept of mind-sets. He followed it in order to test whether or not that pathway, too, left space for the activist educators to reinscribe what has become a remarkably resilient demarcation.

Yet as he reflected on how to further engage their project, Downey realized he had also assigned himself the responsibility to examine how his own project might be construed as enacting practices from theirs. Engaged STS can produce an "epistemic coalition" of projects, he finds, that travel together and can learn from one another. Critique alone can put scholars in competition with one another in zero-sum games of visibility and status, postponing or omitting attention to the practices and problematics of knowledge travel. Scholarly projects that enact critical participation certainly compete for position and resources but, for one to win, others do not have to lose. Recognizing coalition as collaboration becomes a sign of epistemic strength because it "signals a vision of the field as a whole."

KNOWLEDGE EXPRESSION AND TRAVEL AS SENSIBILITY WORK

Adding expression and travel activates STS scholarship by refiguring its problem spaces (Zuiderent-Jerak 2015) and expanding its scale (Downey 2009). The scholarship of making & doing includes but becomes more than outreach, which pictures scholars diffusing knowledge. STS making & doing includes but becomes more than teaching, to the extent that teaching pictures scholars as transferring knowledge. The scholarship of STS making & doing challenges what some academic fields call translational research, which looks to apply findings and discoveries from basic inquiry. Projects in STS making & doing stand out by expanding the practices of STS scholarship, responding to frictions by experimenting with techniques, devices, infrastructures, and selves that they produce and attach to specific empirical settings. The scholarship of STS making & doing is sensibility work.

These narrative demonstrations and interpretive accounts of STS making & doing are producing knowledge about STS initiatives to express knowledge as sensibilities and attach them to the field. Such practices are STS practices. Questions about which STS lessons genuinely make it into empirical arenas, how they get there, and how they are transformed by the journey are fundamental ones. Through projects that genuinely

and thoroughly interrogate relations between knowledge expression and travel, STS scholarship is able to explore fully what it can mean to turn STS lessons onto STS work.

This book gives reasons for optimism. Questions about the relation between STS scholarship and societal challenges involving science and technology have often taken the form of claims about the impact we could or should be making and laments about the absence of STS academic contributions in popular debates and deliberations. Privileging academic theory and hoped-for outcomes, such laments have focused their gaze too narrowly. They miss all the ongoing scholarship that activates STS, making and doing STS sensibilities through nonlinear forms of knowledge expression and travel.

NOTES

1. The practices are too numerous to discuss here. Some that we have found instructive include recognizing captivity (Scott, Richards, and Martin 1990), situating one's knowledge (Haraway 1991), taking account of standpoint (Harding 1986), doing ontology as multiple (Mol 1999), adding concern (Latour 2004), linking ethics and ontology to epistemology (Barad 2007), keeping normativities from damaging scholarship (Lynch 2009), attending to undone science (Frickel et al. 2010), and adding care (Puig de la Bellacasa 2011).
2. The contributors to demo accounts 1 and 4 shared some examples of publications for other audiences. See Jobin, Chen, and Lin (2018); Lin, Chen, and Jobin (2018); and Xie Peiqi 謝珮琪 (2018). See also Drovetto (2018); Juarez (2019); and Piscetta (2020).
3. We prefer to use the ampersand (&) rather than the word "and" to describe making & doing. The ampersand makes clear that "making" and "doing" are connected activities.
4. See, for the STS Making & Doing program, Society for Social Studies of Science (2021). See also Wylie (2018), a "call to action" that extends the presentation of research findings to include STS making & doing.
5. See the coda to this volume for further discussion of this point.
6. During the writing process, we lost one contribution that engages empirical arenas in the Global South. The ten projects include one each in Argentina, Taiwan, Canada, and Denmark; two in the United States; one among Austria, the United Kingdom, and a multitude of countries in Africa and Asia; one between the United States and Latin America; one between the Netherlands and Australia; and one in an international network that includes members from Europe, the Americas, and Australia.
7. We have watched as research examining the social, cultural, and political dimensions of science, technology, and medicine in disciplinary terms has expanded greatly in sociology, anthropology, political science, and other fields. Insisting on simultaneous attention to both knowledge and social dimensions helps to ensure that the projects are contributing to interdisciplinary spaces occupied by STS scholarship.
8. We thank Joseph Dumit for proposing an early version of this practice for the 1993 advanced seminar, *Cyborg Anthropology*, at the School of American Research, Santa Fe, New Mexico (Downey and Dumit 1998). Gary has further experimented with the format.
9. See, for example, Sally Wyatt's challenge regarding technological determinism, which, though declared "dead" within STS, is a prevailing dominant image in many settings (Wyatt 2008).
10. See, for example, the 2010 theme issue "Embodying STS: Identity, Narrative, and the Interdisciplinary Body," in *Science as Culture*, edited by Benjamin Cohen and Wyatt Galusky (Cohen and Galusky 2010, 1–122).

11. Note that Scott, Richards, and Martin (1990, 477) presented in first person their case studies of STS knowledge being captured by controversy. They said it was “for convenience,” a justification that avoided direct challenge by minimizing its significance. Still, as Atsushi Akera wrote in a January 16, 2020 email discussion of Gary’s work, an account that is “deeply personal” can also be “a little hard to read!” (cited with permission).
12. And by revealing the person in the project, they also compel attention to the boundary work that attempts to detach knowledge production from personhood in safe scholarship.
13. The coda to this volume argues for integrating demo accounts of STS making & doing into the infrastructures of publication for STS scholarship.
14. See also Jensen, Birbak, Madsen, and Munk, demo account 5 in this volume.

REFERENCES

- Ashmore, Malcolm. 1989. *The Reflexive Thesis: Wrihting Sociology of Scientific Knowledge*. Chicago: University of Chicago Press.
- Ashmore, Malcolm, Greg Myers, and Jonathan Potter. 1995. “Discourse, Rhetoric, Reflexivity: Seven Days in the Library.” In *Handbook of Science and Technology Studies*, edited by Sheila Jasanoff, Gerald E. Markle, James C. Petersen, and Trevor Pinch, 321–342. Thousand Oaks, CA: Sage Publications.
- Barad, Karen Michelle. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham, NC: Duke University Press.
- Bowker, Geof. 2011. “Emerging Configurations of Knowledge Expression: Values and Infrastructure.” Lecture presented at the Summer School of the Netherlands Graduate Research School on Science, Technology and Modern Culture, Ravenstein, the Netherlands.
- Brown, Steven D. 2002. “Michel Serres: Science, Translation and the Logic of the Parasite.” *Theory, Culture and Society* 19(3): 1–27. <https://doi.org/10.1177/0263276402019003001>.
- Calvert, Jane, and Pablo Schyfter. 2017. “What Can Science and Technology Studies Learn from Art and Design? Reflections on ‘Synthetic Aesthetics.’” *Social Studies of Science* 47(2): 195–215. <https://doi.org/10.1177/0306312716678488>.
- Chen, Hsin-Hsing 陳信行. 2011. “司法正義與科學事實如何交會？從 Daubert 爭議看法律、科學與社會” [How does legal justice meet scientific fact? A view on law, science and society through the Daubert controversy]. *科技、醫療與社會 [Taiwanese Journal for Studies of Science, Technology and Medicine]* 12: 17–60. [In Chinese]
- Cohen, Benjamin, and Wyatt Galusky, eds. 2010. “Embodying STS: Identity, Narrative, and the Interdisciplinary Body (Theme Issue).” *Science as Culture* 19(1): 1–122. <https://doi.org/10.1080/09505430903557924>.
- Cole, Simon A. 2009. “A Cautionary Tale about Cautionary Tales about Intervention.” *Organization* 16(1): 121–141. <https://doi.org/10.1177/1350508408098925>.
- Downey, Gary Lee. 2009. “What Is Engineering Studies For? Dominant Practices and Scalable Scholarship.” *Engineering Studies: Journal of the International Network for Engineering Studies* 1(1): 55–76. <https://doi.org/10.1080/19378620902786499>.
- Downey, Gary Lee. 2014. “Opening Presidential Plenary: What Is STS For? What Are STS Scholars For? Making & Doing in STS.” Presentation at the Joint Congreso/Meeting of the Sociedad Latinoamericana de Estudios Sociales de la Ciencia y la Tecnología (ESOCITE) and Society for Social Studies of Science (4S), Buenos Aires, Argentina, August 24.

- Downey, Gary Lee. 2015. "Opening Presidential Plenary: Making & Doing II: The Formation and Ecologies of STS Practitioners." Presentation at the Annual Meeting of the Society for Social Studies of Science, Denver, CO, November 11.
- Downey, Gary Lee, and Joseph Dumit, eds. 1998. *Cyborgs and Citadels: Anthropological Interventions in Emerging Sciences and Technologies*. Santa Fe, NM: The SAR Press.
- Downey, Gary Lee, and Teun Zuiderent-Jerak. 2016. "Making and Doing: Engagement and Reflexive Learning in Science and Technology Studies." Paper presented at 4S/EASST Conference, Barcelona, Spain, August.
- Downey, Gary Lee, and Teun Zuiderent-Jerak. 2017. "Making and Doing: Engagement and Reflexive Learning in STS." In *The Handbook of Science and Technology Studies*, 4th ed., edited by Ulrike Felt, Rayvon Fouché, Clark A. Miller, and Laurel Smith-Doerr, 223–251. Cambridge, MA: MIT Press.
- Drovetto, Javier. 2018. "En Argentina, unas 450 mil familias dedican hasta seis horas diarias para buscar agua." *Red/Acción*, August 8. <https://www.redaccion.com.ar/en-argentina-unas-450-mil-familias-dedican-hasta-seis-horas-diarias-para-buscar-agua/>.
- Dumit, Joseph, and Dawn Nafus. 2018. "The Other Ninety Per Cent: Thinking with Data Science, Creating Data Studies—an Interview with Joseph Dumit." In *Ethnography for a Data-Saturated World*, edited by Hannah Knox and Dawn Nafus, 252–274. Manchester, UK: Manchester University Press.
- Faulkner, Wendy. 2007. "'Nuts and Bolts and People': Gender-Troubled Engineering Identities." *Social Studies of Science* 37(3): 331–356. <https://doi.org/10.1177/0306312706072175>.
- Frickel, Scott, Sahra Gibbon, Jeff Howard, Joanna Kempner, Gwen Ottinger, and David J. Hess. 2010. "Undone Science: Charting Social Movement and Civil Society Challenges to Research Agenda Setting." *Science, Technology and Human Values* 35(4): 444–473. <https://doi.org/10.1177/0162243909345836>.
- Guggenheim, Michael. 2015. "The Media of Sociology: Tight or Loose Translations?" *British Journal of Sociology* 66(2): 345–378. <https://doi.org/10.1111/1468-4446.12125>.
- Guggenheim, Michael, Bernd Kräftner, and Judith Kröll. 2018. "Incubations: Inventing Preventive Assemblages." In *Inventing the Social*, edited by Noortje Marres, Michael Guggenheim, and Alex Wilkie, 65–93. Manchester, UK: Mattering Press.
- Haraway, Donna Jeanne. 1991. *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge.
- Harding, Sandra G. 1986. *The Science Question in Feminism*. Ithaca, NY: Cornell University Press.
- Harding, Sandra G. 1991. *Whose Science? Whose Knowledge? Thinking from Women's Lives, Science Question in Feminism*. Ithaca, NY: Cornell University Press.
- Jerak-Zuiderent, Sonja. 2020. "How to Care for Our Accounts?" In *The Routledge Companion to Actor-Network Theory*, edited by Anders Blok, Ignacio Farias, and Celia Roberts, 190–199. London: Routledge.
- Jobin, Paul, Hsin-hsing Chen, and Yi-ping Lin. 2018. "Translating Toxic Exposure: Taiwan RCA." *Toxic News*, February 1. <https://toxicnews.org/2018/02/01/translating-toxic-exposure-taiwan-rca/>.
- Juarez, Paula. 2019. "Políticas públicas de agua y saneamiento: No todo es cuestión de infraestructura." *Notas: Periodismo popular*, May 21. <https://notasperiodismopopular.com.ar/2019/05/21/politicas-publicas-agua-saneamiento-infraestructura/>.
- Keller, Evelyn Fox. 1993. *A Feeling for the Organism: The Life and Work of Barbara McClintock*. New York: W. H. Freeman.

- Kember, Sarah. 2003. *Cyberfeminism and Artificial Life*. London: Routledge.
- Kreimer, Pablo, and Hernán Thomas. 2004. "The Social Appropriability of Scientific and Technological Knowledge as a Theoretic-Methodological Problem." In *Science and Technology Policy*, vol. 1, edited by Rigas Arvanitis, 79–90. London: EOLSS Publishers.
- Latour, Bruno. 2004. "Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern." *Critical Inquiry* 30(2): 225–248.
- Latour, Bruno, and Peter Weibel. 2005. *Making Things Public: Atmospheres of Democracy*. Cambridge, MA: MIT Press.
- Law, John, and Vicky Singleton. 2013. "ANT and Politics: Working in and on the World." *Qualitative Sociology* 36(4): 485–502. <https://doi.org/10.1007/s11133-013-9263-7>.
- Law, John, and John Urry. 2004. "Enacting the Social." *Economy and Society* 33(3): 390–410.
- Lezaun, Javier, Noortje Narres, and Manuel Tironi. 2017. "Experiments in Participation." In *The Handbook of Science and Technology Studies*, 4th ed., edited by Ulrike Felt, Rayvon Fouché, Clark A. Miller, and Laurel Smith-Doerr, 195–221. Cambridge, MA: MIT Press.
- Lin, Yi-Ping 林宜平. 2011. "死了幾位電子廠女工之後：有機溶劑的健康風險爭議" [After the death of some electronics workers: The health risk controversies of organic solvents]. *科技、醫療與社會 [Taiwanese Journal for Studies of Science, Technology and Medicine]* 12: 61–112. [In Chinese]
- Lin, Yi-ping, Hsin-hsing Chen, and Paul Jobin. 2018. "The Real 'Best Friend of the Court.'" *Taipei Times*, June 20. <http://www.taipetimes.com/News/editorials/archives/2018/06/20/2003695170>.
- Lury, Celia, and Nina Wakeford. 2012. *Inventive Methods: The Happening of the Social*. Hoboken, NJ: Taylor and Francis.
- Lynch, Michael. 2009. "Science as a Vacation: Deficits, Surfeits, PUSS, and Doing Your Own Job." *Organization* 16(1): 101–119. <https://doi.org/10.1177/1350508408098924>.
- Lynch, Michael, and Simon Cole. 2005. "Science and Technology Studies on Trial: Dilemmas of Expertise." *Social Studies of Science* 35(2): 269–311.
- Marres, Noortje. 2005. "Issues Spark a Public into Being: A Key but Often Forgotten Point of the Lippmann-Dewey Debate." In *Making Things Public*, edited by Bruno Latour and Peter Weibel, 208–217. Cambridge, MA: MIT Press.
- Marres, Noortje, Michael Guggenheim, and Alex Wilkie, eds. 2018. *Inventing the Social*. Manchester, UK: Mattering Press.
- Martin, Aryn, Natasha Myers, and Ana Viseu. 2015. "The Politics of Care in Technoscience." *Social Studies of Science* 45(5): 625–641. <https://doi.org/10.1177/0306312715602073>.
- Mol, Annemarie. 1999. "Ontological Politics: A Word and Some Questions." In *Actor Network Theory and After*, edited by John Law and John Hassard, 74–89. Oxford: Blackwell Publishers.
- Piscetta, Juan. 2020. "Otro drama argentino: Casi cuatro de cada diez chicos no tiene acceso al agua potable." *Infobae*, February 23. <https://www.infobae.com/sociedad/2020/02/23/otro-drama-argentino-casi-cuatro-de-cada-diez-chicos-no-tiene-acceso-al-agua-potable/>.
- Puig de la Bellacasa, Maria. 2011. "Matters of Care in Technoscience: Assembling Neglected Things." *Social Studies of Science* 41(1): 85–106. <https://doi.org/10.1177/0306312710380301>.
- Puig de la Bellacasa, María. 2017. *Matters of Care: Speculative Ethics in More than Human Worlds*. Minneapolis: University of Minnesota Press.

Russell, Andrew, and Lee Vinsel. 2016. "Hail the Maintainers." *Aeon*. <https://aeon.co/essays/innovation-is-overvalued-maintenance-often-matters-more>.

Scott, Pam, Evelleen Richards, and Brian Martin. 1990. "Captives of Controversy: The Myth of the Neutral Social Researcher in Contemporary Scientific Controversies." *Science, Technology, and Human Values* 15(4): 474–494. <http://doi.org/10.1177/016224399001500406>.

Serres, Michel. 1983. *Hermes: Literature, Science, Philosophy*. Baltimore: Johns Hopkins University Press.

Society for Social Studies of Science. 2021. "Making and Doing." <https://www.4sonline.org/sts-resources/making-and-doing/>.

Suchman, Lucy, Heather Paxson, Daniel Breslau, Mary L. Gray, Claudia Castañeda, Tarleton Gillespie, Nick Seaver, Banu Subramaniam, T. L. Taylor, and Clare Kim. 2017. *4S 2017: STS (In)Sensibilities*. Society for Social Studies of Science. http://4sonline.org/files/4S17_program_final_web.pdf.

Thomas, Hernán, and Pablo Kreimer. 2002. "La apropiabilidad social del conocimiento científico y tecnológico: Una propuesta de abordaje teórico-metodológico." In *Panorama dos estudos de Ciência, Tecnologia e Sociedade na América Latina*, edited by R. Dagnino and Hernán Thomas, 273–291. São Paulo: Cabral-FINEP.

Vertesi, Janet, Carl DiSalvo, David Ribes, Doris Allhutter, Nerea Calvillo, Alexandre Camus, Anita Say Chan, Padma Chirumamilla, Marisa Leavitt Cohn, and Stéphane Couture. 2019. *DigitalSTS: A Field Guide for Science and Technology Studies*. Princeton, NJ: Princeton University Press.

Wajcman, Judy. 1991. *Feminism Confronts Technology*. University Park: Pennsylvania State University Press.

Watson-Verran, Helen, the Yolngu Community at Yirrkala, and David Wade Chambers. 1989. *Singing the Land, Signing the Land*. Melbourne: Deakin University Press. <http://singing.indigeneknowledge.org>.

Wieringa, Sietse, Dunja Dreesens, Frode Forland, Carel Hulshof, Sue Lukersmith, Fergus Macbeth, Beth Shaw, Arlène van Vliet, and Teun Zuiderent-Jerak. 2018. "Different Knowledge, Different Styles of Reasoning: A Challenge for Guideline Development." *BMJ Evidence-Based Medicine* 23(3): 87–91. <http://dx.doi.org/10.1136/bmjebm-2017-110844>.

Wyatt, Sally. 2008. "Technological Determinism Is Dead: Long Live Technological Determinism." In *The Handbook of Science and Technology Studies*, 3rd ed., edited by Edward J. Hackett, Olga Amsterdamska, Michael Lynch, and Judy Wajcman, 165–181. Cambridge, MA: MIT Press.

Wylie, Sara, Nick Shapiro, and Max Liboiron. 2017. "Making and Doing Politics through Grassroots Scientific Research on the Energy and Petrochemical Industries." *Engaging Science, Technology and Society* 3: 393–425. <https://doi.org/10.17351/ests2017.134>.

Wylie, Sara Ann. 2018. *Fractivism: Corporate Bodies and Chemical Bonds*. Durham, NC: Duke University Press.

Xie Peiqi 謝佩琪. 2018. "RCA 案三審開庭 公衛學界聲援受害者：用科學替你們發聲！" [RCA case's third trial brings public health and academic community to support victims: Use science to speak for you!]. *風傳媒 [Storm Media]*, June 21. <https://www.storm.mg/article/452061>. [In Chinese]

Zuiderent-Jerak, Teun. 2015. *Situated Intervention: Sociological Experiments in Health Care*. Cambridge, MA: MIT Press.

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