

## Notes

### PROLOGUE

1. This has been a key insight especially of feminist scholars in anthropology and science and technology studies. For a short summary, see Carsten, Day, and Stafford, “Introduction.”
2. Carsten, Day, and Stafford, “Introduction,” 7.
3. Carsten, Day, and Stafford, “Introduction,” 6.
4. Carsten, Day, and Stafford, “Introduction,” 6.
5. Forsythe, *Studying Those Who Study Us*, 125.
6. Scheper-Hughes, “Ire in Ireland.”
7. Forsythe, *Studying Those Who Study Us*, 123.
8. Rolston, *Mining Coal and Undermining Gender*.
9. Though the stresses of navigating corporate employment, temporary research positions, and university promotion and tenure systems are quite different, my institutional location created some resonances with Forsythe’s observation that “it is one thing to write critically about events halfway around the world, or for a tenured professor to publish a critique of local power structures. It is quite another for an anthropologist in a corporation or on soft money to call into question the practices of those who employ her and who may be in a position to affect her future ability to make a living.” Forsythe, *Studying Those Who Study Us*, 123 (emphasis added).
10. Downey, “What Is Engineering Studies For?”
11. I am grateful to Beth Reddy for alerting me to this term and thinking with me about how it applies to those of us who work among engineers and applied scientists.
12. Shotwell, *Against Purity*, 107.

## CHAPTER 1

1. Aaron's experience underscores Daniel Franks's observation that "change agents" inside corporations face challenges in being viewed with suspicion from both inside and outside but excel in drawing different worlds together. Franks, *Mountain Movers*.
2. For a critique of how the concept of stakeholders can privilege "consensus" that can reproduce social and environmental injustices, see chapter 6.
3. In this book I follow other social scientists in using *CSR* as an umbrella term that groups together a very diverse field of practices related to managing relationships between business and society. Companies and personnel label these activities with a variety of related yet distinct terms, such as *corporate responsibility*, *sustainability*, and *social performance*.
4. Winner, "Engineering Ethics and Political Imagination," 59.
5. Mitcham, "True Grand Challenge for Engineering."
6. Strathern, "New Accountabilities," 2.
7. Murphy, "Corporate Social Responsiveness."
8. Franks, *Mountain Movers*; Owen and Kemp, *Extractive Relations*.
9. Hawken, Lovins, and Lovins, *Natural Capitalism*; Porter and Kramer, "Creating Shared Value."
10. Wisnioski, *Engineers for Change*, 69.
11. Star and Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects," 393.
12. Star, "This Is Not a Boundary Object," 604.
13. Blowfield and Frynas, "Setting New Agendas," 512.
14. Welker, "Corporate Security Begins in the Community," 145; see also Fortun, *Advocacy after Bhopal*.
15. Lucena, "Engineers and Community"; Ottinger, *Refining Expertise*.
16. Appel, *Licit Life of Capitalism*; Barry, *Material Politics*.
17. Nixon, *Slow Violence*.
18. Ryan Cecil Jobson insightfully places coal-based industrialization, and its exploitation of wage labor, within a much longer history of plantation slavery turning human labor power into a thermodynamic reserve of potential energy. Jobson, "Dead Labor." See also Appel, *Licit Life of Capitalism*.
19. Kirsch, *Reverse Anthropology*; Jacka, *Alchemy in the Rain Forest*; Ottinger, *Refining Expertise*; Sawyer, *Crude Chronicles*.
20. Argenti and Knight, "Sun, Wind, and the Rebirth of Extractive Economies"; Howe, *Ecologics*.
21. Appel, *Licit Life of Capitalism*.

22. LeCain, *Mass Destruction*, 53.
23. LeCain, *Mass Destruction*, 209. As a case in point, in the Wyoming coal mines I first studied, crews had to move two to three tons of “overburden” (rock and dirt) to reach each ton of coal, leading some miners to joke that they would be more accurately described as “dirt haulers.” Those ratios continue to increase as companies exhaust the deposits that are easier to access.
24. Priest, *Offshore Imperative*.
25. Boyer, “Infrastructure, Potential Energy, Revolution,” 226.
26. Appadurai, “Mediants, Materiality, Normativity,” 24. Quoted in Anand, Gupta, and Han-nah, Introduction, 24.
27. For an overview of this tendency in academic research about mining and energy, see Smith and Tidwell, “Everyday Lives of Energy Transitions.”
28. Berry, *Devoted to Nature*.
29. These life projects resonate with the “moral ambitions” of Mette M. High’s interlocutors but were not as explicitly grounded in Christian religious beliefs. High, “Projects of Devotion.”
30. Ballesterio, *Future History of Water*, 4.
31. Mitcham suggests why this could be: “Engineers often believed that such loyalty was in the public interest because of their strong beliefs that capitalist corporations were themselves public benefactors.” Mitcham, *Steps toward a Philosophy of Engineering*, 159.
32. Appel, *Licit Life of Capitalism*.
33. Appel, *Licit Life of Capitalism*, 5.
34. Following Marina Welker, Damani Partridge, and Rebecca Hardin, I refer to *corporate forms* rather than *corporations* in order to “productively shift away from default conceptualizations of corporations as solid, unified, self-knowing, and self-present actors that relentlessly maximize profits and externalize harm. Such an understanding of corporations, while appealing for its black-and-white guide to judgment, is divorced from history, geography, and actual corporate practice.” Welker, Partridge, and Hardin, “Corporate Lives,” S5.
35. Appel, *Licit Life of Capitalism*, 51; see 44 and 46 for visuals of the corporate archipelago.
36. Benson, “El Campo”; Müftüoğlu et al., “Rethinking Access”; Rajak, *In Good Company*; Shever, “Engendering the Company”; Welker, *Enacting the Corporation*.
37. As Annelise Riles writes, “The fact that the corporation is ‘one’ from the vantage point of the state does not negate the way it might be ‘many’ from another point of view.” Riles, “Too Big to Fail,” 39.
38. Mol, *Body Multiple*.
39. Welker, *Enacting the Corporation*.
40. Williams, Muller, and Kilanski, “Gendered Organizations in the New Economy,” 556.

41. As a case in point, AMAX, the mining company analyzed in chapter 3, also owned and operated the first large-scale coal mine in my hometown and my first research site. When AMAX tried to win public approval for the new mine in the 1970s, its personnel promised environmental stewardship and respectful treatment of miners. The mine was sold and purchased multiple times over the next four decades, until one of the companies declared bankruptcy, failed to make its required contributions to the miners' retirement accounts, and potentially left the state of Wyoming on the hook for remediation.
42. Kirsch, *Mining Capitalism*, 10; Appadurai, "Mediants, Materiality, Normativity," 16.
43. Laura Bear, Karen Ho, Anna Tsing, and Sylvia Yanagisako, "Gens: A Feminist Manifesto for the Study of Capitalism," Society for Cultural Anthropology, March 30, 2015, <https://culanth.org/fieldsights/652-gens-a-feminist-manifesto-for-the-study-of-capitalism>.
44. Ho, *Liquidated*.
45. Mitcham, *Steps toward a Philosophy of Engineering*, 22.
46. On infrastructures exceeding human lifetimes, see esp. Anand, Gupta, and Appel, *Promise of Infrastructure*.
47. Leydens and Lucena, *Engineering Justice*, 1.
48. Anand, Gupta, and Appel, *Promise of Infrastructure*.
49. Jacka, *Alchemy in the Rain Forest*; Jacka, "Anthropology of Mining," 22; Kirsch, *Reverse Anthropology*; Kirsch, *Mining Capitalism*; Sawyer, *Crude Chronicles*; Willow, *Understanding ExtrACTIVISM*; Wylie, *Fractivism*.
50. Folch, *Hydropolitics*; Barry, *Material Politics*; Harvey and Knox, *Roads*; Özden-Schilling, "Infrastructure of Markets"; Barnes, *Cultivating the Nile*.
51. Li, *Unearthing Conflict*.
52. Espig and de Rijke, "Unconventional Gas Developments."
53. Kneas, "Subsoil Abundance and Surface Absence"; Kneas, "From Dearth to El Dorado"; Kneas, "Emergence and Aftermath."
54. Hughes, *Energy without Conscience*.
55. Rajak, *In Good Company*, 236.
56. Welker, *Enacting the Corporation*, 65.
57. Rogers, *Depths of Russia*, 176.
58. Owen and Kemp, *Extractive Relations*, 223.
59. Owen and Kemp, *Extractive Relations*; Welker, *Enacting the Corporation*, 65.
60. Gilbert and Sklair, "Introduction," 4.
61. Ortner, "Resistance and the Problem of Ethnographic Refusal."
62. Ballesterio, *Future History of Water*, 146.

63. Welker, *Enacting the Corporation*, 16.
64. Gilbert and Sklair, "Introduction"; Hughes, *Energy without Conscience*.
65. Hughes, *Energy without Conscience*, 152, 4.
66. Wisnioski, *Engineers for Change*, 4.
67. Mitchell, *Rule of Experts*; Scott, *Seeing like a State*.
68. Lucena, Schneider, and Leydens, "Engineering and Sustainable Community Development."
69. Boyer, "Infrastructure, Potential Energy, Revolution."
70. Harvey and Knox, *Roads*, 9.
71. Puig de la Bellacasa, "Ethical Doings in Naturecultures," 152.
72. Gilbert and Sklair, "Introduction."
73. High and Smith, "Introduction."
74. Ballesterio, *Future History of Water*, 5.
75. High and Smith, "Introduction."
76. This question was posed eloquently by Dean Nieuwma in his feedback on the manuscript for this book.
77. Indeed, one senior mining engineering professor told me that CSR was the "dessert" of the "main meal of mining," reinforcing the technical/social dualism critiqued in chapter 6. This trivialization of "the social" animates many technoscientific workplaces: even Forsythe recalls one of her interlocutors in artificial intelligence viewing her anthropological work as "frosting on the cake." Forsythe, *Studying Those Who Study Us*, 126
78. *Public* is a notoriously slippery term, perhaps most often used to refer to political collectives distinct from both markets and states. This book follows in the vein of work that emphasizes how publics congeal around infrastructure to make claims on governments and corporations. Infrastructures "show how publics are not just made through enunciatory communities, circulations of intention, text, and speech that produce disembodied spheres of deliberation and fantasies free of circulation. . . . Publics are also made by infrastructures that assemble collectives, constitute political subjects, and generate social aspirations." Anand, Gupta, and Appel, Introduction, 23. See also Barry, *Material Politics*.
79. Müftüoğlu et al., "Rethinking Access," 250
80. Müftüoğlu et al., "Rethinking Access," 257.
81. Forsythe, *Studying Those Who Study Us*, 125.
82. This research investigated the place of memorandums of understanding—put forward as a best practice in providing communities with more control over unconventional energy production—in Colorado fracking controversies.
83. Gusterson, *Nuclear Rites*, 115.

84. Memorable exceptions include Rajak, *In Good Company*; Rogers, *Depths of Russia*; and Welker, *Enacting the Corporation*.
85. Müftüoğlu et al., “Rethinking Access,” 257.
86. Boyer, “Thinking through the Anthropology of Experts,” 43.
87. I conducted about half of the project’s total 75 interviews, and anthropologist Nicole Smith conducted about half of the interviews while working as a postdoctoral scholar on National Science Foundation grant 1540298 that funded the research for this book. I follow ethnographic conventions in not identifying the interviewees by name, except for those in chapter 3 who also appear in the public records analyzed here and gave permission to be identified.
88. Mining engineering and petroleum engineering represent a relatively small proportion of engineering undergraduates in the US. The American Society for Engineering Education estimated that, in 2018, 245 bachelor’s degrees in mining engineering were awarded across the country (0.2 percent of the 131,937 total for all engineering bachelor’s degrees) and 2,118 were awarded (1.6 percent of total) in petroleum engineering. In contrast, the report estimated 31,936 bachelor’s degrees in mechanical engineering. Joseph Roy, “Engineering by the Numbers,” American Society for Engineering Education, July 2019, <https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf>.
89. Rajak, “Theatres of Virtue.”
90. Conley and Williams, “Engage, Embed, and Embellish”; Müftüoğlu et al., “Rethinking Access”; Rajak, *In Good Company*.
91. Downey, “What Is Engineering Studies For?”
92. Downey, *Machine in Me*, 199.
93. Kunda, *Engineering Culture*; Yarrow, *Architects*.
94. Yarrow, *Architects*.
95. Müftüoğlu et al., “Rethinking Access,” 2, 4.
96. Müftüoğlu et al., “Rethinking Access,” 4. See also Conley and Williams, “Engage, Embed, and Embellish”; and Dolan and Rajak, “Introduction.”
97. Readers will also note that I refrain as much as possible from using the terminology of “extractive” industries. This is, first, to acknowledge the significant differences between the two industries and caution against social scientists inappropriately collapsing them together. Second, *extractive* is a term that indexes critique of these industries; it is not a term that any of my interlocutors used to describe their own work. Hughes’s ethnography helps explain why the term offends petroleum geoscientists and engineers. He argues that they construct oil as a material that seems to desire to be on the planet’s surface; rather than needing to be “extracted” like mined minerals that are forcibly hauled to the surface, oil is constructed in graphical representations of the subsurface and notions such as hydrocarbon

uplift as “naturally” seeking upward movement, such that the task of engineers and scientists is simply to liberate it so that oil “virtually produces itself.” Hughes, *Energy without Conscience*, 65.

98. Rogers, “Materiality of the Corporation.” See also Ferguson, *Global Shadows*; Kneas, “Subsoil Abundance and Surface Absence”; Kneas, “Emergence and Aftermath”; and Richardson and Weszkalnys, “Introduction.”
99. Welker, *Enacting the Corporation*.

## CHAPTER 2

1. Strathern, “New Accountabilities,” 4.
2. Trnka and Trundle, “Introduction,” 5. See also Laidlaw, “Ethics”; and Kelty, “Responsibility.” For an influential critique of those neoliberal forms of personhood see Rose, *Politics of Life Itself*.
3. Li, *Unearthing Conflict*. In contrast, Trnka and Trundle argue that responsibility is predicated on recognition of the Other. Trnka and Trundle, “Introduction,” 18. It is much more common for engineers and those who study them to use the term *social responsibility*. This preference may reflect the diffuse imagination of public welfare that animates most professional engineering societies’ ethical codes.
4. Downey, “What Is Engineering Studies For?”
5. Latour, “Why Has Critique Run Out of Steam?”
6. Johnson, “Rethinking the Social Responsibilities of Engineers,” 90.
7. Johnson, “Rethinking the Social Responsibilities of Engineers,” 96–97.
8. In practice, however, ethics codes played a strikingly minor role in how the engineers I came to know thought about and practiced accountability to their coworkers and the public: not one of them mentioned referencing a professional code for guidance on a tough decision. Instead, they referenced corporate policies, legal statutes, and standards.
9. Drawing on fine-grained ethnography of the Denver headquarters of Newmont Corporation—the world’s largest gold mining company—and its Batu Hijau copper-gold mine in Indonesia, Marina Welker argues that profit maximization forms a “large and loose target, an imprecise orienting device rather than a clear roadmap prescribing a fixed route for corporate managers and staff to follow.” She interprets invocations of the business case as “claim-making devices that people deploy in particular contexts in order to justify or support particular courses of action.” Welker, *Enacting the Corporation*, 17.
10. For a more in-depth analysis of Joe’s experiences, see Smith et al., “Plea for Enhancing Engineering Ethics.”
11. Mitcham, *Steps toward a Philosophy of Engineering*. For more in-depth engagement with this idea, see chapter 7 of this book.

12. Penelope Harvey and Hannah Knox argue that engineers can point to standards as a way of detaching personal responsibility for their actions, which likely holds true for the other formal accountability schemes. Drawing on their research with civil engineers working on a major infrastructure project in Peru, they argue, “The political formation of the regulatory frame points us to the ways in which standards are devices that allow engineer to control without personal responsibility, without having to acknowledge their involvement, and certainly without having to confront the issue of what gets left out of the picture once the regulations are applied.” Harvey and Knox, “Virtuous Detachments,” 67.
13. Mitcham argues that the practical effect of the loyalty clause in engineering ethics codes was to “undermine independence” and promote a “self-imposed tutelage to capitalist corporate employers.” Mitcham, *Steps toward a Philosophy of Engineering*, 159.
14. Gary Downey concisely summarizes Layton’s original influential argument and critiques of it: “The story of what Edwin Layton called the *Revolt of the Engineers* is told by him as a victory of engineering leaders associated with industry, by Noble as a victory of corporate capital, and by Meiksins as the product of a temporary alliance between elite reformers and rank and file engineers who accepted locations within companies but sought to increase income.” Downey, “Low Cost, Mass Use,” 298.
15. Through the committee, Jackson developed “a wide ranging Canon of Ethics and spent the rest of his time as chairman persuading various regional and national engineering organizations to adopt it. His embrace of the view of engineers as businessmen, coupled with the pro-business orientation of the codes of ethics that emerged during the Progressive Era, lends credence to concerns that corporate interests seep into engineering ethics education even outside of recognized CSR discourses.” Smith and Lucena, “Socially Responsible Engineering,” 664.
16. Mitcham, *Steps toward a Philosophy of Engineering*.
17. Downey, “Low Cost, Mass Use.” See also Layton, *Revolt of the Engineers*; Meiksins, “‘Revolt of the Engineers’ Reconsidered”; Meiksins and Smith, “Why American Engineers Aren’t Unionized”; and Noble, *America by Design*.
18. Wisnioski, *Engineers for Change*, 67.
19. Mitcham, “Historico-ethical Perspective on Engineering Education”; Tang and Nieuwsma, “Contextualizing the Code”; Wisnioski, *Engineers for Change*.
20. See IEEE, “Homepage,” <https://www.ieee.org> (accessed January 1, 2021).
21. Wisnioski, *Engineers for Change*, 68. It is telling that none of my interlocutors pointed to their professional ethics codes as shaping how they reasoned through dilemmas. A few referenced external standards in the form of World Bank/International Finance Corporation performance standards or ISO (International Organization for Standardization) certifications but found that they had to be justified by positioning them in relation to their company’s own CSR policies.
22. Mitcham, *Steps toward a Philosophy of Engineering*.



23. Williamson, “Small-Scale Technology for the Developing World”; Wisnioski, *Engineers for Change*.
24. Mody, *The Squares*.
25. Lucena, Schneider, and Leydens, “Engineering and Sustainable Community Development”; Leydens and Lucena, *Engineering Justice*.
26. Herkert, “Future Directions in Engineering Ethics Research.”
27. Downey, “What Is Engineering Studies For?”
28. Smith, “Ethics of Material Provisioning.”
29. Appel, “Conclusion,” 181.
30. Appel, “Conclusion,” 181.
31. Dahlgren, “Digging Deeper,” 174.
32. The “humans” Kim invokes are actually a privileged group, as not everyone uses Amazon or drives a car.
33. LeCain, *Mass Destruction*, 191–193.
34. Huber, *Lifeblood*, 71, 72.
35. See American Petroleum Institute, “News, Policy, and Issues,” <https://www.api.org/news-policy-and-issues/top-industry-policy-issues> (accessed July 12, 2020).
36. Smith and Tidwell, “Everyday Lives of Energy Transitions.”
37. LeCain, *Mass Destruction*, 186; Wisnioski, *Engineers for Change*, 11–12.
38. Chapman, “Multinatural Resources; Huber, *Lifeblood*, 90; Hughes, *Energy without Conscience*, 309.
39. Hochschild, *Strangers in Their Own Land*.
40. Downey, “Low Cost, Mass Use.”
41. Brueckner and Eabrasu, “Pinning Down the Social License to Operate (SLO)”; Owen and Kemp, *Extractive Relations*.
42. Boutilier and Thomson, *Social License*, 8. For an earlier iteration, see Thomson and Boutilier, “Social Licence to Operate.”
43. Owen and Kemp, “Social Licence and Mining,” 30.
44. Brueckner and Eabrasu, “Pinning Down the Social License to Operate (SLO).”
45. Delborne, Kokotovich, and Lunshof, “Social License and Synthetic Biology.”
46. Gehman, Lefsrud, and Fast, “Social License to Operate.”
47. Thomson and Boutilier, “Social Licence to Operate.” Stuart Kirsch places it a year earlier in the paper and pulp industry, which was seeking to avoid new government regulations. Kirsch, *Mining Capitalism*, 209.

48. These consultants wielded great power to transform industry practice but also came under fire for their “greater fealty to their employers than to the indigenous people these processes were intended to protect.” Kirsch, *Mining Capitalism*, 212.
49. Owen and Kemp, *Extractive Relations*, 30.
50. For a critique of Shell’s CSR reporting, see Livesey and Kearins, “Transparent and Caring Corporations?”
51. Knight, “Profits and principles,” 20.
52. Davis and Franks, “Costs of Company–Community Conflict in the Extractive Sector”; Franks et al., “Conflict Translates Environmental and Social Risk into Business Costs.”
53. On the limitations of Ruggie’s framework, see Kirsch, *Mining Capitalism*, 211.
54. Brueckner and Eabrasu, “Pinning Down the Social License to Operate (SLO)”; Prno and Slocombe, “Exploring the Origins of ‘Social License to Operate’ in the Mining Sector”; Thomson and Boutilier, “Social Licence to Operate.”
55. Boutilier and Thomson, *Social License*.
56. Owen and Kemp, “Social Licence and Mining”; Welker, “Corporate Security Begins in the Community.”
57. Gardner, *Discordant Development*; Rajak, *In Good Company*.
58. Kirsch, *Mining Capitalism*; Ottinger, *Refining Expertise*; Rajak, *In Good Company*.
59. Delborne, Kokotovich, and Lunshof, “Social License and Synthetic Biology,” 4.
60. Kirsch, *Mining Capitalism*, 209.
61. Owen and Kemp, “Social Licence and Mining,” 34.
62. Katy Gardner argues that rumors are a way for people to make sense of what is going on around them, including by expressing and perpetuating fear, which offers us a way of seeing the world as our narrators see it. Gardner, *Discordant Development*, 194, 222.
63. Smith et al., “Industry–University Partnerships.”
64. This was a common analogy among my most senior interlocutors, who argued that safety first moved from being a cost of doing business to being part of corporate missions, followed by environmental protection, and then a variety of “social” concerns of sustainable development and community acceptance. The lack of stability for a term for this domain of practice signals its ongoing contestation and the lack of fit with distinct “social” goals, such as social risk management and sustainable development.
65. Nader, “Controlling Processes.”
66. Smith and Helfgott, “Flexibility or Exploitation?,” 20. See also Cloud, “Corporate Social Responsibility as Oxymoron”; and Eagleton, *Ideology*.
67. His invocation of shareholders supports Kirsch’s argument that the SLO is a technique to assure shareholders that a company can manage risk. Kirsch, *Mining Capitalism*, 209.

68. Smith, "From Corporate Social Responsibility to Creating Shared Value."
69. Welker, *Enacting the Corporation*, 65. See also Owen and Kemp, *Extractive Relations*, 226.

### CHAPTER 3

1. Most of the mining industry personnel I met had moved away aspirations for "sustainable mining" to instead focus on mining's contributions to sustainable development. The most stringent critique I heard was from June, a mining engineer who candidly said, "The other thing that always gets to me as an engineer is, we call this sustainable development. To me, that's a joke. These are not sustainable industries. These are extractive industries. When the extractive industry leaves, there's going to be an impact on the community no matter what you do. All you can do is try and do something [good]." Academics have been far more critical of the proposal that mining can be sustainable, including by arguing that the term sustainable mining is a "corporate oxymoron." Kirsch, "Sustainable Mining."
2. Frynas, "Political Instability and Business"; Watts, "Blood Oil."
3. Rolston, *Mining Coal and Undermining Gender*.
4. The chapter draws from both Stan Dempsey's and Art Biddle's personal archives—which included letters, speeches, notes, newspaper clippings, and public relations materials—as well as multiple interviews with each. I also worked extensively with Biddle in the CSR educational activities I developed at the Colorado School of Mines, described in the prologue and epilogue; he participated as a judge for student projects, presented his experiences in my CSR course, and attended social events bringing together Mines students and alumni. To contextualize Dempsey's and Biddle's work, I also interviewed engineers and applied scientists who worked on these projects as AMAX employees, as consultants, and as state agency officials and made trips to visit the museums and archives in both Gunnison and Crested Butte, Colorado, where I also discussed the mining controversy with residents and historians there. I name Dempsey and Biddle because they took on public-facing roles in the debates and gave me permission to do so, but I do not use the real names of the other people mentioned in this chapter, as they did not take on public roles in the debates. This chapter's focus on two individuals fits within broader calls for "life writing" as a complement to ethnography, which otherwise focuses on social patterns instead of particular individuals. Carsten, Day, and Stafford, "Introduction."
5. Appel, "Walls and White Elephants"; Gilberthorpe and Banks, "Development on Whose Terms?"; Jacka, "Anthropology of Mining"; Kirsch, *Mining Capitalism*; Li, *Unearthing Conflict*; Rajak, *In Good Company*.
6. Barandiarán, *Science and Environment in Chile*.
7. Li, "Documenting Accountability," 218.
8. See chapter 6 for a more in-depth consideration of engineering pragmatism.
9. Franks, *Mountain Movers*.
10. Indeed, Dempsey recognized that the language of cost effectiveness would help to win over engineers to his more progressive views of environmental management and social acceptance,

and he invoked the specter of costly delays forty years before the landmark “Cost of Conflict” study described in chapter 2. One retelling of the Experiment in Ecology stated: “When working with AMAX managers and engineers, Dempsey does not talk about saving the environment just for the environment’s sake. He seeks rather to frame the problems and solutions in terms of cost effectiveness. He tries to show the manager how the environmentally correct way will pay off in the long run even if it costs more in the immediate time frame. Dempsey’s chief argument is that doing the right kind of environmental homework can prevent years of costly delay.” Cahn, *Footprints on the Planet*, 76.

11. Kelty, *Participant*, 36.
12. Increased attention to the environment in the 1970s followed on the heels of the 1950s and 1960s uptick in federal workplace safety regulations.
13. Hoffman, *From Heresy to Dogma*, 12.
14. Cumming, “Black Gold, White Power.”
15. Jenkins, *Decade of Nightmares*.
16. Kaiser, *How the Hippies Saved Physics*; Kaiser and McCray, *Groovy Science*.
17. Mody, *The Squares*.
18. Gottlieb, *Forcing the Spring*, 204; Wellock, *Critical Masses*, 112.
19. Hoffman, *From Heresy to Dogma*, 12.
20. Barandiarán, *Science and Environment in Chile*, 9
21. Barandiarán, *Science and Environment in Chile*, 24.
22. Mathews and Barnes, “Prognosis.”
23. Barandiarán, *Science and Environment in Chile*; Li, “Documenting Accountability”; McNeil, *Combating Mountaintop Removal*; Ottinger, *Refining Expertise*. Moreover, an in-depth comparison of environmental impact projections and actual water quality performance at hard rock mines revealed that the projections systematically underestimated potential pollution. Kuipers et al., “Comparison of Predicted and Actual Water Quality at Hardrock Mines.”
24. Barandiarán, *Science and Environment in Chile*, 37.
25. The baseline studies were done for Henderson mine, and the first full environmental impact statement was for the Belle Ayr coal mine in Gillette, Wyoming. Dempsey argued that, whereas other the companies seeking to develop mines in the booming Powder River Basin hedged their bets on overturning NEPA and its requirements for impact assessment, he took the impending regulatory changes as actuality and began drafting the EIA before NEPA was actually passed in to law. This allowed AMAX to get Belle Ayr up and running before the 1974 Supreme Court injunction that temporarily halted coal development in the basin, beating the other mines to coal production by at least five years. See Rolston, *Mining Coal and Undermining Gender*, chap. 2.
26. AMAX was the product of a merger, in this case, between American Metal Co. Ltd. and Climax Molybdenum Company in 1957.

27. AMAX made the case for the continued and expanded moly production by invoking the ethic of material provisioning in advertisements, a company-wide magazine, the Mt Emmons project's *Moly Newsletter*, speeches, and published documents. A 1981 article about environmental permitting by Biddle and colleagues explained that moly can "improve strengths, hardenability, weldability, corrosion-resistance, abrasion-resistance, and heat-resistance in steels for building spacecraft and aircraft parts, Arctic pipeline, building structures, solar panels, railroad rails, automobiles and machinery. Moly is also used in chemicals and lubricants, including engine oils and grease, pigments in paints and plastic, fertilizers, seed treatments and foliar sprays." Biddle, Livermore, and Poe, "AMAX Inc and the Colorado Joint Review Process."
28. See, e.g., *Journal of Metals*, "Henderson Mine/Mill/Concentrator"; Paxton, "Experiment in Ecology"; and *Engineering and Mining Journal*, "Openness, Cooperation."
29. Government agencies included the US Forest Service; Bureau of Land Management; US Fish and Wildlife Service; Colorado Game, Fish and Parks Department; State Bureau of Mines; and Colorado Water Pollution Control Commission.
30. In 1999, the company received an Environmental Awareness Award from the US Forest Service for the design, engineering, construction, and implementation of a fifteen-mile overland conveyor system that replaced the original rail line.
31. *Journal of Metals*, "Henderson Mine/Mill/Concentrator," 12.
32. The total cost of the original construction was \$500 million, making it the largest private investment in Colorado history at the time.
33. *Journal of Metals*, "Henderson Mine/Mill/Concentrator," 12.
34. MacGregor was a Scottish metallurgical engineer and vocal opponent of organized labor. After retiring from AMAX, he became infamous for his role in Margaret Thatcher's 1980s industrial restructuring of the United Kingdom. As chairman of British Steel, he was ruthless in closing plants and trimming the payroll from 166,000 employees to 71,000. He took a similar approach in his leadership of the UK National Coal Board, which contributed to the 1984–1985 mineworkers strike and the prolonged decline of Britain's coal industry.
35. Dempsey attributed this quote to Pierre Gousseland, who replaced MacGregor as AMAX chairman in 1977. Dempsey made this connection explicit in a 1980 speech to the Business and Industry Advisory Committee of the OECD in Paris: "AMAX Environmental Services Inc. made a special effort to develop new project skills in the 1970s because of AMAX's fast expansion, and because our biggest problems were with regulatory delay and politically motivated permit denials." Stan Dempsey and Ken Paulsen speech notes, "AMAX and Environmental Impact Assessments," Business and Industry Advisory Committee of the OECD, Paris, September 26, 1980, 2, Stan Dempsey archives.
36. Dempsey, speech notes for Caitlin talk, 1, Stan Dempsey archives.
37. Stan Dempsey to MacGregor, Donahue, and Sawyer, February 20, 1974, 1, Stan Dempsey archives.

38. Paxton, "Experiment in Ecology," 8.
39. Jean Bettie Willard to Jean Langenheim, March 1, 1986, in "Bettie Willard, Alpine Ecologist," *Ecological Society of America's History and Records*, <https://esa.org/history/willard-bettie/>.
40. In his 1977 speech to the National Association of Manufacturers, Dempsey described the ecologists with whom he and other AMAX personnel worked "responsible citizen activists." Describing the Minnamax project, he said, "We made a conscious decision to avoid endless dialogue with citizen activists who were clearly dedicated to opposition to any mine, regardless of its environmental acceptability." Dempsey, NAM speech, Washington, DC, (March 25, 1977), 6, 9, Stan Dempsey archives. A consultant observed this in practice at both the Minnamax and Crested Butte projects, recalling that the AMAX personnel "were trying to work with the environmentalists and separate sort of the reasonable ones from the unreasonable ones, and I suspect the number on the reasonable side of the bench was pretty low." Social scientists have noted the tendency of corporations to elect to work with "light green" groups that advocate market-based solutions to problems rather than "dark green" groups that take a more critical stance. See Kirsch, "Sustainable Mining"; Rolston, "Turning Protesters into Monitors"; Welker, "Corporate Security Begins in the Community."
41. *Engineering and Mining Journal*, "Openness, Cooperation," 2. Describing critiques of mining as being "emotional" was clearly a rhetorical strategy of dismissal.
42. Hoffman, *From Heresy to Dogma*, 13.
43. The name *Minnamax* was intended by mine proponents to blend the names of the company and the state, performing harmony between them.
44. AMAX of Minnesota, Inc., "Phase I a Six-Year Study: Minnamax Copper-Nickel Project, 1974–1979, a Period of Testing and Evaluation" (1980), 9, Art Biddle archives.
45. In 1974 the Minnesota Environmental Quality Council ruled that AMAX did not need to produce an EIS for sinking the test shaft on the site, a decision that was affirmed by the Minnesota Supreme Court in 1975 after environmental groups challenged the original decision. The Minnesota Pollution Control Agency granted permits for the shaft in July 1975.
46. These efforts happened alongside the state of Minnesota's regional multimillion-dollar copper-nickel study. For greater detail on those studies and their lasting influence for an engineer who worked for the Minnesota state government, see chapter 5.
47. Drawing on critical studies of audit culture, Marina Welker calls these "rituals of verification" that uphold the company's authority. Welker, *Enacting the Corporation*, 10.
48. Jim Blubaugh, "Sierra, Waltons End Opposition to Copper Test Shaft," *Duluth News-Tribune*, March 18, 1975. See also Art Biddle speech notes, National Conference on the Management of Energy-Environment Conflict, Queenstown, Maryland, May 20–23, 1980, 4, Art Biddle archives.
49. Stan Dempsey, speech to the International Iron and Steel Institute meeting, Colorado Springs, Colorado, October 2, 1978, 4, Stan Dempsey archives.

50. Dempsey criticized, however, the institutional separation of environmental and social performance away from operations, as he believed that they needed to be integrated throughout the company or otherwise risked being marginalized.
51. Phadke, "Green Energy Futures."
52. The other key public official was the town planner, Myles Rademan, who had been persuaded to move to Colorado from New York City by "a slide show of the Rockies and really good grass" offered by a University of Colorado law professor seeking to recruit idealistic young lawyers. Dawn Belloise, "Profile: Myles Rademan," *Crested Butte News*, June 25, 2015, <http://crestedbuttenews.com/2015/06/profile-myles-rademan/>.
53. Crested Butte Mountain Heritage Museum, Crested Butte, Colorado.
54. Gladwin would go onto a long academic and consulting career, culminating in retiring from the University of Michigan Ross School of Business as Professor Emeritus of Sustainable Enterprise and Professor Emeritus of Strategy.
55. Thomas Gladwin, "Constructive Corporate Management of Environmental Conflict," Keystone conference, Keystone, Colorado, September 7, 1977, 17, Art Biddle archives.
56. John Towers, "Opening Remarks, Keystone Conference," Keystone, Colorado, September 7, 1977, 4, Art Biddle archives.
57. Cahn, *Footprints on the Planet*, 79.
58. The "triple bottom line" concept has gained widespread use inside of industry and beyond it, after its first articulation by John Elkington in a 1994 article in the *California Management Review* and then in his formulation of the 3P framework of "planet, people, and profit" in Shell's watershed 1998 corporate responsibility report "Profits and Principles." For a more critical take on triple bottom line, see Norman and MacDonald, "Getting to the Bottom of 'Triple Bottom Line.'"
59. This is an early example of what Stuart Kirsch calls the "new politics of time," though the Mt Emmons case pushes the "newness" back to the 1970s instead of 1990s and 2000s. Kirsch, *Mining Capitalism*.
60. These included the US Forest Service (the lead agency on the EIS), Colorado Department of Local Affairs, Colorado Department of Health, Colorado State Historical Society, Bureau of Land Management, US Environmental Protection Agency, and US Army Corps of Engineers.
61. Biddle, Livermore, and Poe, "AMAX Inc and the Colorado Joint Review Process," 1.
62. Mike Rock, speech notes for the annual meeting of the American Society of Landscape Architects, Denver, Colorado, November 21–24, 1980, 5, Art Biddle archives.
63. Other, shorter-lived concerns included the electric power line and whether the area could build a local power plant to serve the mine.
64. "Kay Ferrin transcript," CJRP meeting, Gunnison, Colorado, March 13, 1981, 1–7, Art Biddle archives.

65. “Kay Ferrin transcript,” 1. Biddle introduced each of the AMAX speakers by noting their specific enjoyment of the outdoors. In so doing, he crafted a public face of the company as one that shared environmental values with the people of the area. See chapter 4 for a more extended discussion of how corporate actors “played the scales” of the corporate person to attribute an environmental ethic to companies.
66. *Gunnison County Times*, July 16, 1979.
67. “Kay Ferrin transcript,” 5. Ferrin began by making fun of highly technical mining jargon by saying, “The milling operation will be a typical sulfide mineral hydro-metallurgical beneficiation project—see, I could say that, which means that we grind that rock up into real small pieces in large grinding mills, ball mills, and then float it in a detergent solution, like big washtubs, and separate the concentrates from the ore at that point and then the tailing will be deposited immediately below the mill.” “Kay Ferrin transcript,” 3.
68. “Kay Ferrin transcript,” 6.
69. “Kay Ferrin transcript,” 13–14.
70. “Second Question and Answer Period—March 13 CJRP meeting,” Gunnison, Colorado, 1981, 1–3, Art Biddle archives.
71. Art Biddle, “August Status Report,” Mt Emmons External Affairs Status Reports, July/ August 1979, 6. Mt. Emmons Mining Project collection.
72. Dempsey described this happening at Henderson as well: “Mutual respect developed, and the project turned out better because all of us were forced to think through the reasons for our actions.” Dempsey, NAM speech, 7.
73. Stan Dempsey speech notes, ESI, Environmental Managers Workshop, Denver, Colorado, November 9, 1978, 6, Stan Dempsey archives.
74. David Isaacson, “AMAX, Inc.,” Encyclopedia.com, <https://www.encyclopedia.com/books/politics-and-business-magazines/amax-inc> (accessed January 1, 2021).
75. Art Biddle internal memo, “Questions and Answers, Proposed 1981 Community Affairs Budget,” 3, Art Biddle archives. Peter Benson and Stuart Kirsch would likely characterize these efforts to promote the inevitability of the mine as engendering a politics of resignation. Benson and Kirsch, “Capitalism and the Politics of Resignation.”
76. Biddle, “Questions and Answers,” 8, Art Biddle archives.
77. As reported by AMAX in the Spring 1982 *Moly News*, vol. 5 no. (1).
78. For Biddle, this adoption of the EIS by the US Forest Service represented an achievement, as it signified the agency’s approval of their work and support of the project. For those critical of the project, this was evidence of a too cozy relationship between AMAX and the agency.
79. David E. Leindorf and Stan Smock, Gunnison County commissioners, and County Planning Commission, to Jimmy Wilkins, US Forest Service, reproduced in the Final Mt. Emmons Mining Project EIS, January 20, 1982, 92. Mt. Emmons Mining Project collection.



80. Thomas S. Cox, mayor of the Town of Crested Butte, to Jimmy Wilkins, US Forest Service, reproduced in the Final Mt. Emmons Mining Project EIS, 109–110.
81. Leindorf et al. to Wilkins, Final Mt. Emmons Mining Project EIS, 92. Mt. Emmons Mining Project collection.
82. US Forest Service, “Purpose and Need,” reproduced in the Final Mt. Emmons Mining Project EIS, 2.
83. US Forest Service, “Public Involvement,” reproduced in the Final Mt. Emmons Mining Project EIS, 27.
84. Dempsey, NAM speech, 7.
85. Dempsey, NAM speech, 12.
86. Dempsey, NAM speech, 15.
87. Dempsey and Paulsen, “AMAX and Environmental Impact Assessments,” 4.
88. Dempsey and Paulsen, “AMAX and Environmental Impact Assessments,” 1. Here Paulsen evokes what Silvio O. Funtowicz and Jerome R. Ravetz would call “postnormal technologies,” characterized by high controversy and experts competing with dueling studies that cannot resolve debates that are fundamentally about values. Funtowicz and Ravetz, “Science for the Post-normal Age.”
89. Ferguson, *Anti-politics Machine*.
90. Sue Wilson, TJ Glauthier, and Ellen Remmer, “Trip Report: Interviews on Colorado Joint Review Process,” January 19–22, 1982, 2. Mt. Emmons Mining Project collection.
91. Ottinger, *Refining Expertise*. See also Kelty, *Participant*.
92. Conley and Williams, “Engage, Embed, and Embellish,” 13.
93. Dempsey, NAM speech, 1977, 13.
94. Art Biddle, “The Mount Emmons Projects and the Colorado Joint Review Process: One Approach for Gaining Community Acceptance through Better Coordination of Local, State, and Federal Permitting Requirements,” June 17, 1986, 2. Art Biddle archive.
95. Harvey and Knox, “Virtuous Detachments in Engineering Practice.” In chapter 6 I analyze pragmatism in detail.

#### CHAPTER 4

1. US Energy Information Administration, “State Profile and Energy Estimates: Colorado Profile Analysis,” March 19, 2020, <https://www.eia.gov/state/analysis.php?sid=CO>.
2. Haggerty et al., “Geographies of Impact and the Impacts of Geography.”
3. This slippage between the legal fiction of a composite, intangible corporate person and the material persons charged with enacting it originally stemmed from Christian theology before entering Tudor legal doctrine and the English parliamentary state. See Shever, “Engendering the Company,” 29; and Welker, *Enacting the Corporation*, 3.

4. Kelty, *Participant*, 19.
5. Kelty, *Participant*, 19.
6. Organizational psychologists have called this a “we-feeling,” which is often an explicit goal of human resource management designed to promote cooperation among workers and identification with a firm while, in the eyes of critics, suppressing internal unrest. Kelty, *Participant*, 110.
7. The literature on the mutual constitution of agency and structure is too extensive to adequately summarize here, but see Ahearn, “Language and Agency.”
8. Latour, *Reassembling the Social*; Callon, “Some Elements of a Sociology of Translation.”
9. Boas, “Methods of Ethnology,” 316.
10. Bourdieu, *Outline of a Theory of Practice*; Certeau, *Practice of Everyday Life*; Ortner, “Theory in Anthropology since the Sixties”; Giddens, *Central Problems in Social Theory*.
11. Butler, *Gender Trouble*; Foucault, *History of Sexuality*.
12. Abu-Lughod, “Can There Be a Feminist Ethnography?”; Ortner, “Theory in Anthropology since the Sixties”; Ortner, “Resistance and the Problem of Ethnographic Refusal”; Mahmood, *Politics of Piety*.
13. Mahmood, *Politics of Piety*, 14.
14. Mahmood, *Politics of Piety*, 34.
15. Layton, *Revolt of the Engineers*, 198; Meiksins, “Revolt of the Engineers’ Reconsidered”; Meiksins and Smith, “Why American Engineers Aren’t Unionized”; Noble, *America by Design*.
16. Kunda, *Engineering Culture*, 15.
17. Kunda, *Engineering Culture*, 218.
18. Edwards, *Contested Terrain*, 148.
19. Mauss, “Category of the Human Mind.”
20. McIntosh, “Personhood, Self, and Individual.”
21. Laidlaw, “Ethics.” Not all connotations of *soul* are so positive, as Mette M. High’s ethnography of the “cosmoeconomies” of gold in Mongolia makes clear. See High, *Fear and Fortune*.
22. Johnson, “Rethinking the Social Responsibilities of Engineers,” 95.
23. As analyzed in greater detail in chapter 5, engineers’ status as employees and clients has undermined their status as professionals.
24. Downey, “What Is Engineering Studies For?,” 60–61.
25. Roland Marchand traces how Progressive Era advertisements for the Chicago meatpacker Swift, for example, portrayed the company as a farm wife feeding chickens, and those for AT&T depicted the company as a female telephone operator and male lineman, setting a

- precedent that other companies would emulate for years to come. Marchand, *Creating the Corporate Soul*.
26. Müftüoğlu et al., “Rethinking Access,” 7.
  27. Kunda, *Engineering Culture*, 159.
  28. Dinah Rajak argues that the field of corporate social responsibility in general is pervaded by proselytizing, in which executives and practitioners strive to convince others that they can be financially profitable by being socially responsible. Rajak, *In Good Company*.
  29. Chapter 5 takes up the position of consultants in detail, especially their double bind as dependent on corporations for contracts yet being asked to be impartial assessors of those corporations’ activities.
  30. In this, they seemed very conscious that the close alignment would be dismissed as insincere. A senior environmental engineer insisted that her commitment to the environment she had just shared with me was “not the company line.” She continued, “I don’t want to sound like a corporate billboard, but we do want to do the right thing because all these people who live in Wyoming live here because they want to. They enjoy the outdoors in some regards more than others. We don’t want to trash our environment because this is where we play and work.”
  31. For a similar point in relation to the ritualized confession of mistakes and commitments to learning from them, see Müftüoğlu et al., “Rethinking Access,” 7.
  32. David Graeber summarizes Marilyn Strathern’s notion of the partible person by explaining, “People have all sorts of potential identities, which most of the time exist only as a set of hidden possibilities. What happens in any given social situation is that another person fixes on one of these and thus ‘makes it visible.’ . . . Other possibilities, for the moment, remain invisible.” Graeber, *Toward an Anthropological Theory of Value*, 39–40.
  33. McIntosh, “Personhood, Self, and Individual,” 4583.
  34. McIntosh, “Personhood, Self, and Individual,” 4583.
  35. Geertz, “Thick Description”; Lamb, “Making and Unmaking of Persons.”
  36. Strathern, *Gender of the Gift*, 13.
  37. Here I happily join others in exploring more relational theories of personhood in a US context. See Buch, “Senses of Care.”
  38. Welker, *Enacting the Corporation*.
  39. Yarrow, *Architects*, 165.
  40. Li, *Unearthing Conflict*; Smith and Smith, “Engineering and the Politics of Commensuration.”
  41. Unconventional energy production articulates with underground geology to produce an economic imperative: the quickly declining production curves of “tight oil” feed the need for more and more wells to keep supplies constant. An environmental engineer with

experience in mining, offshore oil, and onshore oil and gas production explained the uniqueness of unconventional gas production clearly, describing it as

a bit more of an ad hoc type of business. You put a well in, you produce, the production declines, you frack it, you put another well in. It's constantly expanding, versus we're going to put an offshore platform that's going to pump for fifty years. That's very different, right? We're struggling with how to manage that kind of business. And then, odds are you've got an operator, another operator over here, and another operator over here, and another operator over here. You're doing an impact assessment on a well that you know is going to be producing for two years. At the same time, you're putting fifteen others in. The other guy is putting a hundred others in, and the other guy is putting two hundred others in. You're looking at it piece by piece.

He wished that regulations were different to require more regional studies of this kind of extractive activity rather than considering them on a well-by-well basis.

42. Welker and Wood, "Shareholder Activism and Alienation."
43. On the role of religious convictions in the moral ambitions of oil executives, see High, "Projects of Devotion." On the religious underpinnings of corporate social responsibility work in the South African mining industry, see Rajak, *In Good Company*.
44. Compare Gary's story about leaving industry and Scott's founding of a nonprofit function inside his consulting firm for engineers trying to set up professional spaces not determined by profit imperatives; see chapter 5.
45. Lucena, Schneider, and Leydens, "Engineering and Sustainable Community Development"; Leydens and Lucena, *Engineering Justice*.
46. Research suggests that this is also true for engineering students, as women with greater desires for social responsibility leave undergraduate engineering programs. Rulifson and Bielefeldt, "Motivations to Leave Engineering."
47. Williams, Muller, and Kilanski. "Gendered Organizations in the New Economy"; Williams, Kilanski, and Muller, "Corporate Diversity Programs and Gender Inequality"; Miller, "Frontier Masculinity in the Oil Industry."
48. Rolston, *Mining Coal and Undermining Gender*.
49. Of course, her "socially accountable" pit design did not take into account the desires of the local people who wished for there to be no mine at all.
50. The narrative June told provides an example of what John Owen identifies as a key feature of the SLO framework: the fear of losing access. Owen, "Social License and the Fear of Mineras Interruptus."
51. Kusserow, "De-homogenizing American Individualism"; McIntosh, "Personhood, Self, and Individual"; Smith, "From Dividual and Individual Selves to Porous Subjects."
52. Colby and Sullivan, "Ethics Teaching in Undergraduate Engineering Education"; Mitcham and Wang, "From Engineering Ethics to Engineering Politics"; Zhu, "Engineering Ethics Education"; Zhu and Jesiek, "Pragmatic Approach to Ethical Decision-Making in Engineering Practice."

## CHAPTER 5

1. There is significant diversity within the world of professional consulting for engineers and applied scientists. Some worked for large, well-established firms with an international reputation for particular specialties, while others ran one-person independent shops. While some were lifelong consultants, others moved into that work late in life to ease into retirement after successful corporate careers. Still others went into consulting after having been fired; as one seasoned consultant wryly observed, “Everybody that loses their job then calls themselves a consultant.” The youngest consultants I met sought out consulting because it fit well with their self-described “entrepreneurial” spirit and desire to forge their own career path. A few even moved from consulting work to full-time corporate careers in order to “make a difference.” Though it is difficult to pin down the exact percentage of technical professionals who work in these industries as consultants, mining engineering faculty I interviewed estimated that about 10 percent of their graduates eventually worked as consultants, but only after gaining experience and their professional engineering license through working for an operating company. Consulting work was more common for civil, environmental, and geological engineers. About 30 percent of the people interviewed for this book worked as consultants. Of those, about equal numbers worked for large, well-established firms or their own one-person shops.
2. Engineers who worked full-time for corporations also narrated the importance of “choosing” the right employer that aligned with their values. Their stories were strikingly similar, beginning with an acknowledgment that they were skeptical of unscrupulous corporate actors before choosing to work for a company well regarded for its ethical reputation. Applying to particular companies, performing in interviews in ways that demonstrate belonging to them, and accepting job offers are important dimensions of engineers’ agencies. But these agencies were conditioned by structural factors such as interview processes, formal systems for evaluating knowledge, and social capital in the form of professional networks. For example, the companies that my students most admired also tended to have the highest requirements for minimum grade point averages, meaning that students with lower GPAs had fewer opportunities to “choose” their employers.
3. Barandiarán, *Science and Environment in Chile*, 171.
4. Strathern, “Cutting the Network”; Yarrow et al., *Detachment*.
5. Cross, “Detachment as a Corporate Ethic,” 35.
6. Rajak, *In Good Company*.
7. Gardner, *Discordant Development*; Gardner et al., “Elusive Partnerships.”
8. Shever, “Engendering the Company.”
9. Appel, “Walls and White Elephants,” 445.
10. Cross, “Detachment as a Corporate Ethic,” 36.
11. Harvey and Knox, “Virtuous Detachments,” 171.
12. Stein, *Work, Sleep, Repeat*; Dougherty, “Boom Times for Technocrats?”

13. Welker, *Enacting the Corporation*.
14. Barley and Kunda, *Gurus, Hired Guns, and Warm Bodies*, 304. On how the new career models characterizing increasingly precarious employment in the oil and gas industry have gender bias baked into them, see Williams, Muller, and Kilanski, “Gendered Organizations in the New Economy.”
15. Stein, *Work, Sleep, Repeat*, 89.
16. Barley and Kunda, *Gurus, Hired Guns, and Warm Bodies*; Kunda, *Engineering Culture*; Meiksins and Whalley, *Putting Work in Its Place*. In addition to further theorizing this form of engineers’ agency and efforts to cultivate professional autonomy, this insight adds a novel perspective to theories of the corporation. My interlocutors bring our attention to the question of *when* a corporation is enacted. While corporations are enacted by various personnel, from community relations officers to consulting engineers, those people are not always enacting those forms. Put another way, the parts or nodes of the set of relationships that make up a corporation are themselves not always enacting the larger corporate form. The employees and consultants called to enact corporations did so in some social contexts but not in others, and sometimes wholeheartedly, sometimes partially, sometimes with a wink, and sometimes not at all. They managed the playing of scales between their person and the corporate person (see chapter 4) moment by moment, turn by turn.
17. Goldman, “Why We Need a Philosophy of Engineering,” 166.
18. Layton, *Revolt of the Engineers*, 5.
19. For summaries of that literature, see Davis, “Professional Autonomy”; and Meiksins and Watson, “Professional Autonomy and Organizational Constraint.”
20. Barley and Kunda, *Gurus, Hired Guns, and Warm Bodies*, 291.
21. Barley and Kunda, *Gurus, Hired Guns, and Warm Bodies*, 289.
22. Dougherty, “Boom Times for Technocrats?”
23. Barley and Kunda, *Gurus, Hired Guns, and Warm Bodies*, 289.
24. Li, “Engineering Responsibility,” 64.
25. Li, “Engineering Responsibility,” 64. Framing debates about the question of *how* versus *whether* to mine was a key strategy developed by AMAX to manage public controversy surrounding their projects, as described in chapter 2.
26. Li, “Engineering Responsibility,” 64.
27. Here Peter’s narrative of his career echoes the performance of skepticism analyzed in the chapter 4.
28. Peter wished that companies would be less concerned with avoiding reputational risk and openly share their lessons learned with the wider academic and industry communities. “The companies have some really good data, but they don’t want to share it because they’re afraid that it’s going to highlight something that’s going to cause them more problems. . . .

It's like, nothing is perfect, but this is really a glass half-full story. And we should be telling it, but I can't get them to tell it because people [outside of industry] look at it as glass half empty." Stan Dempsey, the AMAX executive profiled in chapter 3, felt a similar frustration. He stopped conducting the internal environmental audits he developed at AMAX because he was worried they could set up the environmentalists' cases against the company if they were to fall into their hands.

29. See chapter 7, note 9, on the desire to help.
30. While Scott appreciated being part of a group that shared his political sensibilities, he also saw the drawbacks to hiring "a bunch of identical people" and specifically tried to hire different kinds of people so that his firm could bring a wider variety of perspectives to their projects.
31. Harvey and Knox, *Roads*, 10.
32. Gary traced this desire to a specific moment in his professional development. While contracting for major multinationals, he jumped at the chance to travel professionally in Eastern Europe and Russia when the Berlin Wall came down in 1990. He found himself fielding such questions as, "How do you teach your kids capitalism?" He recalled that when he tried to use garage sales as a way of answering that question, he experienced culture shock, realizing that his interlocutors did not have cars—and therefore no private garages—or the privilege of having old yet functional stuff to discard. Gary experienced culture shock a second time on that trip when he eventually made his way to the multinational's headquarters in Moscow, where he and the other "experts" on the project convened in a "Lufthansa hotel . . . drinking French wine imported through California." From that moment on, he found it impossible to detach issues of mineral development from broader concerns of culture and political economy.
33. Stein, *Work, Sleep, Repeat*.
34. PolyMet Mining Corp., "Polymet Strengthens Permitting Expertise Groundwater Monitoring Requirements Satisfied," Newsfile, September 11, 2012, <https://www.newsfilecorp.com/release/2842/Polymet-Strengthens-Permitting-Expertise-Groundwater-Monitoring-Requirements-Satisfied>.
35. John Meyers, "Safety of PolyMet Tailings Basin Dams Is Point of Contention in Permit Process," Twin Cities Pioneer Press, August 28, 2017, <https://www.twincities.com/2017/08/28/safety-of-polymet-tailings-basin-dams-is-point-of-contention-in-permit-process/>; emphasis added.
36. PolyMet Mining Company, "Tailings Basin Stability and Environmental Protections" brochure. March 30, 2017. <https://www.polymetmining.com>.
37. Phadke, "Green Energy Futures," 163.
38. PolyMet Mining Corp., "Polymet Strengthens Permitting Expertise Groundwater Monitoring Requirements Satisfied," Newsfile, September 11, 2012, <https://www.newsfilecorp.com/release/2842/Polymet-Strengthens-Permitting-Expertise-Groundwater-Monitoring-Requirements-Satisfied>.

-Requirements-Satisfied. Not all of the consultants and their firms are local, however, as the case of June profiled in this chapter makes clear.

39. Alder, *Engineering the Revolution*.
40. Downey, "PDS."
41. Meiksins and Watson, "Professional Autonomy and Organizational Constraint," 578.
42. Quoted in Leydens and Lucena, *Engineering Justice*, 4.
43. Zussman, *Mechanics of the Middle Class*; Miller, "Professionals in Bureaucracy."
44. Dougherty, "Boom Times for Technocrats?," 452. See also Barandiarán, *Science and Environment in Chile*.
45. Harvey and Knox, *Roads*, 196.

## CHAPTER 6

1. Coloradans for Responsible Energy Development, "About Us," <https://www.cred.org/about-cred-coloradans-for-responsible-energy-development/> (January 1, 2021).
2. Coloradans for Responsible Energy Development, "Scientists Agree: Fracking Doesn't Harm Our Water," <https://www.cred.org/scientists-fracking-doesnt-harm-water/> (accessed January 1, 2021).
3. Rajak, "Theatres of Virtue"; Müftüoğlu et al., "Rethinking Access"; Welker, *Enacting the Corporation*.
4. Many advocates for engineers celebrate their pragmatic agency in building the infrastructures, products, and processes that constitute our world. Former BP executive and engineer John Browne, for example, opens his 2019 book by praising engineers as "best known for their practical impact; while others talk and pontificate, they are out in the world, influencing and shaping it. If you look around, you will see a world made richer, freer, and less violent by engineering." Browne, *Make, Think, Imagine*, 1–2.
5. Minter, "Pragmatism, Piety, and Environmental Ethics."
6. Reddy, "Measuring like an Engineer"; Riley, "Engineering and Social Justice."
7. Discourses of the social license to operate are firmly grounded in this particular pragmatism—the social license, after all, values good community relations as good for business (chapter 2).
8. Mitcham, *Steps toward a Philosophy of Engineering*, 2.
9. Appel, "To Critique or Not to Critique?," 32.
10. Ottinger, *Refining Expertise*, 133.
11. Faulkner, "Nuts and Bolts and People."
12. Cech, "Culture of Disengagement in Engineering Education?"
13. Auld, Bernstein, and Cashore, "New Corporate Social Responsibility."



14. Philanthropy remained a powerful image of social responsibility for my interlocutors as well. Professionals in community relations termed such activities “strategic investments” and viewed them as most effective when they supported the overall mission of their companies. A petroleum engineer who had achieved significant influence by building up a successful private company with her family pointed to the strategic importance of philanthropy for creating an educated and healthy workforce. Speaking with the *ue* of the oil and gas industry in Denver, she called this work “proactive”:

We work with a lot of philanthropic organizations, and the Denver oil and gas community is incredibly generous with community service and projects, raising funds for education, for the arts and for the health community. . . . And I think that ties in with being socially responsible. That’s a different avenue of here you’ve got the side of, “Let’s protect the people and environment where we’re working.” This is actually, “Let’s enhance our community so that we’ve got kids going to college and we’ve got good health programs and good health research programs going on in our community.” So it’s a lot more than just that reactive or preventive method. It’s actually trends are now toward a proactive environment.
15. Downey, “What Is Engineering Studies For?,” 56.
16. Downey, “Are Engineers Losing Control of Technology?”
17. Lucena, Schneider, and Leydens, “Engineering and Sustainable Community Development,” 125.
18. Here Aaron acknowledges a difference between Hannah Appel calls lack and loss: whereas corporations often position their CSR activities as addressing a lack in the communities closest to them, she argues they are often mediating a loss (of environmental quality, of traditional livelihoods, etc.) that they themselves created. Appel, *Licit Life of Capitalism*.
19. Li, *Unearthing Conflict*. Social science research shows that these economic benefits can create or heighten inequalities, as mineral owners receive substantial money in the form of royalties, whereas surface owners receive much smaller payments for surface land disturbance, and other nearby residents may receive nothing at all outside of the funds directed to local governments. For a summary, see Jacquet, “Review of Risks to Communities from Shale Energy Development.”
20. Nader, “Controlling Processes.” Science and technology studies scholars would also rightly point out that shared infrastructure and design for community acceptance are grounded in a form of “techno-optimism” that proposes technological solutions for problems that are fundamentally political in nature.
21. Collier and Ireland, “Shared-Use Mining Infrastructure,” 20.
22. In her research on water and mine conflicts in Peru, Fabiana Li shows how water use does not always map onto legal designations, meaning that mining companies can take legal shelter while worsening water quality by arguing that it was not suitable for human consumption to begin with. Li, *Unearthing Conflict*.

23. Sellwood, “Peru’s Fight for Millions in Tax Revenue from Cerro Verde Mine,” Oxfam, September 20, 2017, <https://politicsofpoverty.oxfamamerica.org/perus-fight-for-millions-in-tax-revenue-from-cerro-verde-mine/>. For the more positive case studies of the plant, see International Council on Mining and Metals, “Shared Water, Shared Responsibility, Shared Action: Cerro Verde, Peru,” March 21, 2017, <https://www.icmm.com/en-gb/case-studies/cerro-verde>; and Christopher Connell, “This Peruvian Mine Produces Clean Water for Arequipa,” Share America, December 21, 2016, <https://share.america.gov/peruvian-copper-mine-also-produces-clean-water/>.
24. Munoz and Burnham, “Subcontracting as Corporate Social Responsibility”; Li, *Unearthing Conflict*.
25. Gardner, *Discordant Development*; Welker, *Enacting the Corporation*.
26. Love and Garwood, “Electrifying Transitions.”
27. Kroepsch, “New Rig on the Block”; Kroepsch, “Horizontal Drilling.”
28. Kroepsch, “Horizontal Drilling,” 470; emphasis added.
29. Ottinger, *Refining Expertise*; Li, *Unearthing Conflict*.
30. Virtual frack centers, in which engineers can monitor wells from a distance, may be replacing this on-the-ground learning about the context of oil and gas development.
31. Appel, “Walls and White Elephants”; Rajak, *In Good Company*; Welker, *Enacting the Corporation*.
32. Smith, “From Corporate Social Responsibility to Creating Shared Value.”
33. Li, “Engineering Responsibility”; Kirsch, *Reverse Anthropology*.
34. Horowitz and Watts, *Grassroots Environmental Governance*.
35. International Finance Corporation, “Performance Standards,” [https://www.ifc.org/wps/wcm/connect/Topics\\_Ext\\_Content/IFC\\_External\\_Corporate\\_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards](https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards) (accessed July 17, 2021).
36. Hommels, *Unbuilding Cities*.
37. John R. Owen and Deanna Kemp identify this temporal relegation as one of the key limitations of community relations work in mining. Owen and Kemp, “Social Licence and Mining.”
38. Callon, Lascoumes, and Barthe, *Acting in an Uncertain World*; Hébert, “Chronicle of a Disaster Foretold.”
39. This stands in contrast with other engineers who evinced what Matthew Wisnioski, in *Engineers for Change*, calls an “ideology of technological change” that attributed change to the technology itself rather than to those who produced it, thus absolving engineers of responsibility for its effects. The most prominent example of the more “autonomous” technological change was how petroleum and other engineers told the story of the fracking revolution itself. With vertical drilling, the story goes, engineers had to spread out multiple wells across

a set area of space to access the oil and gas below. With the advent of horizontal drilling and hydraulic fracturing, in contrast, engineers could concentrate fewer multiple wells radiating out in multiple directions on a single pad, thus reducing their overall footprint on the surface. For a critique of how this concentration of wells on a single pad generates more harms for people who live closest to enlarged well pads, see Kroepsch, “New Rig on the Block”; and Kroepsch, “Horizontal Drilling.”

40. Harvey and Knox, “Virtuous Detachments in Engineering Practice.”
41. Lucena, Schneider, and Leydens, “Engineering and Sustainable Community Development.”
42. See, e.g., Jalbert, Kinchy, and Perry, “Civil Society Research and Marcellus Shale Natural Gas Development”; Kinchy, “Citizen Science and Democracy”; Ottinger, *Refining Expertise*; and Wylie, *Fractivism*. Benjamin’s experiences, however (see chapter 5), show how transformative more community-based research can be for how engineers think about the purpose of their work.
43. The growing power of premining referenda may be providing more space for people to say no to both mining companies and the national governments who facilitate their activity. Kirsch, *Mining Capitalism*.

## CHAPTER 7

1. Kelty, *Participant*, 19.
2. Ballesterio, *Future History of Water*, 53, citing Nader, “Controlling Processes.”
3. Ballesterio, *Future History of Water*.
4. Downey, “PDS.”
5. Direct opportunities to listen to critics did not always result in increased empathy, however, as Emma’s story of her exchange with the disgruntled landowner reveals in chapter 4.
6. Cech, “Culture of Disengagement in Engineering Education?”; Rulifson and Bielefeldt, “Motivations to Leave Engineering.”
7. Trevelyan, *Making of an Expert Engineer*.
8. National Society of Professional Engineers, “NSPE Code of Ethics for Engineers,” <https://www.nspe.org/resources/ethics/code-ethics>. My thanks to Dean Nieuwsma for raising this point.
9. Donna Riley argues that the “desire to help” is a persistent engineering mindset that can serve social justice ends only if implemented in a nonpaternalistic manner. As critics of philanthropy argue, “help” can often shore up the good feelings of the helper without fundamentally transforming the relationships of power that create injustice in the first place. Riley, *Engineering and Social Justice*, 39.
10. Owen and Kemp, “Social Licence and Mining.”
11. Biersack, “Reimagining Political Ecology,” 14. See also Haraway, *Modest Witness@Second Millennium*; Latour, *We Have Never Been Modern*; and Strathern, *After Nature*.

12. Richardson and Weszkalnys, "Introduction," 7. See also Bakker and Bridge, "Material Worlds?"; Barnes, *Cultivating the Nile*; and Kneas, "Emergence and Aftermath."
13. Ferry and Limbert, *Timely Assets*; Weszkalnys, "Anticipating Oil"; Metzke, "Framing the Future of Fracking."
14. This appreciation for nature as more than resource was sometimes prompted by crisis, such as when John read anthropological work on kinship and land to understand indigenous resistance to the oil and gas facilities his company was building.
15. For analysis and history of the conflict, see Rolston "Turning Protesters into Monitors."
16. Discourses of environmental stewardship are direct responses to criticisms of industry practice. The notion of environmental stewardship, cast in the mold of settler colonialism, entails particular relations of responsibility that legitimize industrial management of nature. Suzana Sawyer argues, "The authority of corporate capital today is related in important ways to historical practices of imagining, representing and purifying 'natural' landscapes . . . the way Arco imagined the terrain of its operations significantly affected its rights, responsibilities and legitimacy to explore for and exploit petroleum in Ecuador." Sawyer, *Crude Chronicles*, 103. Geographer Gavin Bridge argues that mining corporations developed discourses of environmental stewardship to mediate the tensions among accumulation, production, and environmental protection in order to legitimize their continued operation. He traces how officials have co-opted the language of nongovernmental organizations in their public policy statements by embedding ecological concerns within their business practice. Bridge, "Excavating Nature," 222–223, 227.
17. Bowker, "Sustainable Knowledge Infrastructures," 211.
18. Barry, *Material Politics*.
19. Kelty, *Participant*; Ottinger, *Refining Expertise*.
20. Kelty, *Participant*, 25–26.
21. Kelty, *Participant*, 30.
22. Dahlgren, *Digging Deeper*.
23. Owen and Kemp, *Extractive Relations*, 34.
24. Delborne, Kokotovich, and Lunshof, "Social License and Synthetic Biology."
25. Smith, "Boom to Bust, Ashes to (Coal) Dust."
26. Cronon, "Trouble with Wilderness."
27. Chakrabarty, "Climate of History."
28. A representative of one of Canada's First Nations critiqued the industry's paternalism and reliance on the ethics of material provisioning during a major mining conference. He said, "I hear it often in these kinds of events. There's a real bemoaning of the industry saying, 'If only people understood us.' It kind of sounds like the dad talking to the kids. 'If you guys

only understood what I did for you, how hard I worked for you to put food on the tables, minerals in your phones, then you would appreciate me.”

29. Kelty, *Participant*, 56.
30. Kelty, *Participant*, 83.
31. Appel, “To Critique or Not to Critique?,” 32.
32. Gilbert and Sklair, “Introduction”; Carrier, *After the Crisis*.
33. Appel, “To Critique or Not to Critique?,” 32.
34. Bowker, “Sustainable Knowledge Infrastructures,” 211.
35. Karwat, “Self-Reflection for Activist Engineering,” 37
36. Bowker, “Sustainable Knowledge Infrastructures,” 205.
37. Mitcham, *Steps toward a Philosophy of Engineering*, 259.
38. Downey, “What Is Engineering Studies For?”
39. Boyer, “Infrastructure, Potential Energy, Revolution,” 231.
40. Downey, “Critical Participation,” 14.
41. Elsewhere Downey writes, “Changes for the future always have to begin with what is positioned as given in the present. Even fundamental challenges to the hegemony of dominant practices have to address the question of fit with dominant practices.” Downey, “Engineering Cultures Syllabus as Formation Narrative,” 428.
42. Welker, *Enacting the Corporation*, 32.
43. Appel, *Licit Life of Capitalism*; Ballestero, *Future History of Water*.
44. Layton, *Revolt of the Engineers*.

## EPILOGUE

1. Berlant and Stewart, *Hundreds*, 42.
2. Many of those broader efforts—which included hosting a campus lecture series, creating new university organizations, and collaborating with engineering faculty in their classes—echo the strategies that Jon Leydens and Juan Lucena propose for integrating social justice into engineering problems, assignments, projects, courses, programs, and universities. Leydens and Lucena, *Engineering Justice*.
3. Kelty, *Participant*.
4. Downey, “What Is Engineering Studies For?,” 74, 57.
5. Nieusma, “Analyzing Context by Design,” 417.
6. Downey, “Low Cost, Mass Use”; Noble, *America by Design*; Seely, “Research, Engineering, and Science in American Engineering Colleges.”

7. Wylie, *Fractivism*, 289; see also Leydens and Lucena, *Engineering Justice*.
8. Wylie, *Fractivism*, 127.
9. Faulkner, “Nuts and Bolts and People”; Cech, “Culture of Disengagement in Engineering Education?”
10. Bowker, “Sustainable Knowledge Infrastructures.”
11. Lucena, *Defending the Nation*.
12. There are notable exceptions to this general rule, such as Olin College, which has no departments or tenured faculty in an attempt to foster collaboration and focus engineering on the needs of people in the real world.
13. Cech, “Culture of Disengagement in Engineering Education?,” 45.
14. Herkert, “Future Directions in Engineering Ethics Research.”
15. Catalano, “Engineering Ethics.”
16. Rulifson and Bielefeldt, “Evolution of Students’ Varied Conceptualizations,” 939.
17. Rulifson and Bielefeldt, “Motivations to Leave Engineering.”
18. Nieusma, “Conducting the Instrumentalists,” 160. See also Leydens and Lucena, *Engineering Justice*.
19. Li, *Unearthing Conflict*; Smith and Smith, “Engineering and the Politics of Commensuration.”
20. Delborne, Kokotovich, and Lunshof, “Social License and Synthetic Biology.”
21. Social acceptance and social responsibility are different, though some engineers collapsed them, for example, by believing that one’s social responsibilities were fulfilled as long as social acceptance was achieved. In this book I have teased out the differences between social acceptance and social responsibility principally by considering the question of whether engineers and the companies they work for are willing to consider the question not just how but whether resource extraction should take place.
22. For a description of the courses and activities, see Smith et al., “Student Learning about Engineering and Corporate Social Responsibility.”
23. For more details on how the survey was developed and validated, see Smith et al., “Student Learning about Engineering and Corporate Social Responsibility.”
24. Greg Rulifson, Shurra Denning, Cassidy Grady, Juliana Lucena, Christopher Spotts, and Courtney Stanton were indispensable in helping to organize, clean up, and analyze thousands of undergraduate student survey responses.
25. Smith et al., “Industry–University Partnerships”; Smith, McClelland, and Smith, “Engineering Students’ Views of Corporate Social Responsibility.”
26. Smith et al., “Industry–University Partnerships.”
27. Smith et al., “Student Learning about Engineering and Corporate Social Responsibility.”

28. Smith et al., “Counteracting the Social Responsibility Slump?”
29. Smith et al., “Counteracting the Social Responsibility Slump?”
30. Canney and Bielefeldt, “Framework for the Development of Social Responsibility in Engineers.”
31. The rest of this section draws from a co-authored ASEE conference paper noted in the acknowledgements to this book: Smith et al., “Counteracting the Social Responsibility Slump?”
32. Smith et al., “Counteracting the Social Responsibility Slump?”
33. Rajak, *In Good Company*, 11.
34. “Corporations shape human experience not only in spectacular and disastrous ways but also in mundane, everyday, ambivalent, and positive ways. They are, after all, the source of or conduit for much of what we wittingly and unwittingly produce and consume as we breathe, eat, drink, read, work, play, and move about the world. . . . No human alive today is breathing air or drinking water that has not been touched by corporate action.” Welker, Partridge, and Hardin, “Corporate Lives,” S4.
35. Downey and Lucena, “Engineering Selves,” 120; Downey, “Engineering Cultures Syllabus as Formation Narrative,” 455.
36. York, “Doing STS in STEM Spaces.”
37. York, “Doing STS in STEM Spaces.”
38. See chapter 7 of this book and Kelty, *Participant*.





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By: Jessica M. Smith

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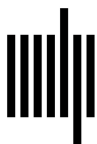
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