



# The Social Functions of Ignorance

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Conventional wisdom has it that mankind's knowledge doubles every ten years. Or is it every five years? When talking about knowledge, people are usually pondering problems of plenty nowadays. The general feeling is that there is an abundance of information out there, readily available through the Internet and other media, leaving experts and decision-makers with the challenging task of keeping up to date. Of course, gaps in our knowledge remain, but those will surely disappear with some more research. Against this background, deeper thoughts about the limits of our knowledge may appear obsolete, or even risky: when Donald Rumsfeld talked about the difference between "known unknowns" and "unknown unknowns" in a press conference, he earned himself an overwhelmingly cynical response, and the 2003 "Foot in Mouth Award" of the Plain English Campaign.<sup>1</sup> After all, haven't we known the response to the problem of ignorance ever since Francis Bacon noted that "knowledge is power"?

The self-proclaimed knowledge society of the twenty-first century is having a hard time accepting ignorance as more than a temporary phenomenon, bound to shrink and disappear with the march of scientific progress. Environmentalists in particular have been hesitant to reflect more deeply about the social functions of ignorance. After all, they frequently insist that action, rather than knowledge, is the crucial challenge. The current debate over climate change is the most recent example: over the last decades, researchers have described and explained the ongoing changes with growing precision and certainty, and yet the political response is agonizingly slow. Ignorance seems to be a problem of politicians and lobbyists unwilling to take cognizance of the scientific state of the art—a situation that looks by all means typical for environmental debates. Time and again, environmental historians have described the identification of environmental problems through research as a mere prelude to the actual conflict. For example, the risks of DDT were known long before its ban, and actually before Rachel Carson's famous rallying cry in *Silent Spring*.<sup>2</sup> The health hazards of lead were also quite familiar when tetraethyl

lead was introduced as a fuel additive in the 1920s, a fact that was already troubling to industrial hygienists back then.<sup>3</sup> With that, the place of ignorance in environmental debates might seem clear: it is a notorious source of problems that we can control through careful, independent research.

At the most basic level, this volume seeks to challenge this reading, and to show that ignorance is a far more complex and far more ambiguous phenomenon than scholars and activists have thought. Most prominently, we plan to push the debate beyond the moral view that ignorance is first and foremost a bad thing: in this volume, ignorance is simply a fact of life that we need to analyze as to its origins and consequences. Who or what was responsible for knowledge gaps? What did people do to improve the state of affairs? How have academic disciplines and epistemologies coped with ignorance when it refused to go away over time? And how does all this relate to interests and worldviews? Raising these questions promises a new approach to a standard theme of environmental scholarship, the management of resources: the information problem underlying the quest for sustainable paths of resource use is more complicated, and more troubling, than scholars have assumed so far.

Reflections on the social functions of ignorance are not an entirely new endeavor, as the pioneering essay of Wilbert Moore and Melvin Tumin some sixty years ago serves to attest.<sup>4</sup> However, research on the topic failed to gather momentum, and publications still spend a good deal of time and energy justifying attention to ignorance.<sup>5</sup> In order to overcome this defensive posture, Robert Proctor and Londa Schiebinger proposed to assemble research on the making and unmaking of ignorance under a common label: agnotology. With an impressive volume, covering issues from military classification to archaeology, the scholars emphasized the breadth of the topic, as well as the gaps in our methodological toolbox that the study of ignorance reveals.<sup>6</sup> “Our primary purpose here is to promote the study of ignorance,” Proctor and Schiebinger noted in their preface.<sup>7</sup> The present volume seeks to follow up on this rallying cry, continue the debate, and look more closely at its merits for environmental studies.

## **Agnotology and the Environment**

It does not take long explanations to see that the environment is a good topic for studies of ignorance. After all, the natural world comprises an enormous number of species and environments, making for a hugely complex set of interactions and interdependencies. The most obvious case in point are neophytes, a topic that some of the following essays will touch upon, thus following the trail that Alfred Crosby blazed with his influential *The Columbian Exchange*.<sup>8</sup> The introduction of plants or animals into new environments has

frequently produced unexpected and sometimes troublesome consequences. In fact, Proctor and Schiebinger already sensed the importance of environmental issues, as their volume includes articles on climate science, genetically modified organisms, and the “manufactured uncertainty” in debates over environmental and public health hazards.<sup>9</sup> However, the latter title already indicates that the volume is tilting towards a specific type of ignorance: targeted manipulation of information and deliberate creation of deficient knowledge. One of the editors even experienced the corporate construction of ignorance first-hand: Robert Proctor not only wrote about the link between smoking and cancer as a scholar but also testified against the tobacco lobby in lawsuits.<sup>10</sup>

Needless to say, it is important to keep an eye on the vested interests, and not only in high-stakes courtroom situations. The wanton suppression of knowledge will always be part of the study of ignorance, and the essays in this volume demonstrate the importance of this perspective. In Susan Herrington’s essay on Canadian forestry, the power of logging companies is clearly a crucial aspect. With lumber companies and the pulp and paper industry emerging as the dominant branches of the economy of British Columbia, the provincial government did not even ask for an inventory when it gave out licenses for harvesting forests in the early 1900s. As a result, management plans were not required until 1947, and sustainability standards even had to wait until 1976. Under pressure from vested interests, we also see the continuation of exploitative practices even after the underlying assumptions have been discredited. Ole Sparenberg shows that there were doubts about the notion of infinite marine resources early on, and yet they did little to irritate Nazi leaders who were expanding fishing and whaling in their quest for autarky. In Mark Finlay’s essay, we even see the intentional burning of plants in the field and the feeding of precious seed to cattle in an effort to end the guayule experiment as swiftly as possible. But in spite of these cases, it seems that the study of ignorance will remain below its potential if we focus only on ignorance that resulted from targeted action. Ignorance about the environment has multiple dimensions and causes, and this volume makes a point of exploring them broadly.

For example, Herrington shows that ignorance about Canada’s forests was the result of several complications. To be sure, lax regulation was important, but it was only one condition of ignorance. Even if the government had sought an inventory from companies, the picture would have been far from complete, as railroad fires proved far more destructive for forests than logging did. Then there was the issue of non-academic knowledge: lumberjacks knew a lot about the state of woodlands through their daily work, but their knowledge got lost as unskilled laborers took their place. Finally, the vast size of the territory made it difficult to get an overview, as did the lack of roads and infrastructures, and the advent of flight changed that only to a certain extent. With all these forces amplifying the degree of ignorance, it was only

consequential that the need for conservation grew out of observations from railroad windows and cars, rather than from the maps and statistics produced by professional foresters. In order to understand the significance of this story, it is crucial to note that forestry was the model discipline when it came to the sustainable management of resources. When even this discipline was facing multiple layers of ignorance and uncertainty as its knowledge base was established, we may take that as a hint that the information problem was a tremendous challenge for the rise of the conservation movement across the globe, and not only during the initial phase.

Needless to say, Canada's forests were a classic frontier region, where knowledge was almost inevitably scarce. However, ignorance was also a problem in an area that humans had settled a long time ago. In Central Europe, peasants had worked the soil for centuries, and yet knowledge about the most essential requirement of farming was far from satisfactory. In fact, the problem grew in importance with the advent of science-based agriculture. Chemists, bacteriologists, and other scientists offered new perspectives on the soil, but combining these insights into a coherent vision was exceedingly difficult: the more scholars looked at the soil, the more complicated it appeared. In the end, farmers essentially abandoned this growing complexity and focused exclusively on one discipline, namely agrochemistry, hoping that exclusive reliance on chemical approaches would boost productivity. To be sure, it did, but farmers also produced a wide array of follow-up problems that more refined approaches would have forestalled. Quoting George Orwell, Frank Uekötter notes that ignorance was strength when it came to modern industrialized agriculture, but that was true only from a short-term economic perspective. The reliance on ignorance had a huge toll, environmental and otherwise.

With that, the essay demonstrates that ignorance is not necessarily about an actual dearth of information and may indeed exist in the presence of a substantial body of knowledge. Academic specialization emerges as an important force in Uekötter's reading, as the fragmentation of soil knowledge into separate disciplines ultimately increased cognitive uncertainty—a phenomenon that Niklas Luhmann already highlighted in his sociology of risk.<sup>11</sup> Finlay's article makes a similar point on the paradoxical co-existence of knowledge and ignorance: the failure of the guayule experiment was clearly not due to a lack of research and experimentation. In fact, Finlay argues that from a scientific perspective, guayule may be the best-understood plant that was never put into commercial use. Ignorance was on the side of the consumers here: would there actually be a market for the commodity, and under what conditions? Even the U.S. war economy could not produce certainty in this regard. Perhaps the crucial factor was time: it took four to six years for the plants to reach maturity, obviously a prohibitive factor for the impatient agriculturalists of the twentieth century.

Endusers also figure as the great unknown in Sparenberg's discussion of the fishing and whaling boom in Nazi Germany. For the Nazi planners, the uncertainty about long-range sustainability took a back seat to the challenge of getting German consumers to actually eat the catch. Part of the solution was catering to people who had no choice, for instance in hospitals or prisons; however, clever marketers also developed new products like the wonderfully named "Neptun-Bratwurst" (in an act showing uneasiness about the boom of Ersatz products, the ministry of the interior mandated a change of the name so that consumers would be alerted as to the fish content). Finlay and Sparenberg thus show that uncertainty about resource use remained a powerful force even in situations where the rigor of autarky regimes had taken the place of the free-wheeling invisible hand of the market.

Ignorance about the environment also took the shape of tropes that suggested cognitive certainty. Both Herrington and David Schorr emphasize the idea of changing climates through forest policies, a concept quite on a par with the famous trope that "the rain follows the plow": the idea was not completely bogus but was certainly an exceeding generalization that encapsulated an enormous degree of ignorance. However, one cannot evaluate these tropes adequately if one fails to take note of the wisdom of hindsight. As Schorr stresses for the case of Palestine, neither the British nor the Zionists *knew* the unknowns: "They did not know what the original forest cover of the country was; they did not know why the environment, with its arid and semiarid climate, and rocky hillsides, was the way it was; and they did not know how to go about returning the environment to what they thought was its original and superior state."<sup>12</sup> Their only source of cognitive certainty was the Bible, another trope that provided encouragement as much as irritation, as the dire state of the environment in the holy land was so strangely different from the mythical land of milk and honey.

Another dimension of deficient knowledge was ignorance about the future. Rüdiger Graf provides a great example with his discussions of energy prophecies: he quotes Klaus Michael Meyer-Abich predicting a critical shortage of fossil fuels from the mid-1980s—just at the time when the oil price actually declined at an unprecedented rate, opening the door for more than a decade of extraordinarily cheap oil. Meyer-Abich also envisioned fusion and solar energy reigning supreme after the year 2000, and that turned out to be wide off the mark as well, with the former being an elusive technology and the latter a niche technology that has defied high hopes so far. But deficient knowledge can also open up chances: as Schorr points out, the colonial state took a step into the unknown when it began to regulate private forests, something that the British usually tried to avoid in their Empire. However, with the system in place to the present day, the experiment now looks like a pretty good idea.

However, ignorance may also lodge where one would least expect it: in the orders of knowledge that are at the heart of every academic discipline. We see that in two articles that deliberately challenge conventional ways of thinking by highlighting the importance of cycles and scenarios, respectively, as a means to deal with the unknown. Hugh Gorman looks at the invention of industrial-scale nitrogen fixing by Fritz Haber and Carl Bosch, a watershed event in that it demolished the strict limits that had heretofore constrained the human production of nitrogen. However, Gorman tells this story in an unusual way, as the story of a changing nitrogen cycle, thus demolishing the certainties that a thinking in resource terms implies. Cornelia Altenburg pursues a similar line in her discussion of the Enquete Commission “Nuclear Energy-Policy of the Future.” The adoption of a new cognitive framework, the scenario method, rearranged existing orders of knowledge. In both cases, we see a hegemonic cognitive frame being challenged, if not replaced, by an alternative system that offers a new set of perspectives, certainties, and unknowns.

All in all, ignorance about the environment could take many different forms, and the present volume does not claim to provide a complete list. In fact, it seems crucial to refrain from defining a typology of ignorance, as that may do more to constrain scholarly interest than to stimulate it. For example, Graf ties ignorance about the future with a discussion of professional development that increased uncertainty in spite of countervailing intentions, and these ironies and ambiguities in the management of the unknown deserve a prominent place in the field of agnotology. Managing the unknown was difficult not least because ignorance was devoid of cognitive structures: ignorance was not simply about a lack of information but also about the lack of paths to make sense of information. Little wonder, then, that people have shown scant interest in the unknown: for most parties that figure in this volume, ignorance was essentially a ghost that was painfully hard, if not impossible, to exorcise.

## **Ignorance and Action**

From an academic perspective, there was a simple remedy for ignorance: assemble a group of researchers and give them sufficient money and time. However, modernism begat not only scientific knowledge but also an impatience when it came to resources: letting things run idle while researchers clarify the issues was usually out of the question. At best, knowledge co-evolved with action, and that made for numerous complications in dealing with ignorance. With that, time emerges as a crucial problem in the relationship between deficient knowledge and action, or more precisely the lack of it. For instance, time was short for the Nazis in Sparenberg’s narrative: they did not know whether fishing would solve their food problems, but they did know that they were facing

a scarcity situation, and that became the defining push for action. Time was even more precious for the farmers who used mineral fertilizer but lacked the cognitive means for a scientifically proper decision. They *had* to make a decision in a small timeframe or else lose an entire growing season.

Ignorance was clearly a problem for people who were ready for action. But it was also an opportunity: ignoring inconvenient information provided a great excuse for bold action. A farmer not only saved time when he fertilized according to rules of thumb like “a lot helps a lot”—he could also duck concerns about erosion, groundwater contamination, and soil life in the process. In other words, ignorance not only constrained action but also encouraged it in some regards: the liberating powers of ignorance are one of the most fascinating aspects of the topic at hand, but also one of the most irritating from an environmental perspective. It was much easier to invest in modern whaling—a complex and expensive industry, after all—if one ignored that whaling had historically shown dramatic boom-and-bust cycles, as ignorance rendered worries about a bad investment obsolete. It was easier to exploit Canadian forests if one conceived them as endless, since one could then dispense with awkward sustainability requirements. In short, deficient knowledge allowed modes of behavior that more informed agents would have abhorred, or at least shied away from—though these merits of ignorance rarely played out to the advantage of the environment.<sup>13</sup>

The liberating powers of ignorance demonstrate a crucial point for the field of agnotology: situations may look extremely different on the collective and the individual level. Users may actually profit from ignorance, at least from a short-term perspective. Scientific disciplines may profit as well, since cognitive uncertainty often leads to the allocation of resources for the experts in charge, but that may prove a mixed blessing in the long run. Graf provides an interesting case in point: the growing uncertainty about the remaining oil reserves was an unintended result of the upswing of geological work and knowledge; the chapter thus describes “the self-marginalization of an expert-culture because of its own success.” It should not come as a big surprise that scientific disciplines look badly in a volume of ignorance: forestry does not make an impressive appearance in Herrington’s and Schorr’s chapters, and neither does agrochemistry in the land of Liebig. However, it is interesting to note that the situation could be bleak even for an expanding discipline.

Speaking of the actors involved, one of the striking insights is that the state emerges as a weak actor in most of the following articles. For instance, the colonial state in Palestine showed a notable readiness to accept limits to its power when its forest policy took private interests into account. Even under the conditions of autarky, state authorities had difficulties getting their act together: the Nazis’ fishing boom was essentially a huge malinvestment, and so was the U.S. guayule strategy (if one wishes to speak of a strategy at all).

The weakness of states is also evident in the fact that other fishing nations did not see Nazi Germany—essentially a newcomer when it came to whaling and fishing beyond the continental shelf—as an intruder in the exploitation of the global fishing commons. In Graf’s article, the key issue was professional allegiance, and not whether people worked for the government.

A final theme is the interplay between scientific and indigenous knowledge, as mutual charges of ignorance are a running theme in the age-old battle between both.<sup>14</sup> Given the secular trend towards modern science, it is probably not surprising to see indigenous knowledge under pressure in the present volume. Herrington mentions indigenous people as one of the stakeholders in Canada’s forests, but they remained silent in the debates that she describes—and certainly not because they had nothing to say. Indigenous knowledge is important not only in its own right but also because it often includes sensual modes of knowledge—smelling, tasting, and touching, along with non-verbal methods of recollection. As Finlay notes, one of the drawbacks of guayule was that farmers could not feel the rubber content. Ignorance is not necessarily about words.

## **Paths Toward Solutions**

The issue of solutions is arguably the trickiest theme in the social studies of ignorance. It goes without saying that every management strategy is dependent on reliable information, and that spells trouble for situations of cognitive uncertainty. So are managers of the unknown inevitably bound to stumble from one mistake to the next? Or can we identify strategies that allow more reflective paths of management? On first sight, the outlook is not good. When we go through the following case studies, the most benign conclusion is probably that of the guayule story. Unfortunately, that conclusion was based on evading the problem altogether: modern chemistry made the hassle with the new plant obsolete through the invention of synthetic rubber. If we confine our view to the issue of guayule, Finlay’s story is one of the bleakest. The general conditions were as close to a free lunch as one might get in agriculture: they had seed ready for planting, they had plenty of land with no competing uses, and they had the urgency of a war economy context, and still things somehow failed to come together.

Nonetheless, two chapters set out to identify paths towards solutions, or at least approaches that look more responsible than others. Altenburg describes the scenario method as an approach to reduce uncertainties. Her case study is the Enquete Commission “Nuclear Energy-Policy of the Future,” which the German parliament assembled in the late 1970s. The backdrop was rather discouraging: the conflict over nuclear power had escalated in a way that

divided society into camps of bitter proponents and opponents. Nonetheless, the Enquete Commission succeeded in bringing these parties into a constructive dialogue and ultimately agreed on four potential energy paths—two with nuclear power and two without. Altenburg discusses the circumstances that led to this unexpected outcome, arguing that “the commission is a role model for comparable contemporary discussions, because it shows that caved paths of argumentation could be turned off to reveal new and as yet undiscovered ones.” The Enquete Commission provides a fitting illustration of the shift that Michael Smithson observed as follows: “Not long ago, the dominant methods of coping with ignorance were to try eliminating or absorbing it. The emerging frameworks now seem to have jettisoned the assumption, that ignorance is ultimately reducible, and the new style is ‘managerial’ in the sense of attempting to understand, tolerate, and even utilize certain kinds of ignorance.”<sup>15</sup>

The issue of solutions is also one that Gorman arrives at by way of conclusion. After all, Gorman’s story of nitrogen is also about the evolution of a new, heretofore unknown environmental problem: ground and surface water contamination from fertilizer runoff. Anti-pollution efforts came to include nitrogen since the 1970s, but many of them have failed spectacularly. Against this backdrop, Gorman suggests a process of learning to think in cycles: rather than trying to impose limits at certain points, regulators are well advised to consider the total flow of nitrogen and seek to manage it in a way that takes the complex, interwoven processes of the nitrogen cycle into account. In the context of the present volume, that approach can also claim a second advantage: it forces us to rethink the notion of the resource. While we usually take resources as a given, they are a matter of perspective in Gorman’s article. All of a sudden, the conventional view of resources looks terribly naive, and that offers new perspectives for the environmental history of resource use.

## **The Silence of the Ground: Toward a New History of Resources**

In sum, this volume shows that there are a whole host of issues waiting to be explored when agnotology comes to environmental issues. And yet this introduction would be incomplete if it did not highlight one basic point that this volume seeks to make. At its core, these essays are about resources, and at the risk of generalizing unduly, it might be said that resources have not received the kind of scholarly attention that they deserve. Even environmental historians have become disenchanted with the topic in recent years. For an earlier generation of scholars, that was a bit different, as U.S. environmental history grew out of the study of conservation to a significant extent.<sup>16</sup> However, the boom of cultural history has not left environmental historians unimpressed, and it is a bit shocking indeed to see that key publications like Daniel Yergin’s

*The Prize* or Jean-Claude Debeir's *In the Servitude of Power* are now twenty years old.<sup>17</sup> It is arguably a drawback for this field that, in an age of cultural history, resources seem to provide little fodder for discourse analysis. Students of resource use frequently encounter a resounding silence in their work: even in cases of reckless exploitation, it is not guaranteed that someone will speak up. As a result, scholars tend to stick to the material side of resource history.

However, some processes are remarkable not only for what they do, but also for what they *fail* to do. It is noteworthy that the spectacular changes of petroknowledge as described by Graf did not impress consumers at all: the growing uncertainty as to how long petroleum reserves would last did not inhibit consumption to any significant extent. One could take this as a cue to write the history of environmental ignorance on a much grander scale. In a way, all the stories in this volume are part of an even bigger story of ignorance: the wanton agnosticism of the modern consumer society as to its finite resource base. On one level, every consumer knows about the unsustainability of our resource-intensive lifestyle; on another level, we nonetheless continue to support exploitation through our choices as consumers. If we take this hint seriously, agnotology may open the door for a new history of resources that includes both the material history and the social construction of resources, and analyzes them as two sides of the same coin even when they look vastly different. We simply should not conceive resource exploitation and ignorance about resource exploitation as two separate issues any longer.

As we said, most people shun situations of ignorance. Maybe this volume can convince scholars that they should do the opposite.

## Notes

1. "Foot in Mouth Award," accessed February 13, 2012, <http://www.plainenglish.co.uk/awards/foot-in-mouth-award/foot-in-mouth-winners.html>.
2. Lukas Straumann, *Nützliche Schädlinge. Angewandte Entomologie, chemische Industrie und Landwirtschaftspolitik in der Schweiz 1874–1952* (Zürich, 2005); Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (Cambridge, 2001); James Whorton, *Before Silent Spring: Pesticides and Public Health in Pre-DDT America* (Princeton, 1974).
3. Christian Warren, *Brush with Death: A Social History of Lead Poisoning* (Baltimore and London, 2000); Frank Uekötter, "The Merits of the Precautionary Principle. Controlling Automobile Exhausts in Germany and the United States before 1945," in *Smoke and Mirrors: The Politics and Culture of Air Pollution*, ed. E. Melanie DuPuis (New York and London, 2004), 119–53.
4. Wilbert E. Moore and Melvin M. Tumin, "Some Social Functions of Ignorance," *American Sociological Review* 14 (1949): 787–795.
5. See, for instance, S. Holly Stocking, "On Drawing Attention to Ignorance," *Science Communication* 20 (1998): 1, 165–178, and Kathrin Passig and Aleks Scholz, *Lexikon des Unwissens. Woraufes bisher keine Antwort gibt* (Berlin, 2007).

6. Robert N. Proctor and Londa Schiebinger, eds., *Agnotology: The Making and Unmaking of Ignorance* (Stanford, 2008).
7. Proctor and Schiebinger, "Preface," *ibid.*, vii.
8. Alfred W. Crosby, *The Columbian Exchange: Biological and Cultural Consequences of 1492* (Westport, 1972).
9. Naomi Oreskes and Erik M. Conway, "Challenging Knowledge: How Climate Science Became a Victim of the Cold War," in Robert N. Proctor and Londa Schiebinger, eds., *Agnotology. The Making and Unmaking of Ignorance* (Stanford, 2008), 55–89; David Magnus, "Risk Management versus the Precautionary Principle: Agnotology as a Strategy in the Debate over Genetically Engineered Organisms," *ibid.*, 250–265; David Michaels, "Manufactured Uncertainty: Contested Science and the Protection of the Public's Health and Environment," *ibid.*, 90–107.
10. Cf. Robert N. Proctor, *Cancer Wars: How Politics Shapes What We Know and Don't Know About Cancer* (New York, 1995), and Robert N. Proctor, *Golden Holocaust: Origins of the Cigarette Catastrophe and the Case for Abolition* (Berkeley, 2011).
11. "It is no accident that the risk perspective has developed parallel to the growth in scientific specialization. Modern risk-oriented society is a product not only of the perception of the consequences of technological achievement. Its seed is contained in the expansion of research possibilities and of knowledge itself." Niklas Luhmann, *Risk: A Sociological Theory* (Berlin and New York, 1993), 28.
12. See p. 78.
13. It would be tempting to probe deeper here, and explore more fully the psychology of ignorance. It would seem that ignorance as discussed in this volume fits squarely into a strict dichotomy of knowledge and lack of knowledge, instead residing in some kind of cognitive twilight zone. However, it would seem that the scholars in this volume can offer little in the way of training to ponder questions of this kind.
14. See, for instance, Mark Hobart, ed., *An Anthropological Critique of Development: The Growth of Ignorance* (New York, 1993).
15. Michael Smithson, *Ignorance and Uncertainty: Emerging Paradigms* (New York, 1988), viii.
16. See, for instance, the classic Samuel P. Hays, *Conservation and the Gospel of Efficiency* (Pittsburgh, 1999), originally published in 1959.
17. Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power* (New York, 1991); Jean-Claude Debeir, Jean-Paul Deléage, and Daniel Hémerly, *In the Servitude of Power: Energy and Civilisation through the Ages* (London and Atlantic Highlands, 1991).