# Conclusion

The EPA has been and remains a major institutional site for the development of risk sciences and their use in regulation and policy. It is an organization through which risk assessment and risk management were conceived, tested, and gained credibility as a standard for the administration of uncertainty. The EPA, in return—its constitutive expertise, the material organization of the production of decisions, indeed its overall image and legitimacy—was shaped by risk decision-making. The history of risk and the EPA represents a complex case of mutual construction of one science and one agency, because risk decision-making is not a unified rationality. It is comprised of several rationales crystallizing over time in the midst of the many controversies engaging the EPA, or parts of it.

This book has examined multiple episodes connecting controversy to the shaping of the credibility of an administration. Back in the 1970s, the goal to cancel the registration of a range of pesticides linked to serious pollution problems and cancer risks, and the difficulty of obtaining such decisions in the courts, given the structural uncertainty surrounding what causes cancer and the merit of getting rid of any substance suspected of causing cancer in laboratory animals, led to the replacement of fixed judgment principles by a mixed decision system. This system rested on both calculation and judgment criteria, taking the form of a risk assessment guideline (chapter 3) that was essentially a procedure to force the explication of criteria of toxicity, and then of decision-making. That technology benefited from the nascent science of toxicological extrapolation and medical carcinogenesis, but also from the procedural competence embodied by Alvin Alm, the agency's premier policy analyst. A few years later, the enduring dispute concerning the EPA's standard use of a linear extrapolation method, combined with

the outright, arbitrary intervention of deputy and assistant administrators under Ann Gorsuch to rescue benzene, formaldehyde, and DEHP, intensified the debates concerning the boundary to be drawn between scientific calculation of the risk and political judgment about the acceptability of these risks and decisions to reduce them. This was the context that led to this other technology of legitimate decision-making—the separation of risk assessment and risk management (chapter 4).

Once established, this design helped articulate provisional solutions for many of the complicated, apparently undecidable cases of chemical risks, where the legal authority of the agency and the credibility of regulation development process were insufficient to impose a decision on disagreeing parties. The ozone controversy—particularly the difficulty to set an ozone standard in the absence of consideration of costs—anchored the practice of risk management as a "weighing of policy options" (chapter 4). The controversy surrounding arsenic in air led to the Tacoma public hearing experiment and, indirectly, to the stabilization of risk communication processes and principles (chapter 5). The formalization of a comparative risk assessment methodology is inextricably linked to the revelation of widely diverging assessment of iconic chemical substances, such as formaldehyde, at the end of the 1970s, but even more so with the intense questioning of the agency's priorities in the radon and alar affairs (chapter 8). The deployment of a risk characterization discipline in the agency, starting at the end of 1992, was triggered by the passive smoking controversy (chapter 9).

Many more risk controversies—some contained in the agency, others public, but always reflective of the oppositions among audiences concerning the reality and acceptability of particular risks—influenced the definition of risk assessment: The internal dispute about PCE led to a revision of the scheme for carcinogen classification. The formaldehyde case led to a standardization of exposure calculation. The divergences among program offices on the risks of arsenic precipitated the invention of a notion of an "uncertainty factor" (chapter 7). Each time, these affairs accelerated the formalization of a mode of administration, which led to its installation in the EPA. It also inspired discourse by its leaders to represent how the agency generically addresses uncertain issues.

## The Political Nature of Frameworks

Despite their apparent logic and mimicking of the scientific method, the risk assessment–risk management framework, and others that succeeded it, are fully political objects. They are a response to existing controversies, as well as a resource to restructure, if not resolve them. Science is instrumental to the EPA because it helps in analyzing, structuring, and responding to controversy. The networks of scientists—of this special kind of scientist that pertains to the broad area of bureaucratic design sciences, those who care to manage risks and learn from contexts of administration—have consistently been active, observing the limits of the administration of uncertain issues and adapting bureaucratic knowledge and technologies to ensure the assemblage of people and of their views. It is, in the deepest sense, a political science, which helps make decisions in the face of apparently intractable situations and respond to selected, idealized audiences.

As this book has illustrated at length, bureaucratic knowledge evolves through contests, counterpropositions, and political interventions. The risk assessment–risk management framework is a reflection of a time when the EPA tried to articulate demands for protection against chemical risks; a rising agenda of deregulation championed by the chemical industry and Republican presidents; and continued demands, inscribed in its statutes, to be science-based, and quantify risks. The framework articulated and ordered all of this at once. The scientization of risk assessment is inseparable from the aggression of various Republican administrations toward environmental regulation in the early 1990s and between 2002 and 2010. Once Republicans in Congress went in the same direction as the industry in the 1990s, this sealed the political fate of risk assessment, which came to be perceived negatively by those who wanted to advance the goals of health and environmental protection.

The environmentalist critique of risk assessment crystallized between 1994 and 2000 because Republicans in Congress embraced it to constrain and roll back environmental policy. The political disinvestment of risk assessment and risk-ranking under Carol Browner is also a testimony to this politicization of the design applied within the agency. Ecological risk assessment, exposure assessment, and cumulative risk assessment developed thereafter, we can assume, in order to restore capacities to make protective

decisions as other technologies conservative decision-making, namely the linear extrapolation model in chemical risk assessment, started to be put in question. The invocation of sustainability as a broader imperative, taking over that of risk, probably reflects the failure of a risk-based paradigm to continue to protect the legitimacy of the EPA.

Despite constant talk of a paradigm, there is no clear shift from one paradigm to another at a particular time. There is an incremental invention of new forms, in networks that are continuously active across Washington, that observe and reconceptualize what is happening in a variety of environmental decisions. New knowledge representations and bureaucratic technologies emerge in these networks, connected to one or another office of the agency—not least its ORD—that administrators pick up on depending on the agenda that they wish to promote, to assemble and defend the identity of the organization in new ways. Problem formulation and public engagement are two bureaucratic technologies that are central to the sustainability paradigm that emerged more forcefully in the 2000s. These concepts already existed somewhere in the EPA, but they became instrumental when its leaders felt the need to advertise the complexity of environmental health issues, the interconnections among them, and the limits of a chemical-by-chemical approach. Again, there is a strong link between bureaucratic technologies for making decisions and the broader political context. The former are conceived and incorporated into grander administrative plans, depending on the evolution of the latter.

The fact that the risk paradigm ended does not mean that the whole apparatus of knowledge and technologies that crystallized to handle risk disappeared. The knowledge and technologies are still there, important and employed day after day. They still evolve, one by one, and incrementally. When the whole set of technologies seems to have changed, another name is given to it. But they are less central to the representation of what the agency does as a whole, to the images of its action that circulate in the polity.

## "Not Invented Here": The Autonomy of the EPA

Throughout the various episodes recounted in this book, the EPA has consistently been, if not the sole agent of invention of rationalistic forms of decision-making, at least an important site for it. It is a rationalizing agency

of some sort—an organizational space that stimulates and hosts design. It is an agency that rationalizes from within.

This can be observed in the fact that nearly all the concepts that the EPA administrators put forward and applied across the agency already existed in one corner of it. No framework emerged wholesale from the NAS, however laudable RAFG and its authors were. The authors of RAFG relabeled and reordered concepts and processes that had been proposed inside the EPA. Much of the history of the decision-making frameworks at the EPA is also the history of the codification of implicit practices and concepts that constitute the typical knowledge of the bureaucratic organization.

Guidelines for quantitative risk assessment and risk-ranking are other blatant examples. Only under Administrator Bill Reilly did the latter acquire greater public visibility, particularly with the release of *Unfinished Business*. Only then was it promoted to become a defining vocabulary for the agency as a whole. But people in the Toxics Integration program, starting in 1977, already knew the value of this methodological concept for the EPA. Risk characterization emerged in the early 1990s, ten years after both the authors of RAFG and Milton Russell established how instrumental an explication of uncertainties and uncertainty-reducing techniques was for legitimating the decisions of an agency. Risk communication crystallized through the "seven rules of risk communication" memo, under the pressure of the radon controversy, years after being conceptualized by Milton Russell and William Ruckelshaus. Problem formulation, finally, was already inscribed in the guidelines for regulatory impact assessment of the early 1980s, but it took on a far greater importance later on, in the context of the development of the practice of ecological risk assessment in the Superfund office and regional branches. They were elevated to become a more generic concept for application across programs by Administrator Carol Browner.

The idea that these designs were emerging inside the EPA is actually not lost on the officials and managers of the agency. They can always argue, when external designers try to impose a new approach or ask for its generalization, that the agency is already doing what is being asked of it (even it is doing so only in part, or only in a particular corner of its organization). This discourse arose in the 1990s when risk characterization emerged as a new imperative, or around 2010, when problem formulation was publicly floated.

Another implication of this rationalization from within is that people in the agency can always argue that it is learning and improving. The trajectory of these techniques—first confidential and not very sophisticated, then precise and generalized—forms the basis of a narrative of rationalization. Pointing to the difference between the times when a method was being experimented in only one part of the agency and the days of its generalization, the EPA will appear to have grown more competent and more dedicated to the implementation of a given approach. Most of the notions that define its way of operating and expertise are generic and can appear in multiple forms and versions. They thus tolerate, or even enable, this discourse about rationalization, of progression from a basic and local practice to a fully conceptualized, global one. Convergence across program offices and between human health and ecological risk assessors on problem formulation in the 2000s, convergence of very different NRC panels on building on the codification proposed in RAFG, and convergence, after some reflection, of Administrator Browner on the memo of the preceding deputy administrator, Hank Habicht: these are examples of references that, over time and depending on circumstances, gain support to become standard bureaucratic knowledge.

## EPA and Its Design Networks

And so, from the politics of design standpoint used in this discussion, an agency like the EPA appears to have a fairly high degree of autonomy. This does not mean that it rationalizes alone and on its own terms, though. Rather, it means that the agency is a site in which the formation and activity of *design networks* are stimulated.

RAFG helped the agency combine two separate ideal designs. One was health risk assessment, which combines scientific experimentation of the risk with defined policy criteria to avert uncertainty and legitimize regulatory intervention despite any doubts—a form of precaution predating the principle. But the report also made space for the economists' passion for comparability, consistency, and control over decisions. This rationale found its expression in cost-benefit analysis and regulatory analysis. Through this framework, the vision and expertise of toxicologists, economists, policy analysts, and political managers were articulated. This has happened in a particular configuration, provoked by the extreme uncertainty of the early

1980s concerning the existence of the EPA. This was, in many ways, an exceptional moment. At other times, it is more common to hear that toxicologists and policy analysts in the agency do not manage to speak to each other, or they cannot quite establish routine cooperation (Powell 1999). Scientists, particularly when placed in the ORD, and decision-makers in regulatory offices often do not manage to align. This is a nearly constant condition at the EPA, as the repeated attempts to organize its research and make it more useful to regulatory agencies—in 1977, in 1983, in 1994, and other times—demonstrate.

But design networks are continually active in and around the agency. The enduring cancer risk assessment method cannot be disentangled from the existence of a network of health scientists that consistently defended this calculative-protective method of making decisions. A pivotal person in this group is Bernie Goldstein. Goldstein, academically, was the founding director of the Environmental and Occupational Health Sciences Institute, a joint program of Rutgers University and Robert Wood Johnson Medical School in Piscataway Township, New Jersey. He was trained by Roy Albert, the scientific leader of the early CAG, and a staunch defender of the cancer risk assessment and decision-making technology described in chapter 2. He advised the department of the environment of the state of New Jersey, then facing some of the highest levels of cancer in the United States and pollution of water sources by chemicals, many of which were carcinogenic. Goldstein became head of ORD in 1983, in a critical moment of adaptation of the risk framework in the agency. He recruited Peter Preuss, who had started his career working for the state of New Jersey. Preuss went on to have a long career at the ORD, for many years leading the center that performed risk assessments and working to improve the coordination between the ORD and regulatory offices, or between risk assessment and risk management, holding the ground of the more precautionary approaches embedded in the guidelines used in the agency for both cancer and noncancer risk assessment.

Preuss had worked with a young epidemiologist, Tom Burke, at the department of environmental protection of New Jersey. Burke's mentor was Reuel Stallones, the chair of the committee that produced RAFG. He learned risk decision-making thanks to Joseph Rodricks (a toxicologist involved in the IRLG effort [see chapter 2] and the production of RAFG as well as *Science and Decisions* [chapter 4 and 10]), during a national conference in San

Antonio that was set up to spread the framework to state officials. Burke later became the chair of the panel that produced *Science and Decisions* and then was deputy assistant administrator of the ORD, as well as the EPA's science advisor during the administration of Barack Obama. This group of people forms a loose network that spanned the boundaries of the agency, working at times inside the agency, at other times outside, advancing the same rationale of using science to engineer health-protective decisions. All were marked by the situation of New Jersey in the 1970s, and all started to find their place in the relevant administrations through the notions of risk assessment and risk management emerging from the RAFG.

Other networks have been active across the few decades covered by this book, focusing on other dimensions of uncertainty and advancing alternative designs. A network of policy analysts and economists, successively active in the agency or close to it in universities or think tanks such as Resources for the Future, has supported the various developments in terms of risk comparison and risk ranking in the agency. Alvin Alm, Richard Morgenstern, Terry Davies, and Adam Finkel, among others, advocated the rationale of strengthening the agency's cohesion through transversal, synoptic consideration of lists of risk. The 1990s saw the emergence of a coalition of actors with a scientific background, engaging with the methods of risk assessment applied by the agency to overturn them. The way that John Graham trained and mobilized scientists through the Harvard Center for Risk Analysis to engage on this front over two decades is highly representative of this movement. It helped a network supporting an alternative design—one that regulates based on calculation and prediction—to come together and contest the decisionistic rationale embedded in EPA guidelines, notably when one of Graham's close colleagues, George Gray, took on the position of head of the ORD in 2006.

All three networks documented in this discussion are, in their own ways, deeply concerned by and involved in the fate of the EPA and of the administration of the environment. Despite changing functions and organizational affiliations at the individual level, they are consistently engaged in environmental regulation collectively. They are cross-organizational networks, cutting across the boundaries of EPA offices and other organizations in the area—public academic organizations, think tanks, committees, and services of the executive or Congress, and more occasionally private organizations such as research institutions, consultancies, and industry lobby

groups. This means that the networks are always present and active, either inside the EPA or through one or more of their members.

The relationships between people in the same network are maintained over time: All three networks are multigenerational. In an important sense, these networks harbor and perform a particular regulatory morality, more or less liberal or conservative, helping the EPA administration to sustain regulatory intervention, with others trying to optimize this regulatory intervention, and yet others actively working to roll regulations back. Design networks are sometimes explicitly connected to either the Democratic or Republican Party. This political affiliation is generally not made explicit, but it is sufficiently strong to explain that a given network will be more present in the agency, depending on the president and the chosen EPA administrator.

These networks comprise, at their heart, competences coming from this particular sort of science, which I have called *design science*. Their members are trained in and draw from a wide spectrum of disciplines, which go from quantitative health risk assessment to economic regulatory analysis (see chapter 1). They accumulate experience in the performance of analytical tasks for regulatory purposes, observing where and when it seems effective, or not, and delivering the kind of environmental standards that they prefer. Their action on the agency and environmental regulation is mediated by existing bureaucratic knowledge and technologies. Their influence is all the greater in that they work on established designs, from within, to subtly reformulate them. In this kind of administrative politics, it appears more effective to argue that established forms of bureaucratic knowledge have failed and should be adjusted than to put forward an altogether different, but unrecognizable model of administration.

Networks intersect and tie in certain places and moments, making the process of bureaucratic design suddenly more contentious. This book has shown the importance of a number of institutional venues where this happens. From the design perspective adopted here, the NRC has influence on the EPA not only because of its accumulated scientific prestige. It has power, insofar as it is the center of a design configuration—a place where various networks intersect, suitable for elaborating a common design and borrowing proposals from various networks and rationales. Because RAFG contributed to the institutionalization of a mode of administration at the EPA, it seems to be inevitable, for anyone wishing to alter this mode of

administration, to work through the NRC. In actor network theory parlance, it has become an obligatory point of passage, the institutional-geographical point at which design networks can be brought together.

Judging by the recurrence of influential reports produced by the NRC and the number of reports concerning chemical risk assessment in the past decade alone, it seems clear that the Academies, the National Academy of Science and the National Research Council in the first place, have become an even more important site to forge institutional responses to controversial situations since the 1983 publication of RAFG. This observation is coherent with the number of participations in NRC panels of protagonists of the design process encountered in the various chapters. Joseph Rodricks, a toxicologist by training and former FDA official, participated in the panel that published RAFG, but also took part in the development of *Science and Judgment*, and of *Science and Decisions*. Gil Omenn, a geneticist and toxicologist, served in the OSTP under President Jimmy Carter, was a pivotal member of the RAC that produced RAFG, and later served as chair of the PCCRARM in 1997. Warner North, a decision scientist, was a member of the panels of RAFG, *Improving Risk Communication, Science and Judgment,* and *Understanding Risk*. The latter report was special, in that it was produced by a panel that included the science and technology studies scholar Sheila Jasanoff, the philosopher Kristin Shrader-Frechette, and the psychologist and risk perception specialist Paul Slovic. Slovic had been a member of the RAFG panel, while Sheila Jasanoff had been on the panel for a precedent NRC report, *Science and Judgment in Risk Assessment*. The importance of maintaining a good relationship with the Academies and the status of its recommendations, asserted by EPA officials, testifies to the centrality acquired by the NRC in the production and management of change at the agency.

The agency and these design networks are not evolving independent of each other. It is probably more accurate to say that the agency is a site of formation of such networks, and its goals a motive for their actions. All of these people were linked to the EPA through one or several of the positions they held during their careers as scientists, former officials of this agency or another, as consultants for the EPA, as members of one of its advisory panel, as members of a service of the White House overseeing the agency, and others. The source of the capacity of the EPA to rationalize itself is this use of networks and of the venues in which they take form and in which they try to design modes of administration. Tellingly, the interactions between the

agency and the NRC have become somewhat more critical over the years. Discussing the charge and the selection of experts for panels, feeding panels with detailed information about what the EPA knows and does, advancing concepts to shape its thinking … all of these pertain to the critical strategic work that EPA people and leaders consistently perform in order to take part in the shaping of the standards of rational decision-making.

## The EPA's Rationalities

Risk assessment and risk management, as we are reminded here, is not a homogeneous rationality. This poses the question of what, fundamentally, is the underlying material rationality of the EPA—if it can be at all qualified in such a global, integrated fashion.

Some see the agency as home to a large population of committed environmentalists who are ready to ignore the science where and when it indicates a moderate level of risk. Others consider that the EPA, like other agencies, is captured by private interests—a situation that holds thanks to the injunction to be science based, to use scientific evidence, and to reduce uncertainty (Wagner 1995). This pressure mostly results in delays and the inability to decide. The sophisticated scientific methods and data that justify the pursuit of ever-more-refined risk assessments—such as for dioxin—are jointly defended by private interests and many scientists and decision-makers in the agency. Recently, an investigation traced the more frequent use of PBPK models in risk assessment to the continual influence of an industry-funded group of scientists (Brown and Grossman 2015). Quoting the proponents of this kind of modeling method, the paper claims that it has contributed to blocking processes of a special review of pesticides. The authors of the investigation find coherence between this outcome and the fact that the most well known proponents of the method were affiliated with a contractual research institute working for the chemical industry, in which a string of EPA scientists were trained. The case of PBPK modeling would thus illustrate the pressure exerted by networks of industry-linked scientists on the EPA to always make "use of the best available science" (McClellan and North 1994, 629) and reduce the use of defaults and protective assumptions.

But especially since the 1990s, predicting risk and reducing uncertainty through the search for more knowledge, and more accurate knowledge,

appear to have become a strong rationale. It remains difficult to argue that the EPA in general became more scientistic, paralyzed by the uncertainties that an evolving science was supposed to lift, by following strictly deterministic, science-dictates-decisions kind of frameworks. What is certainly true, however, is that businesses and associated scientists are much more central, active, and influential in the configurations in which this bureaucratic knowledge is forged.

Attention to and pressure on the EPA has only increased, and the 1990s were a striking moment in that respect. The changes of the 1990s—the beginning of this discourse according to which the EPA had followed a model, and the fact that this model of separating risk assessment from risk management stemmed from a report dubbed the "Red Book"—took place in a much denser configuration, with cross-linkages and multiple workshops that intermingled EPA people with their opponents and supporters. These were days when workshops of the Silver Book succeeded at a fast pace to conferences and panel meetings at the NRC, and more and more frequent meetings of the Society for Risk Analysis. The Office of Technology Assessment and the GAO produced more reports about the EPA in those years. Think tanks, from Resources for the Future to the Carnegie Foundation, took their share as well. In the early 1990s too, the OMB was extremely active on the topic of EPA concepts and methods, as illustrated in chapter 9, as were the AIHC and the American Petroleum Institute, and the American Chemistry Council in the more recent past. Businesses may not be influential down to every minute decision of the EPA. But they may be influential in setting the course of the slow development of the agency's bureaucratic knowledge.

This pressure combines with the dominance, over the years, of what I have termed a *decisionistic design,* strongly ingrained in the agency. The strength of decisionism shows in the emergence of the risk assessment–risk management framework itself, which made the methods of debating values—risk evaluation, as discussed in chapter 4—redundant. Risk communication, once a central exercise during the second term of William Ruckelshaus as EPA administrator, lost political importance in subsequent years. Public engagement, in the latest frameworks for risk management (e.g., Presidential and Congressional Commission 1997), has become an important prescription. But as the many graphs depicting the new, holistic risk management methods show, it remains peripheral to the processes of risk calculation and regulatory analysis.

## Rationalizing (in) Adversity: Institutional Innovation at the EPA

One of the puzzles that motivated this work, finally, lies in the fact that the risk assessment–risk management framework became a standard. As mentioned in the Introduction, risk assessment, risk management, risk characterization, and communication form part of a global gospel of risk governance—a repertoire of rules that frame the practices of bureaucracies worldwide (Jasanoff 1999; Jardine et al. 2003; Renn 2005; Renn and Walker 2008; Winickoff and Bushey 2010; Demortain 2011, 2012). A conventional narrative ties these rules to RAFG, as the source of the framework, and to the EPA experience of the early 1980s (see note 3, chapter 1).

This process of institutional innovation is puzzling if we accept the premises of new institutionalism, according to which organizations tend to incorporate those scripts that are standard among organizations in the same field (Di Maggio and Powell 1983). The authorization of the generic concepts of risk assessment and risk management by a panel of scientists of the NRC, of course, was a very important factor to explain that the EPA officially embraced these notions and extended them across the organization to restructure it. This ceremonial adoption resembles the sort of process that new institutionalists describe as part of the notion of isomorphism. And it helped the agency become a manifestly rational organization, with an apparent plan and purpose.

But this explanation does not fit the history recounted here. The EPA did not buy risk decision-making wholesale from another organization or institutional carrier. The framework gradually emerged through a process of definition of the agency's cross-office procedures for quantifying risk. It was not adopted because of its a priori legitimacy, but it gradually articulated it, as and when it appeared that the categories emerging in the configuration of the early 1980s effectively reduced the disagreements, misunderstandings, and conflicts, both inside and outside the agency, about what the various processes of risk assessment, risk analysis, risk evaluation, hazard or health assessment and the like meant and implied. Once embedded in the organization, the framework represented more than an empty ritual. Although there is some measure of decoupling between frameworks and the reality of practices inside the agency—in part because the agency needs what I have termed a *bureaucratic screen,* a function that the risk assessment–risk management framework fulfilled alongside other tools, such as the risk

assessment guidelines—risk frameworks do correspond to the way people behave, the knowledge they acquire and use, and the roles and identities that they take on.

It would be an exaggeration, however, to argue that the EPA possesses a large, autonomous capacity of institutional innovation. First, the design of decision-making frameworks is motivated and constrained by the need to articulate the manifold audiences and criteria of legitimate environmental action—starting with the heterogeneous criteria of risk and of proof inscribed by lawmakers in environmental statutes, as well as in the work of the agency's offices. This rationalization took place in a complex environment at the EPA comprised of the multiple audiences with which it is constantly grappling. Being strategic, in such a configuration, arguably implies reducing the distance between your audiences and aligning the criteria of decisions that they favor and impose on the agency.

In a deep sense, a framework is such a multicriteria organizational plan—one through which various audiences, and approaches to risks, can be articulated together. The science of decision-making, one could assume, is animated by, and embodies, such an ambition to balance and order multiple criteria and public audiences. Further, the assembling of the framework was not done by EPA scientists and bureaucrats alone. It was forged within networks of professionals circulating in and around the EPA, working together in particular moments of questioning and refashioning of administrative institutions.

These elements point to the fact of drawing from an institution—that of science and its ambition to frame and avert dispute—so as to appear to be an organization that can respond to, and even reconcile, multiple audiences. This mode of rationalization concerns organizations whose legitimacy and indeed existence are regularly threatened because of the multiplicity and ambiguity of the audiences and demands that they have to satisfy. Simultaneously, it is accessible only to these organizations that are densely connected to these other parties, forming networks within which this adversity can be re-created, the source of the controversies explicated and analyzed, and solutions drawing on culturally accepted repertoires, like science, tested.

Both of these dimensions stand out in the case of the EPA. This agency, first, is caught in a complex web of evaluations and prescriptions, projected by the multiple audiences and principals on which its existence depends.

The White House and the OMB evaluate the agency, posing questions about the appropriateness of each and every one of its acts. A diverse network of audiences, NGOs, and industry groups attack all the agency's decisions or at least publicly disparage them, with hardly anyone left to defend them. Courts, therefore, question the benefits and meanings of the EPA's actions. EPA officials are very common invitees to Congress, too. The number of reports of the Academies concerning the EPA, its methods, and its assessments is impressive. This agency is subject to greater scrutiny than any other. Each of the landmark NRC reports studied in this book are now referenced outside the area of chemical risk assessment, but all originated in a review of the work of the EPA. It is also an agency of which people say that it is "asking the wrong questions" (Landy et al. 1994) or has "gone mad" (Fleming 1994), and one that Republicans do not unfrequently want to reengineer, if not shut down entirely. The EPA is caught in a dense set of relationships with people, principals, and organizations that all evaluate and contest parts of its action, attributing negative dispositions to it (Dowling and Pfeffer 1975).

Second, the EPA is also an agency that benefits from the engagement of its professionals and leaders in the networks in which the norms of scientific reasoning and the scientific method are defined, tested, and stabilized. What I have emphasized, through the description of design networks, is the web of relationships that tie the agency to the many places in which audiences forge their criteria of what an environmental agency should be doing, and infuse it (Selznick 1949). In the case of the EPA, this institutionalization is forced by even greater legitimacy problems, or existential threats. And this relation with the environment is particularly complex: Each mission and statute executed by the agency implies one or several audiences. The attribution of a unified character to the organization is constantly hindered by its internal fragmentation and the diversity of environmental issues it administers. But if and where science puts its ability to identify and articulate together the criteria of decisions, and if logic and objectivity translate into testing systems for ordering the diversity of knowledge and viewpoints to arrive at common positions, it seems in this case that its broad cultural authority can be put at the service of administration and of legitimacy.

The history of the EPA, at the end of the day, reveals a tension that characterizes most science-based bureaucracies. Science hardly protects, as such, these administrations from conflicts among their audiences and principals,

or from the kind of political polarization that the adversarial American political system typically engenders (Jasanoff 1990). At times, however, if it enables analyzing conflict and testing solutions to avert it, then it does legitimize government. It is, in sum, because agency officials and the professional network of design sciences supporting the agency have consistently searched for ways to create the articulation between conflicting parties and opposed views of the environment and risks that it succeeds in instituting forms of decision-making, in the United States and beyond.

# The Science of Bureaucracy

## Risk Decision-Making and the US Environmental Protection Agency

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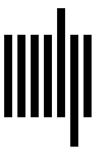

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