

THE RADIANCE OF FRANCE

NUCLEAR POWER AND NATIONAL IDENTITY
AFTER WORLD WAR II

GABRIELLE HECHT

FOREWORD BY MICHEL CALLON
AND A NEW AFTERWORD BY
THE AUTHOR



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Nuclear Power and National Identity after World War II

Gabrielle Hecht

*Foreword by Michel Callon and a new afterword
by the author*

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Contents

Foreword by Michel Callon xi

Acknowledgments xxv

Introduction 1

Technology, Politics, Culture, and National Identity

Conceptual and Methodological Tools

Research Stories and Oral Histories

1

A Technological Nation 21

State Engineering before World War II

State Institutions after World War II

What Is a Technocrat?

The Future of France

The Mentality of the Future

The Plan

2

Technopolitical Regimes 55

The Creation of the CEA

The Emergency of a Nationalist Technopolitical Regime

The G2 Reactor: Developing a Nationalist Technopolitical Regime

EDF: The Emergence of a Nationalized Regime

The EDF1 Reactor: Developing a Nationalized Technopolitical Regime

3

Technopolitics in the Fifth Republic 91

Technology and Gaullism

Technopolitics from the Fourth to the Fifth Republic: EDF2 and EDF3

Optimization and the Competitive Kilowatt-Hour

Controlling Fuel and Pricing Plutonium

Industrial Competitiveness, Exporting Reactors, and the Future of France

4

Technological Unions 131

The Politics of Unionism

Conceptualizing National Technological Progress

Recruiting Technical Elites

5

Regimes of Work 163

Marcoule

Chinon

6

Technological Spectacles 201

Salvation, Redemption, and Liberation

Reconciling Modernity and Tradition

Châteaux for the Twentieth Century

The Critics: “Two Steps Away Is the Abyss”

Counter-Spectacle: “When the Tale of Marcoule Is Told”

7

Atomic Vintage 241

Representations of Public Opinion

Peasants and Engineers: Bagnolais de Souche and Marcoulins

Interlude: Reflections on Local Memory

The Little Kuwait of the Indre-et-Loire

8

Warring Systems 271

Preliminaries to the War: Public Relations and Technological Mishaps

The War Starts in Earnest: The Horowitz-Cabanius Report

PEON: Defining the Context for Technological Development

Breeder Reactors: Flexibility and Consensus

Unions Strike Back

Boiteux Declares the End of the Gas-Graphite Program

The CEA Strikes

Economic Comparisons, Union-Style

Back to Bagnols

The Cleanup at Saint-Laurent: Healing the Technopolitical Wound

The Battle Fizzles Out

Conclusion 325

Imagining a Technological Nation

Technology and Politics

Afterword 341

Notes 349

Bibliography 421

Index 455

Foreword

Michel Callon

France is an ideal object for science and technology studies (STS). Its particular way of combining technical, social, and economic progress, and the unshakeable confidence of its elites in the universal power of reason and science, make this country—which so likes to think of itself as an exception—a truly exceptional object, a sort of laboratory animal specially designed for analyzing relations between science, techniques, and societies. Gabrielle Hecht saw this. Thanks to her talent and insight, the French nuclear program that she chose to explore has turned out to be for STS what the drosophila was for genetic research. This book not only sheds new light on the role of technology in the construction of national identities, it is also a seminal contribution to the history of contemporary France.

The French Exception as an Exceptional Subject for STS

One of the unquestionable contributions of STS is to have shown that techniques and societies are not distinct entities or sub-sets (as they are referred to in the case of relations between the two) but rather the components of socio-technical arrangements or assemblages. Thomas Hughes, whose work profoundly inspired Hecht, proposed the term *seamless web*, now commonly used to describe these hybrid realities. Any arrangement or behavior consists of an entanglement of heterogeneous elements that, depending on the situations and points of view, are defined for some as technical and for others as social, political, or economic.

The seamless web metaphor has been and still is very useful. It perfectly sums up the main contribution of STS, which has been to rid social theory of the supposedly universal distinctions (as between science, technique, and society) concealing the diversity of observable

configurations and associations. But this diversity exists, and to restore it one has to go through a second stage and allow oneself the means to study the differences that make it possible. The first turn of *undifferentiation* must be followed by a second turn, that of *re-differentiation*. For the past ten years STS have been working hard on this re-differentiation. In this respect Hecht's book is a key contribution: first, because it provides new, glaring proof of the necessity to look into the black box of techniques to unfold these differences; and second, because it proposes a set of concepts, above all the technopolitical regime, that are particularly fertile in analyzing the dynamics of complex, varied, and evolving relations between the technical and the political.

What a contrast, for example, between Hecht's attention to technical details, and the repetitive studies devoted to so-called national innovation systems—which roughly and superficially explain the content of technical innovations in terms of the institutional configurations in which they develop. France has produced an abundance of studies without any imagination, generally by foreigners, who have delighted in pinpointing French Jacobinism, its excessive centralism, overwhelming state bureaucracy, preference for plans rather than markets, and atavistic Colbertism. This literature has been countered by equally conventional and repetitive analyses showing, on the contrary the diversity and complexity of institutional configurations, which vary by the sector and industry or by region. In both cases the social serves to explain the particular forms of technologies.

By plunging to the heart of reactors, Hecht departs from this approach. She teaches us more about Frenchness and the French nation from the controversies surrounding the choice of a nuclear power plant's loading system than we would learn from an author who once again invoked the role of the grand technical corps and the centralism of political power. In this way, she reveals the cracks and dynamics invisible to those obsessed with institutions. Instead of explaining technical decisions in relation to social context, she uses them to reconstruct the socio-technical configurations that these decisions help to bring about. Rather than explaining nuclear choices by French society, that improbable entity, she shows how, on the contrary, it was the engagement in the production of nuclear power that helped to enact a French society that is, at least partially, unexpected. Nuclear power "happened" to French society like an adventure happens to the hero of a novel and alters the course of his life. As I explain below, nuclear power instituted and established, at its very core, an undifferentiated, sluggish, ignorant public

that alternated between gaping adhesion and violent opposition. This politically passive public, that French society is still dragging around like a millstone, is no less a by-product of nuclear power than is radioactive waste.

Plunging into reactors to discover what French society is made of, like Tocqueville said that one had to visit the colonies of a country to get to know it, is one thing, showing that a country is the fruit of these technical works, just as it is the outcome of its colonial adventures, is another. But to go all the way and to switch the direction of the causal analysis, one still has to develop the right analytic tools. The observer cannot rely on notions such as institutions, values, norms, interest groups, professions, or political regimes, which imply a society that is already there and sharpen the distinction between humans and non-humans (rather than revealing the variable configurations that they comprise.) Hecht proposes the concept of a technopolitical regime to describe these socio-technical arrangements and to study the unexpected differences that they generate.

A technopolitical regime consists of a configuration of heterogeneous elements, combining mainly technical materialities, discourses, texts, rules, procedures, plans, operating instructions, and calculation techniques—the list is open—which are rendered mutually interdependent and support one another. An important characteristic of these regimes is that they describe themselves as both political and technical. This dual qualification is not the outcome of a decision by an observer who discovered its hidden nature; it is constructed by the arrangement itself and is embedded in it.

For instance, as Hecht recalls, in the early 1960s several systems for loading nuclear fuel were envisaged. The one that was finally chosen, for its technical characteristics, ensured a regular production of plutonium and thus left the military option open. Here is a very simple case in which the technical and the political are carefully defined and distinguished, but are at the same time made interdependent. The nuclear power plant, designed by industrialists, engineers and scientists, is a hybrid sociotechnical *agencement*, both a technical device (capable of producing plutonium *and* electricity) and a political contrivance (it paves the way to the atomic bomb). To be able to say that this type of plant functions adequately, one has to ensure that it simultaneously, and satisfactorily, fulfills both functions. The plant produces plutonium and electricity and . . . politics, because it is designed to carefully separate the two domains while making them closely dependent on each other.

The concept of a technopolitical regime to account for this strange arrangement requires us to go further than traditional analyses of the political dimension of a technology. The two symmetrical positions between which analyses usually oscillate (the technical is the continuation of the political; the political is constrained or predetermined by technical choices) become untenable. Neither the technical nor the political are given in advance. The starting point is the *agencement* whose particular configuration explains and enacts a certain definition of the political and the technical, and of their relations. The “plant” is at the heart of this *agencement* that it shapes and that shapes it in turn, which is why the analysis has to start with it.

If the nuclear power plant can be interpreted as a technopolitical machine, it is because it is simply an element—albeit an essential one—in an entity that includes many other elements which it supports and which enable it to function as a technical and political machine. Consider the meeting between Guillaumat and Mendès-France in 1954. The former was responsible for the French nuclear program, the latter was Prime Minister; the former was an eminent engineer, the latter an exemplary politician. Mendès-France, concerned about the future of the nuclear program, called Guillaumat to his office to ask him if the time was ripe to decide whether to build the bomb or not. Guillaumat hesitated. Before answering he stepped aside, spoke with a colleague for a few minutes—this kind of thing can only be discussed between technicians—and then turned back to the man who embodied political virtue until his death. The gist of what he said was: Mr Prime Minister, you have time. You don’t have to decide now; you can do so later. This primitive scene, a perfect illustration of a common conception of relations between science and politics (the decider chooses between options presented by the expert), is not external to the nuclear plant; it is made possible by it, embedded in it. If Guillaumat can answer, without lying, that the time for political decisions is not ripe, it is because the nuclear plant, as a technical device, still leaves both options open (either making the bomb and electricity, or making only electricity). This scene is part of the regime and the *agencement* that it establishes. It is not external to the plant, just as the plant cannot exist and last independently of this scene. Without the loading system Guillaumat cannot reassure Mendès-France and support him in his role as political decision-maker; without Guillaumat and Mendès-France the loading system is destined to disappear. The regime includes *both* the loading system *and* the primitive scene: it is material as much as discursive; it constructs a reality *and* its interpretation.

It may seem that the distribution of roles proposed by the nationalist regime (this is how Hecht qualifies the *agencement* advocated by Guillaumat and the Commissariat à l'Énergie Atomique [CEA] that he headed) is the only option. (Is it not the standard definition found in most political science treatises, in which technology describes possible worlds and politics chooses a desirable world?). The strength of the book and of the notion of technopolitical regime is that it rids us of this illusion. The other regime, which Hecht qualifies as nationalized and which was supported by EDF (the public firm with the monopoly on production and distribution of electricity) configured the technical, the political, and the relations between the two differently. This regime *politicized* nuclear technology by *economizing* it, that is, by including it in economic models and calculations evaluating existing and future techniques in terms of one criterion only: the cost per kilowatt hour. The EDF economists' calculation was based on the simulation of a market characterized by pure and perfect competition (pricing at the marginal cost.) It also included a constraint of equity: each subscriber, irrespective of his or her location, was to pay the same price. In this technopolitical regime, which mobilized different technologies than the preceding one (the production of plutonium was no longer a priority objective), the nuclear power plant was *economized*—that is, qualified in terms of its carefully calculated economic performance. This *economization* simultaneously organized a certain form of *politicization* corresponding to the French definition of the public service: everyone's right to equal access to a regular, quality service, supplied at the best price. The *politicization*, embedded in the regime and especially in its technical choices (very different from those of the CEA), required a regulatory state which ensured that everything went according to the model and was supported by the country's main trade unions and political forces. *Economization* does not exclude politics; it establishes a particular form of politics. By *economizing* the nuclear (that is, by proposing an economic calculation of technical choices, embedded in the most orthodox economic theory), the nationalized technopolitical regime politicized it, but in a different sense than the *politicization* produced by the nationalist regime.

The notion of a regime thus highlights the diversity of possible forms of *politicization* of technical artifacts. It emphasizes the complexity of the *agencements* (discursive, material, calculative) framing these *politicizations* and ensuring their conditions of felicity. It also shows that a sociotechnical arrangement is not politicized in a social void. First, a regime that emerges and is established feeds on available elements of

discourse, statements, and material devices that orient certain forms of politicization. EDF did not invent the notion of a public service; the CEA did not create a vision and a doctrine in terms of which governing means choosing. As different as they may be from one another, these conceptions of the political and its relations with the technical are, at least partly, already there and ready for use. Second, a technopolitical regime is rarely in a situation where it occupies the entire field. It appears in opposition to other technopolitical regimes. The confrontation described by Hecht between the two main French nuclear regimes exemplifies this point of view. The *economization* proposed by EDF and the associated *politicization* of the technology were at least partially a weapon against the *politicization* that the CEA wanted to impose. EDF's economic calculation was also intended to put the CEA engineers in a weak position, and at this it was entirely successful as they found nothing on which to oppose the EDF economists. The economic calculation was then transformed into a successful political calculation which divided two territories: that of civilian electronuclear power, whose economic interest could be calculated, and that of military nuclear power, subject to other rules of calculation, those of national sovereignties battling with one another in the Cold War world. The competition between technopolitical regimes meant that, in order to survive and grow, each regime had to take the others into account in every sense. The choices made by the two regimes and the trajectories they followed were not simple, mutually exclusive alternatives. The nationalized technopolitical regime, defended by EDF, prevailed because it imposed a demarcation line between economic policy and foreign policy, which enhanced the legitimacy of the nationalist regime (defended by the CEA) while simultaneously limiting its scope.

From the above we conclude that analyses of phenomena of socio-technological lock-in can be inspired by the analysis proposed by Hecht. The intense confrontation between EDF and the CEA was not simply a clash between two options (the light-water sector which prevailed and eliminated the graphite-gas sector), arbitrated by economic and political interests or by the contingencies of history, and in which EDF and its branch were the winners. It is better described as a complex process of formatting a compound world characterized by the singular *agencement* and hybridization of contradictory definitions of national sovereignty, military strength, technical prowess, economic efficiency, and social justice. Every time that (socio)technical sectors, trajectories, options, or standards compete, it would probably be fruitful to see them as

interpenetrating, hybridizing technopolitical regimes likely to spawn new *agencements*, rather than as mutually exclusive or juxtaposing worlds.

France as a Performance

The concept of a technopolitical regime is not only useful for analyzing the multiple theoretical and practical differences that can be introduced between the political and the technical; it also has the effect of profoundly renewing analyses of the so-called French exception—an exception reflected in the fact that 75 percent of the country's energy production is nuclear.

Explanations that start with the singularity of the French nation (that is, the singularity of its history, institutions, political culture, or way of conceiving of its place in the world) to explain how certain choices were made and imposed, fall away on their own. Hecht shows us that the French singularity is not only evolving, multiple, and contradictory (like any national singularity), but that it is also constantly performed, enacted, and reconfigured through adventures such as those imposed by the nuclear program. The direction of causal relations therefore has to be reversed, and this simple reversal is in itself illuminating.

In particular, Hecht's analysis shows—and I would now like to comment on this point—that the nuclear program contributed powerfully to the establishment of a form of functioning of French political institutions, which we have proposed to call delegative democracy (Callon et al.) This particular version of democracy was present in an unfinished and inchoate form even before the program got off the ground; the decisions made concerning nuclear power led to its clarification and its accomplishment of a sort of perfection. Pure delegative democracy is a (monstrous!) French invention to which nuclear power contributed decisively.

Delegative democracy (Hecht does not use this concept but her entire book shows its interest) is based on a twofold delegation that constitutes two great divides.¹ The first delegation is that through which laypersons entrust specialists with the task of developing the knowledge and techniques required to answer their questions or the requests and needs they (will) formulate. The second delegation reproduces the same mechanism, but in this instance between ordinary citizens and their elected representatives who, on their behalf, make legitimate decisions concerning the organization of collective life and adjustments between general and particular interests. These two delegations are performative.

They do not start off with the existence of the ordinary citizen and the layperson. They simultaneously enact ordinary citizens and political representatives, laypersons, and scientists—causing them all to exist.

The first effect of this double delegation is to establish an even stricter separation between the scientific and political spheres, the former being responsible for the production of unquestionable facts while the latter organizes the trade-off between values. The second effect is to shape two distinct social worlds, distant from each other: that of the technical and political elites, and that of the public comprising a multitude of passive and anonymous individuals who watch the show proposed by the elites—a show consisting of dramatic political decisions and the striking achievements of science and technology. Such delegations have to be produced, maintained, and constantly deepened. Hecht's analysis teaches us that in France the nuclear program was instrumental in lastingly establishing delegative democracy and the divides on which it is based and which it enacts.

Take the case of the technocratic way as an alternative way for organizing political institutions. In the aftermath of the Second World War, France was confronted with the immense task of reconstruction. Technocracy appealed to many because it promised efficiency and rapidity. But it also had staunch opponents, especially intellectuals, so influential in France, who saw it as a perversion of democracy. They were supported by the technicians, engineers trained in the elite *Grandes Ecoles*, who wanted their skills to serve the general interest and preferred to have a direct relationship with the political decision makers, without being screened first by the technocracy. Hecht, whose demonstration I am faithfully following, explains how the nuclear program afforded them an undreamt of opportunity to impose their views. The scene between Guillaumat and Mendès-France perfectly illustrates the defeat of the technocratic solution. Between the two men there is no intermediary. The engineer and the politician are face-to-face. As we have seen, this strict role-play was part of the technopolitical regime defended by the CEA, and after reading the first chapter we understand that it was no improvisation. This face-to-face had been prepared, we could say, in a long process of collective reflection, primarily within the *Commissariat Général du Plan*, a sort of think tank responsible for preparing the future in close collaboration with the social partners. That was where systemic thinking, as Hecht calls it, was elaborated. Systemic thinking is a war machine against technocracy. It stresses that the scientific and technological are distinct from the economic, social, cultural and ethical,

and simultaneously affirms the existence of interdependencies between them. It is in the taking into account and the management of these differences and of their interdependencies that the political resides. Guillaumat and Mendès-France embodied and actualized systemic thinking: let everyone play their part, and the system will be politically and scientifically well managed! By refusing the hybridization of positions, favored by technocracy, the CEA's technopolitical regime established and supported one of the pillars of delegative democracy.

The strict and near-dogmatic separation between the technical and the political obviously is at the heart of delegative democracy. But it generates huge difficulties that the technocratic solution makes possible to avoid. Would Guillaumat not be tempted to disguise the reality, which he alone knew, so that he could pull all the strings? If Mendès-France was not honest, could he not simply ignore the technician's advice? In short, the risk was dissimulation and arbitrariness on either side.

It was in this respect that the technopolitical regime conceived of by EDF afforded guarantees and elegant solutions. First by *economizing* the technical and making the market a sort of judge of peace, EDF definitively eliminated the temptation of technocracy. That option was replaced by a calculation and models which objectified the criteria of choices and decisions while explicating them and making them debatable. These models were developed, implemented, and discussed by a squad of experts (economists, jurists, sociologists), and their evaluation involved a series of stakeholders (administration, unions). Second, the technopolitical regime promoted by EDF continued to separate technical choices from political ones, but instead of displaying a somewhat terrifying face-to-face between technicians and decision-makers, it set between them the market and its cohort of experts and stakeholders of all kinds. The separation between the technical and the political was still postulated (as in the CEA technopolitical regime), but the mediations between the two were multiplied, the role of the political being precisely to watch over the existence of this diversity so that, once everyone had been heard, it could make a final decision. This is how the nuclear program, with the confrontation and cooperation that it organized between the two regimes, established the separation between the political and the technological, expelled the figure of the technocrat working in the shadows, and replaced it with a host of mediators and constituted groups expressing themselves in the public sphere.

The contribution of the nuclear industry to the performance of a "purified" and viable delegative democracy goes even further. The two

regimes explicitly and spectacularly, each in its own way, also established the separation between on the one hand technicians and decision-makers and on the other, laypersons and ordinary citizens. Without this great divide, there is no real delegative democracy! Hecht shows how nuclear power created an undifferentiated public, composed of individuals who were rendered ignorant and entirely deprived of a capacity to participate in decision-making. This public, condemned to powerlessness and ignorance, and then transformed into an admiring one, was already there from the outset, in an embryonic form. With nuclear power it became entrenched in French society, where it was to become one of the key players, especially in issues with technical and political dimensions.

To create a broad, undifferentiated, passive public, prey to its most violent passions (which alternately triggered its wrath or threw it into a state of profound prostration,) the nuclear industry took the notion of theatrical performance seriously. Thanks to nuclear power, democracy became spectacular; it exhibited the elites and their works for the public's pleasure, transforming political life into a scientific adventure and a dramatic plot.

Delegative democracy is a sort of on-going show that plays on all the meanings of the word representation. As we know, the notion of representation is central in political philosophy when it comes to understanding how a usually silent ordinary citizen nevertheless talks through intermediary spokespersons in order to participate in the decisions determining the modalities of collective life. It is also central in science to denote all the mechanisms and devices that produce a layperson contemplating the objective picture of a natural or social reality objectified in the form of laws or regularities that the scientist reveals. Technology transformed into a theatrical and dramatic representation merges the two modalities of representation and adds up the two forms of authority that they impose: that of the general will imposed on each citizen who participated in its elaboration; and that of the laws of nature from which no one can escape. The nuclear program, its proud power plants resembling latter-day cathedrals, its dramatic events punctuating its history (like the multiple leaks of radioactive elements or of confidential information), its alarmist discourses or promises of a bright future, and its decisions made by invisible authors, constitute a show to which French society is invited. The nuclear program has turned France into a huge theatre and transformed French society into a passive and astounded public. The dramatization of the nuclear program, which Hecht

describes in abundant detail, is not outside of the program, simply a *mise-en-scène* to sweeten the pill; it is an integral part of the program. It establishes a great divide between those who know and those who don't, between those who decide and those in whose name decisions are made. It furthers the establishment of delegative democracy. The history of French society's reactions to the electronuclear program is largely confused with that of the public, rendered passive and pliable. When the tension is unbearable, the public can rail against the actors involved and sometimes even invade the scene. The popular march against the Creys-Malville supergenerator, and the populations which forty years later expelled with pitch forks the senior officials responsible for finding granitic sites to bury nuclear waste, were modalities of action and expression by this public which had slowly been constructed and maintained by the technopolitical regimes of the nuclear industry.

The passive, silent public whose reactions are sometimes unpredictable and violent, is becoming an object of study because people are wary of it. Squads of sociologists, psychologists, and anthropologists are mobilized to sound it and determine its thinking and ulterior motives (Barthe 2005). It is talked about, taken into consideration. Now, it is really starting to exist! Surveys and opinion polls show that this "public" is increasingly ignorant and less and less interested in decisions. As the comments that they trigger attest, these results reassure the deciders and engineers: the beast is anaesthetized, tamed. This does not stop it from sporadically protesting and rebelling, but its crises are not alarming. A few extra squadrons of riot police are enough to calm the most violent elements, and a small increase of the funds allocated to psychosociologists is enough to gain more insight into what has gone wrong. Slowly the great divide, monitored by the social sciences, watched by the police, starts to effectively exist. Delegative democracy is progressing. The divisions that it establishes are being reinforced and extended, gradually applying to other techno-political activities. Between the elites and the public the gap is widening; each side camps on its positions, and the trench war has started. The dread generated by this artificial Leviathan, putting on a show and trained to be feared, fuels the violence that has punctuated French nuclear history. The public is there and really there, a formidable pool of recalcitrance and resentment that will be expressed on other issues such as GMOs.

But the public is not condemned to choosing between apathy and revolt; it can play other games without ceasing to be a public. The relevance of the analysis proposed by Hecht is confirmed by an

extraordinary and completely forgotten episode that she found in the archives. Condemned to witnessing theatrical representations decided and written by others, reduced to putting their fate in the hands of those more knowledgeable and wise than themselves, people living near a nuclear power plant played out the scene of the trick that backfires on the trickster. If things had to be theatrical, they would show just how theatrical they could get! The people living near the Marcoule plant, prisoners of the spectacular logic devised by the CEA and of the role-play that it imposed, decided to switch the roles. Since it was a matter of representation, of a show, why not become the authors of the nuclear show? They wrote a parody of a famous film describing the morals at the court of Versailles, in which the political and technological elite were ridiculed. This presentation of the abysmal divide resembled carnivalesque episodes in which, for the duration of a masquerade, the weak and downtrodden could mock the all-powerful. Delegative democracy, an extreme form of representational democracy, nourishes this politics of derision—derision that is often the only weapon available to those who have been excluded from knowledge and decision making.

*

After reading this book, one can only be convinced. Hecht demonstrates superbly that French society was profoundly transformed by the nuclear adventure. By choosing to enter into the details of nuclear technologies and the technopolitical regimes in which they were stakeholders, this author has made an about-face that profoundly renews the analysis *both* of the relations between science, technology, and society, *and* of the historical trajectory followed by the French nation. Without the nuclear program France would probably not have gone so far in establishing a form of democracy, delegative democracy, that deepens all the great divides—between science and politics, experts and laypersons, ordinary citizens and political decision-makers—turning French society into a huge theatre and the French into a public of passive spectators. By studying the French nuclear industry, Hecht has not only provided science studies with invaluable analytic tools, she has also furthered understanding of why the French nuclear program has been a remarkable success from a technical and economic point of view but a resounding and ruinous failure from a political point of view. The French people are no doubt pleased to learn that their electricity makes them less dependent on oil and that it pollutes less than that produced from coal. But they no longer readily stand by as witnesses of decisions

made in their name, even if those decisions finally prove to be less disastrous than they might have been.

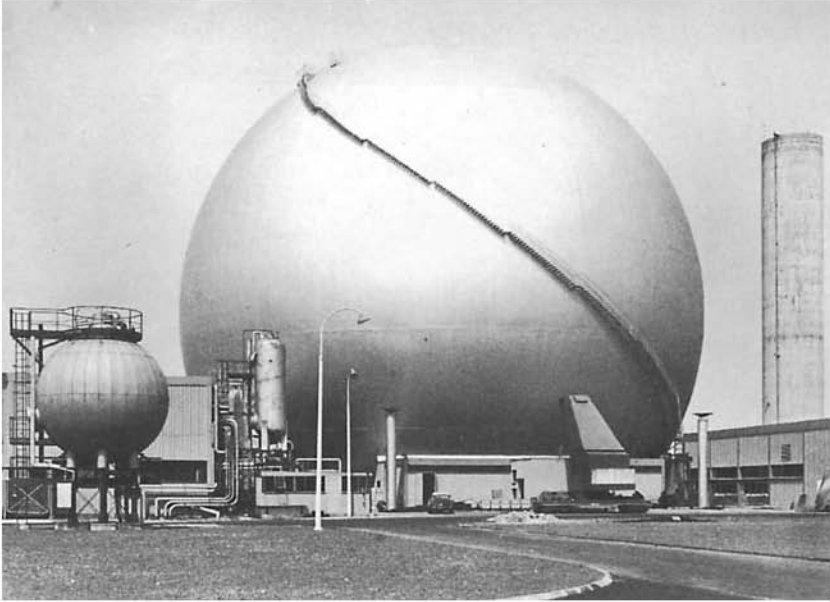
Note

1. Political scientists have used the concept of delegative democracy to describe a mode of government, frequently found in South America, in which power is delegated, without any parliamentary control, to a powerful president. The meaning that we give to it here is obviously different.

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The EDFI reactor at Chinon. Source: EDF Photothèque.

Introduction

France cannot be France without grandeur.

—*Charles de Gaulle*¹

It would be good if it were French research that produced the first useful and humane applications of this diabolical marvel. To master these terrifying forces of unlimited destruction, to have this stupendous invention metamorphose itself into a humane discovery through the filter of our national genius, this would bring honor to our country.

—*Raoul Dautry, first Administrator-General of the Commissariat à l'Énergie Atomique, October 1945*²

In June of 1940, German troops marched into France for the second time in less than thirty years. On June 17, Marshal Pétain announced that he would seek peace with Hitler. Charles de Gaulle launched the Resistance the following day in a broadcast from London. Thus began four years of opprobrious occupation and fractured resistance. In June of 1944, Allied troops landed on the beaches of Normandy to liberate a nation humiliated by defeat, ravaged by war, disgraced by collaboration, and only partly redeemed by resistance.

France had lost nearly a million and a half people in the war. The industrial infrastructure was in shambles. Food was scarce and expensive. France had lost its self-respect. It had also lost its standing among world leaders—a loss made glaringly obvious by de Gaulle's absence at Potsdam and Yalta. The bombing of Hiroshima and Nagasaki highlighted the enormous technological gulf between France and the United States. The consequences of the war for the French empire remained unclear, but prospects already looked grim in Indochina. The embarrassed, destitute nation resigned itself to accepting American economic aid in the slow and painful task of reconstruction. To use Robert Frank's phrase, France entered the second half of the twentieth century "haunted by its decline."³

No wonder, then, that the nation expressed such enthusiasm when Zoé, its first experimental nuclear reactor, underwent a chain reaction in December 1948, only four years after the Liberation. This success, proclaimed one newspaper, was “a great achievement, French and peaceful, which strengthens our role in the defense of civilization.”⁴ The following year, scientists isolated France’s first milligram of plutonium. President Vincent Auriol paid Zoé a visit and solemnly declared: “This achievement will add to the radiance of France.”⁵

“The radiance of France”—a phrase usually interchangeable with “the grandeur of France”—appeared regularly in many realms of postwar discourse. These two notions referred back to France’s glorious past, from the golden reign of Louis XIV to the “civilizing mission” of the empire.⁶ France’s radiance had taken a severe beating during the war, and decolonization threatened to hasten the decline.⁷ How could the nation regain its former glory? What would radiance or grandeur mean in the radically reconfigured geopolitics of the postwar world?

Technical and scientific experts offered a solution to these dilemmas: technological prowess. In articles, lectures, and modernization plans, experts repeatedly linked technological achievement with French radiance. Industrial, scientific, and technological development would not only rebuild the nation’s economy but also restore France to its place as a world leader. For the nascent nuclear program, “le rayonnement de la France” carried special punch: “rayonnement” means radiation as well as radiance.

The nuclear program epitomized the link between French radiance and technological prowess. Before World War II, Marie and Pierre Curie, Jean Perrin, and Frédéric and Irène Joliot-Curie had become national heroes thanks to their Nobel prizes in physics and chemistry. After the deadly explosions at Hiroshima and Nagasaki, nuclear technology became a quintessential symbol of modernity and national power.⁸ France could claim a modest role in the Manhattan Project, thanks to a few researchers who had fled the occupation to work in Britain and Canada.⁹ No other technology could better enhance French radiance. With this logic in mind, de Gaulle fostered the creation of an atomic energy commission in 1945. After building several experimental reactors, the Commissariat à l’Énergie Atomique (CEA) began to work on plutonium-producing plants in the mid 1950s. Its scientists and engineers also collaborated with their colleagues at Electricité de France (EDF, the nationalized electric utility) in the construction of a series of power reactors. Despite the fact that similar reactors existed elsewhere (notably in

Britain), the gas-graphite design developed by the CEA and EDF became known as the *filière française*—the French system.

What was French about the French nuclear program? This question appeared vital to nuclear engineers and scientists during the 1950s and the 1960s. It apparently interested social scientists and humanists as well: I heard it repeatedly over the eight years I spent researching this book.

On one level the answer seems simple. French engineers, scientists, and technicians developed most of the designs and techniques for their gas-graphite reactors. The resulting system, therefore, was French. Or was it? After all, some of the CEA's most important scientists had learned a great deal from their Canadian experiences. The 1955 Atoms for Peace conference had made possible a slow but steady international flow of information. French nuclear engineers and scientists increasingly discussed technical matters with their colleagues abroad, officially and unofficially. Such circumstances make the Frenchness of the French nuclear program rather difficult to pinpoint.

The question raises more complex issues on a deeper level. Its very formulation presumes a stable notion of Frenchness: somewhere, it implies, exists an essential French identity that can provide not only a description for how things happen in France but also an explanation for why they happen that way. Yet French identity is not inherently stable.¹⁰ The effects of World War II extended well beyond threats to French radiance. The war had called everything into question, from military and industrial structures to systems of government and cultural identities. What would be the essence of a renewed France in a world transformed by the atomic bomb and superpower geopolitics? Could a new social order regenerate the nation's identity? Of what would that identity consist? These questions did not have simple or immediate answers.

As a *guide* to historical inquiry, then, the question "What is French about the French nuclear program?" has little value. We cannot simply gesture toward the Napoleonic institutional heritage or the Colbertist tradition of state-directed industrialization in order to describe or explain nuclear development in France. There was no such thing as an essential French technological style. Engineers did not make the choices they did *because* they were French.¹¹

Rather, I argue in this book, engineering choices must be understood as part of a struggle to define Frenchness in the postwar world. For this very reason, the question "What is French about the French nuclear program?" is valuable as an *object* of historical inquiry. How and why did the

people who designed, built, worked in, wrote about, and lived near reactors forge and understand the relationship between nuclear technology and French national identity? What role did invoking Frenchness play in nuclear development? How did nuclear technology figure in changing notions of Frenchness?

The answers to these questions depend greatly on people's involvement with the nuclear program. Engineers wove links between nuclear technology and national identity into the fabric of reactor design and program development. Workers forged these links in both labor union ideology and workplace practices. Neighbors of reactor sites understood these links primarily as symbols that justified changes in local socioeconomic structures—symbols with which they had to contend in order to make sense of modernization.

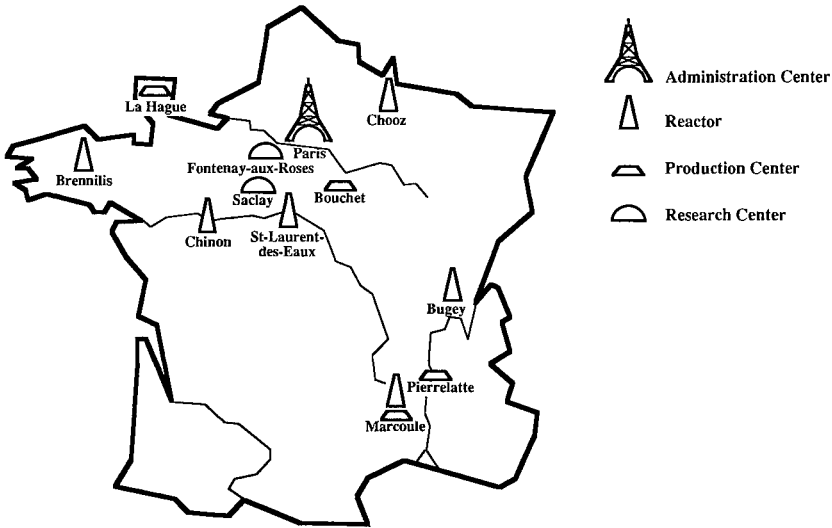
The continuities among these three domains—nuclear engineering and program development, reactor work, and the communities around nuclear plants—were as significant as the discontinuities. For example, the fact that the “radiance of France” notion operated in all three domains demonstrates the strength and flexibility of the association between technological prowess and national identity. This notion, together with its constellation of symbols, provided the foundation for a vocabulary through which to imagine modernity and technological change. But the diverse meaning of the symbols it employed highlights the profound differences in how various groups imagined the new technological France and their places in it.

Important differences also existed *within* these three domains: the groups they incorporated were by no means homogeneous. For engineers, disagreements over reactor core design, construction materials, and industrial contracting were also debates about how to connect reactor development with France's political and economic future. Some nuclear workers felt themselves to be active participants in the making of an ultra-modern nation, while others viewed their workplace as the extension of an oppressive technocratic state. Some local residents perceived reactor sites as socioeconomic opportunities, while others experienced the sites as instruments of a suffocating modernity. Conceptions of technological France thus varied greatly. The fault lines for difference could be technological, political, institutional, professional, geographical, or cultural. Usually they were several at once. The stakes of any given dispute went far beyond the matter apparently under debate. The history of the French nuclear program, therefore, is both a history of technology and a history of France.

In this book I connect these three domains by tracing the multiple links between technological prowess and national identity. But the politics and culture of nuclear development did not revolve solely about redefining Frenchness. As an exploration of the complex relationships between technology and politics, my arguments have equal relevance for nations other than France. Let me first sketch out the book's terrain, and then discuss the theoretical considerations that frame my analysis.

From the very beginning of this project, my goal has been to trace the social, political, and cultural life of reactors as artifacts. This goal arose in part from my realization that much historical scholarship focuses on a single aspect of the life of an industry or a technology. This is particularly true of twentieth-century technologies. A single book might discuss design, development, and diffusion; or the organization of work in a system; or cultural representations of technology; or the social impact of an industry. But what kind of picture emerges from examining all these together? This question formed the foundation of my research strategy.

In the first three chapters of this book I explore the domain of engineering and state expertise. I begin not with the nuclear program but with a general consideration of the history and ideology of French state experts, whom I also refer to as "technologists." This overview provides a broad context for understanding how these "men of action" (as they thought of themselves) conceptualized the relationship between technology and politics. Debates about the nature of this relationship were contests for the power to shape the future of France and its identity. Technologists located French radiance not only within the technologies they built but also in their potential ability to export their expertise, thereby evoking the imperial connotations of the notion of "radiance." In chapters 2 and 3 I follow this theme into the nuclear program by examining the design and development of gas-graphite reactors in the 1950s and the 1960s. I focus on the CEA and EDF, the two state institutions that directed the program. These two agencies collaborated in designing nine reactors, but their administrators and engineers had different goals and espoused different design and development practices. I argue that the artifacts elaborated within each institution can be best understood as hybrids of technology and politics.¹² Engineers and administrators used these hybrids—along with invocations of the nation and of their public-service ideology—to define and implement military and industrial policy. In the process, they also made nuclear technology both French and indispensable to Frenchness.



French nuclear sites in the late 1960s (not to scale). Drawing by Carlos Martín.

While state experts propelled large-scale technological development, their ideologies and conceptualizations did not dominate all levels of technological activity. Workers also played a role. The next two chapters shift to the domain of labor. In chapter 4 (which parallels chapter 1) I focus on labor union discourse about technological change in general. Again, I examine conceptualizations of the relationships between technology and politics. Labor militants reflected on the role of technological change in France's future, as well as on their own role in implementing such change. In one sense, their ideas *challenged* those of technologists. Militants envisioned an important position for technically trained workers in France's future social order. Two of the three labor unions actively criticized the development policies pursued by state institutions. In another sense, though, union militants and technologists were equally active as *participants* in the construction of a French technological identity. In chapter 5 I examine work inside two nuclear reactors: one operated by the CEA at its Marcoule site and the other by EDF at its Chinon site. Here I consider how the ideologies and technologies described in chapters 2 and 3 combined to produce two different workplaces. Marcoule and Chinon featured distinct labor organizations and work practices. Some of the issues raised by the labor unions at the national level were played out

at these reactor sites: the relationship between technical training and authority, the role of workers in nationalized companies, the development of a high-tech workforce, and the relationship between workers' jobs and their place in the new technological nation.

In the next two chapters I explore a different kind of politics. In chapter 6, in parallel with chapters 1 and 4, I discuss articulations of the technological nation in the popular media. Moving beyond the national level, I examine how political and intellectual elites in the regions around Marcoule and Chinon presented the nuclear sites to their constituents. I argue that journalists, politicians, scholars, and technologists together (though not always in a concerted fashion) produced a drama of regional salvation and redemption in which large-scale technologies functioned as icons and actors. A survey of the critics of this spectacle demonstrates that not everyone rejoiced at the technological France imagined therein. In chapter 7 I discuss the reactions of the spectacle's audience. After a brief look at national public opinion polls, I explore the history and the memory of the two nuclear regions. The drama of regional salvation had promised residents around Marcoule a harmonious blending of tradition and modernity. Most residents, however, construed the arrival of the nuclear site and its employees as a wholesale invasion by the modern state. Residents around Chinon, meanwhile, had been promised a spectacular display in which reactors would function as modern châteaux. This was a far easier promise to fulfill. Though some tension did accompany the site's development, by and large the residents seemed to sublimate it and to concentrate instead on the economic benefits. Together, chapters 6 and 7 argue that the nuclear sites operated as a lens through which local communities re-imagined their political and cultural relationship with the nation.

In chapter 8 I unite the book's three domains in an extended consideration of the late 1960s' "war of the systems," which pitted the "French" gas-graphite reactor system against the "American" light-water reactor system. Each system had proponents in EDF, in the CEA, and in the French government. In this chapter I explore the debates among administrators, engineers, and labor unions in EDF and in the CEA. I discuss the 1969 strike in which CEA engineers and workers demonstrated in defense of the French system, examine the reactions of the residents around Marcoule to the abandonment of the gas-graphite system, and show how EDF workers dealt with the consequences of gas-graphite's demise during the cleanup of a reactor accident in 1969. During the course of this protracted "war," relations between the CEA and EDF were reshaped. The

nexus of technology, ideology, expertise, and definitions of Frenchness shifted. Conceptions of the relationships between technology and politics were reconfigured. And workers and residents played out their imagined roles in the new technological France.

Inevitably, there is much I have not covered. My investigation stops in 1970, and even within this time frame I have set important limits. Readers hoping to find here an exhaustive scientific and technical history of the early decades of the French nuclear program will be disappointed. This study is limited to gas-graphite reactors; bombs, experimental reactors, fuel processing plants, waste disposal, and research programs remain peripheral. Further, I examine gas-graphite reactors primarily from the point of view of the two state establishments that developed the program; private industry enters my analysis only through their perspective. While these topics are important in their own right, I have omitted them in order to conduct a sustained examination of the multiple meanings of nuclear power and technological development for French politics and national identity.

Let me now turn to the methods and theories that inspired my analysis.

Technology, Politics, Culture, and National Identity

In researching and writing this book, I have combined methods and theories of technology studies with those of political and cultural history. When discussing issues of cultural or national difference, historians of technology frequently engage in cross-national comparisons. Thomas Parke Hughes masterfully demonstrated the fertility of this analytic tool in his study of electrification in the United States, Britain, and Germany, showing how distinctive approaches to system building emerged in response to particular political, geographical, and institutional conditions.¹³ As other scholars have also shown, comparing technological systems and practices in different countries reveals national patterns that may remain hidden when countries are examined in isolation.¹⁴ In contrast, French cultural historians focus on internal struggles over cultural forms and social relationships. They seek to understand how values, ideologies, and the language and symbols that constitute them arise and change. Culture thus provides not the explanation but the entity that demands explanation.¹⁵ Understanding the significance of technological development across a broad range of sites within a single nation, as I attempt to do in this book, requires combining these two approaches and problematizing *both* technology and culture.¹⁶

The relationships of technology, politics, and culture have long preoccupied the history and sociology of technology.¹⁷ The major insight of this scholarship is that political, social, and cultural choices shape the design and growth of technical artifacts and systems.¹⁸ Some scholars have sought to counter progress ideologies and other forms of technological determinism: the ideas that technology develops according to its own internal logic; that every technology has an inherently “best” design, which, left to market forces, will inevitably prevail; and that technological change clearly leads to social progress.¹⁹ The battle against determinism has produced an impressive array of theoretical tools. Hughes’s “seamless web” (a metaphor for the inseparable connections among technical, social, and economic aspects of large-scale technological systems) allows us to understand how those connections define and propel systems. John Law’s “heterogeneous engineering” provides a way to talk about the interactions among the technical, social, political, and economic dimensions of engineering work.²⁰ A host of other concepts attempt to refine our understanding of these relationships.²¹

A loose consensus has developed around the notion that technology, politics, and culture are mutually constitutive, but by and large the history of technology and its disciplinary cousins have expended considerably more energy on the construction of technology than on the construction of culture or politics. Perhaps the fear of relapsing into technological determinism has led scholars to use culture primarily as an explanatory factor. Certainly the focus on constructivist approaches and on their attendant epistemological issues has induced many scholars to limit their research to technological design and construction, thereby avoiding anything that might resemble the “effects” of technology.

There have been a few attempts in technology studies to take the construction of society, culture, and politics seriously. Some sociologists and anthropologists have argued that “society” is itself an intellectual construct that cannot explain technology any more than the technical can explain the social.²² Perhaps the most compelling sociological demonstration of the mutual shaping of technology and politics is Donald MacKenzie’s account of nuclear missile guidance, which shows how socially constructed technology shaped policy decisions about nuclear strategy.²³ Recent significant historical attempts in this direction include Paul Edwards’s analysis of computers and Cold War politics and culture and Ken Alder’s study of gun manufacturing and revolutionary politics in eighteenth-century France.²⁴

Only recently and sporadically, then, has technology studies begun to assemble a toolbox for examining the *mutual* construction of technology, politics, and culture. This is not really surprising: the history and sociology of technology have based their disciplinary strength on their ability to explain *technology*—not politics or culture, which are the province of many other disciplines. Recent efforts have shown, however, that seeking to explain politics and culture enriches our explanations of technology. Opening the black boxes of culture and technology *simultaneously* can (for example) give us insight into how technologies constitute a terrain for transforming, enacting, or protesting power relations within the social fabric. Taking politics and culture seriously as objects of analysis greatly deepens our understanding of technological change.

Of course, “politics” and “culture” are big, vague concepts. Before going any further, therefore, let me specify which pieces of these concepts I examine in this book.

The politics I investigate here consists of the constitution, assertion, and exertion of power through material and discursive practices. More concretely, I am interested in how technologists define their niches in national policy making and enact policy choices in technical practices and artifacts, how workers establish their place and assert agency in hierarchical structures, and how local communities situate themselves within a nation.

Culture is an even broader concept than politics. Here I limit myself to two manifestations of culture: national identity and social identity. By national identity, I mean the ways in which people imagine the distinctiveness of their country and define uniquely national ways of doing things. I explore social identity specifically with respect to the nation, and I define it as the set of ways in which groups understand and portray their relationships with one another and with the state. Particularly interesting to me are the aspects of identity that are related to politics. I thus focus on moments when statements about identity are acts aimed at asserting power or position within a sociopolitical order. Other, less deliberate and more affective forms and assertions of identity are also important, but they remain outside the scope of my analysis.

With these specifications in mind, I will now review how scholarship in political and cultural history has tackled some of these issues and suggest how the insights of technology studies might benefit these discussions.

Scholars have debated at considerable length the question of whether post-World War II France is a technocratic society.²⁵ Most agree that “technocrats” (a term that, in France, usually refers to high-level state adminis-

trators trained in the elite schools known as *grandes écoles*) make many of the nation's industrial and financial policy decisions. But the means through which this elite exerts power remain murky. Technologists themselves legitimate their power as meritocratic, arguing that only they are qualified to make certain decisions. Justifiably skeptical of such claims, many scholars have argued that technologists derive their power from a system of social privilege that enables them to create a closed community. The language of technical rationality and professional competence serves as a tool of exclusion and a cover for raw power. Yet these scholars have paid little attention to technologies, knowledge, and practices—perhaps out of a somewhat perverse combination of skepticism about technologists' claims and belief that technological knowledge is indeed hermetic and impenetrable.²⁶

As the history and the sociology of technology have demonstrated, however, the construction of a technological system is not an impenetrable, apolitical act. In this book I argue that to understand how French technologists acted politically we must analyze their artifacts and their practices. Institutions certainly provided powerful support, but they did not, by themselves, constitute the means through which these men shaped national policy. Technologies gave this elite a unique vehicle for political action—one that cannot be dismissed lightly.

Although scholars in the cultural history of labor and in the history and sociology of technology almost never cite one another, they make similar arguments about the cultural shaping of the material world. Recently, for example, labor historians have sought to transcend the artificial opposition between experiential and linguistic approaches imposed by historiographic debates. Focusing on how language and culture mediate material experience in shaping identity or politics, they have observed, does not obviate the examination of experience. Their approach enables us to explore and explain experience, and the material world more generally, in fresh ways. The linguistic approach need not imply an anti-materialist position. Instead, it can show how the material world both derives meaning from culture and performs culture.²⁷ Although they rarely phrase it this way, historians and sociologists of technology also transcend stark oppositions between the material and the cultural world by showing that technical artifacts and practices (the supposed epitomes of the material world) are deeply social, cultural, and political.²⁸ Synthesizing these two literatures makes clear that, instead of asking whether workplace experience is prior to culture or whether culture is prior to experience, we should look for ways in which experience is cultural *and* culture is experiential.

I seek to do this by examining the relationship between workplace practices and the social identities of nuclear workers. The material practices in which workers engaged derived meaning from a constellation of sources, including the labor unions that represented them and the institutions that employed them. The men I write about did not have a priori identities as nuclear workers. Nor did they articulate or forge those identities solely or even primarily through language or union discourse. Instead, I argue, their identities as nuclear workers emerged as they performed the meaningful material practices of their jobs. Those identities, in turn, not only situated workers in the nuclear program but also defined their place in a national sociopolitical order. The identities of these men as nuclear workers both referred to existing ideas about national identity and reshaped those ideas to fit into the specific context of nuclear work.

What do I mean by “national identity” in this book? My conception of this notion is inspired by a broad range of scholarship on nationhood and nationalism. I ground my treatment in Benedict Anderson’s classic formulation of the nation as an “imagined community.” At the most basic level, this means that nations are not autochthonous social units but rather communities whose coherence is imagined through political and cultural practices. The content and function of these imaginings vary according to time and place. However stable a sense of nationhood may appear, national identity is in fact continually subject to negotiation and contestation. For Pierre Nora, this means that French national identity is “a reality that is entirely symbolic.”²⁹ Ideas about national identity do not grow by themselves. They must be actively cultivated in order to persist. Further, articulating and rehearsing these ideas often reformulates them.³⁰

Discussions of national identity typically refer back to the past. But ultimately national identity discourse is not about the past per se, or even about the present. Instead, it is about the future. National identity discourse constructs a bridge between a mythologized past and a coveted future.³¹ Nations and their supposedly essential characteristics are imagined through a telos in which the future appears as the inevitable fulfillment of a historically legitimated destiny. This process naturalizes change; it makes proposed novelties appear to be the logical outgrowth of past achievements. In postwar France, the notion of radiance is precisely such a bridge: radiant through its empire before the war, France must maintain its radiance to maintain its Frenchness. This entails engaging in various political, cultural, and technological acts, many of which derive legitimacy by invoking the relationship between France and the

rest of the world.³² Similarly, proponents of large-scale technological systems justify modernization by placing the systems in direct historical lineage with past national achievements—for example, calling nuclear reactors the modern heirs of the Eiffel Tower and the Arc de Triomphe, nineteenth-century symbols of technological progress and military prowess. Such discursive moves give the nuclear program cultural legitimacy: they aim to make reactors French and to make a non-nuclear France impossible.

Invocations of national identity are thus not gratuitous acts, and this is one reason why historians of technology must take them seriously. Consciously or not, people usually invoke the nation to perform political, cultural, and sometimes even technological work. Anderson notes that the very concept of the nation conjures up the notion of disinterestedness: “For most ordinary people of whatever class the whole point of the nation is that it is interestless. Just for that reason, it can ask for sacrifices.”³³ Here Anderson refers to the personal sacrifices entailed by warfare, but disinterestedness need not have such extreme ends. French state engineers cultivate an ideology of disinterested service to the nation that enables them to justify particular approaches to technological development. Invoking the nation thus creates a sense of objectivity, which in turn performs the work of legitimation.

Peter Sahlins discusses a different kind of work done by national identity discourse. Sahlins found that residents of communities on the border of France and Spain called upon national identity in their pursuit of local economic and political interests, thereby legitimating those interests and adjudicating among them. Through repeated invocation of the nation, locals in this borderland came to imagine themselves as national citizens.³⁴ This example frames another aspect of national identity discourse that will prove important in this book: that ideas about national identity are not simply imposed by the center on the periphery.³⁵ Provincial communities create their own ideas about national identity. As we shall see when we examine the reception of nuclear reactors in central and southern France, these ideas incorporate local interests, metaphors, and histories, and they are deployed in local contexts.

Explorations of French national identity have yielded rich analyses of how that identity is imagined in debates over issues such as Americanization, modernization, immigration, and colonization.³⁶ But technology (writ large) is glaringly absent from this literature, as though it were not a site for discourse about national identity. Indeed, in this scholarship technology is cultural only insofar as it becomes an icon or a

consumer item; its construction and its attributes do not appear as outcomes of cultural processes. Yet in France technologists, workers, and provincial communities involved in large-scale technological development deployed national identity in a wide variety of circumstances and toward diverse ends. In so doing, they imagined not only a technological France but also their role in such a nation. Thus, if technological development is treated as a social, political, and cultural process, the history of technology can contribute to the historiography of national identity.

The reverse is also true: historians of technology can learn from the scholarship on national identity. One crucial point to take away from this literature regards the instability of culture. Considerable work goes into making culture, and into keeping it stable. Contests over culture are often political; debates about national identity are, at least in part, about who has the power not just to define the identity of a nation but also to shape the nation's sociopolitical order. In the case I examine here, this is not a merely symbolic matter. Debates about the identity of France were not so much about what France was in the present as about what France would become in the future.³⁷ Attempts to define a specifically French technological style were not frivolous gestures of nationalist fervor but interventions in a contest over the power to shape the future of the nation. Taking the instability of culture seriously means digging more deeply into the power dynamics involved in technological change.

Conceptual and Methodological Tools

In my search for a deeper understanding of the mutual construction of technology, politics, and culture, I have fashioned a set of conceptual and methodological tools that synthesize some of these scholarly insights.

The first tool consists of a question: How do the historical actors we study themselves conceptualize the relationship between technology and politics?

Historians have put great effort into examining the ontology of the relationships between technology and politics. Sociologists have probed these categories, arguing that we cannot decide ahead of time what counts as technology and what counts as society—that these categories emerge from, rather than precede, the construction of an artifact or a system.³⁸ But these scholarly efforts, and debates over technological determinism more generally, can overlook an important dimension of the story they seek to tell. Even if we do not or should not, historical actors *do* have a priori ideas about the nature and the relationship of technology and

politics (or society, or culture). Their *beliefs*—be these beliefs in technological determinism, or more complex ideas about how technology and politics relate—shape their actions and decisions. We must therefore ask how engineers and workers *themselves* conceptualized such relationships, and explore what is at stake in those conceptualizations. Here, posing this question reveals that French state technologists did not conceive of technology as something radically separate from politics (or culture, for that matter). Quite the contrary: many of them saw technology as a thoroughly political entity. Comprehending the reasons behind and the manifestations of this view is crucial to understanding both the shape of the nuclear program and the political behavior of the technologists who built it. I do not mean to deny that we should seek our own understanding of these relationships. Of course we must. But in doing so, we cannot simply dismiss the conceptualizations of historical actors.

My second tool is an elaboration of the concept of *technopolitics*.³⁹ I use this term to refer to the strategic practice of designing or using technology to constitute, embody, or enact political goals. Here I define technology broadly to include artifacts as well as non-physical, systematic methods of making or doing things. Two examples of technopolitics in this book are nuclear reactors designed with the express goal of creating and implementing military atomic policy and optimization studies aimed at shaping industrial policy. From the very beginning, engineers and administrators consciously conceived of these reactors and these optimization studies as hybrids of technology and politics. Many of the criteria that shaped their technical choices were consciously political. Calling these hybrids “politically constructed technologies” is correct but insufficient, because technologists intended them as tools in political negotiations. At the same time, these technologies were not, in and of themselves, technopolitics; rather, the practice of using them in political processes and/or toward political aims constitutes technopolitics.

Why not just call that practice “politics”? The answer lies in the material reality of the technologies. These technologies cannot be *reduced* to politics. In deciding between fuel loading systems, engineers did not have infinite choices; they only had a few. Further, the effectiveness of these technologies as objects designed to accomplish real material purposes (such as producing plutonium, or calculating the energy efficiency of a reactor) *matters*. On the most basic level, it matters because, for example, this plutonium really did exist, and France really did develop a military nuclear capability, which it shared with other nations, including Israel and Iraq.⁴⁰ In addition, the material effectiveness of technologies can affect

their political effectiveness. For example, the fact that the CEA's three Marcoule reactors generally worked well served to boost that institution's reputation in the eyes of Charles de Gaulle, while the fact that EDF suffered repeated technical setbacks in the construction of its Chinon reactors angered him; one result was that throughout the war of the systems de Gaulle staunchly backed the CEA over EDF. Finally, the technological aspect of these hybrids shapes the *kind* of political voice that technologists have. (Other factors shape that voice too, of course—especially educational background, institutional provenance, and sociopolitical hierarchies.) Technologists did not participate in French political life as members of a party, or thanks to their clever way with words (though some did have considerable rhetorical skills); they participated because they engaged in, or supervised, or organized the design of material artifacts. Their skills differentiated them from ordinary politicians and contributed greatly to their authority and influence. For all these reasons, the term “politics” captures neither the nature nor the power of these strategic practices.

The third and final tool I develop is the concept of *technopolitical regimes*. These regimes, grounded here in institutions, consist of linked sets of people, engineering and industrial practices, technological artifacts, political programs, and institutional ideologies, which act together to govern technological development and pursue technopolitics. This concept is anchored in the Hughesian notions of technological system and technological style. A technological system is a linked network of artifacts, knowledges, and institutions operating in a coordinated fashion toward a series of specified material goals.⁴¹ Thus, the French nuclear program is a technological system whose components include state agencies, private companies, reactors, laboratories, uranium mines, university curricula, factories, and portions of the electricity distribution network. The technopolitical regimes that I examine operate within this system. They emanate from different institutions, and they have distinct (if sometimes overlapping) goals and ideologies. For the sake of convenience, I have labeled the regime based in the CEA the *nationalist* regime and the one based in EDF the *nationalized* regime. (These labels, however, are associated with institutional stereotypes, and I try to characterize the regimes more subtly in my analyses.) Both regimes seek to shape the French nuclear system. In this sense, one might say that they promote different styles of technological development. Yet “style,” albeit an important concept for describing systems, elides the purposeful policies pursued by these regimes.

I have chosen the “regime” metaphor for three reasons. The first reason relates to the use of the term “regime” in political parlance to refer at once to the people who govern, to their ideologies, and to the various means through which they exert power. By analogy, “technopolitical regime” provides a good shorthand for the tight relationship among institutions, the people who run them, their guiding myths and ideologies, the artifacts they produce, and the technopolitics they pursue. The term aims both to evoke the similarity with political regimes and to convey the difference that technology makes. Second, “regime” conveys the idea of regimen, or prescription. The regimes I examine aim, through the pursuit of technopolitics, to prescribe not just policies and practices but also broader visions of the sociopolitical order. This is especially evident in regard to reactor operation: through artifacts and work practices, the workplaces in these regimes performed distinct visions of the sociopolitical order. Third and last, “regime” captures the contested nature of power. The two technopolitical regimes I examine aimed at governing nuclear development at a national level and at governing specific technological practices at an institutional level. But these regimes were not uncontested. Just as national political regimes (democratic or otherwise) must grapple with opposition, these technopolitical regimes had to contend with varying forms of dissent or resistance, both from outside and from within the institutions they governed. As we shall see, these regimes were neither static nor permanent: a technopolitical regime is easier to topple than the technological system within which it operates.

Research Stories and Oral Histories

I began this project with considerable trepidation. Several historians and political scientists had warned me that my ambitions might prove impossible to fulfill. France has fairly restrictive laws governing archival disclosure. Documents that might pertain to national industrial secrets are protected for thirty years, and those pertaining to national defense for sixty years. Waivers are sometimes granted, but I was warned that because of the sensitive nature of my topic I should expect no favors. Things looked even bleaker when I first tried to gain access to the official archives of the CEA and EDF. With exceedingly polite explanations (“We deeply regret, mademoiselle, that we have not yet catalogued our papers”), I was denied entry.

In desperation, I followed the advice of one historian who suggested that I interview old-timers in the nuclear industry. Perhaps, he speculated,

some of them had kept private papers. My single experience with oral history was a series of interviews I had conducted with a computer scientist for an undergraduate paper four years earlier. Still, this route seemed my only hope. After a crash course in interviewing techniques, I nervously set out for my first appointment.

My luck changed immediately. The first man with whom I spoke, Claude Bienvenu, had been a project engineer at Marcoule, Chinon, and Saint-Laurent. He had kept a vast amount of documentation: blueprints, memoranda, reports, letters, meeting minutes, and more. Neatly arranged in chronological order in his office, the collection took up nearly 2 meters of shelf space. In a stunning act of generosity, Bienvenu not only allowed me to work in his office but even let me take the occasional folder home to read at my leisure. It took me several months to work through the entire collection.

Meanwhile, I had begun to develop a taste for interviewing. Most people seemed eager to share their memories, look for documents, and put me in touch with others who might help. A few devoted entire days to me. I benefited from extensive tours of Marcoule, Chinon, Saint-Laurent, Saclay, Fontenay-aux-Roses, and even a fuel rod manufacturing plant in Annecy. True, not all encounters went so well. One engineer sourly commented that my interests were outdated (*ringard*) and that I should really study light-water reactors. Another spent 45 minutes lecturing me on why Euratom would make a far better research topic. In a transparent effort to control the havoc they feared I would wreak in the official version of events, a few told me ludicrous, blatant lies: two researchers insisted that there had never been any conflict between the CEA and EDF, and another maintained that EDF had never produced plutonium for the CEA.

Still, most people I interviewed did not seem interested in lying to me. Of course, this does not mean that we can take their stories as faithful, transparent accounts. Everyone has a personal perspective on events, recent or distant. Memories reveal as much about the storyteller's relationship to his or her history and community as they do about the events themselves. Let me cite one striking example. In 1996, I spoke with a former director of EDF. This man had seen many journalists and scholars, and I had transcripts of some previous interviews. As much as I tried to steer the conversation elsewhere, he kept returning to the same stories. A skilled rhetorician and politician, he had no intention of revealing anything new. In fact, not only did he tell the same stories he had told fifteen years earlier; on occasion he even repeated the same sentences word for

word. Clearly he had rehearsed these tales so often that they had become rote. I discuss other examples later in the book.

Thanks to a few key private collections, some treasure troves buried in the dusty closets of Chinon and Saint-Laurent, and the awesome documentation efforts of the Confédération Française Démocratique du Travail, I eventually found sufficient evidence to produce a version of this book that would not rely on interviews at all. Municipal and departmental archives contained plenty of information about local community responses to nuclear sites. And the CEA even granted me limited access to its archives during my last research trip. Why, then, have I made use of such a notoriously unreliable source as human memory?

One fairly simple reason is that some things conveyed in interviews are not in any document, accessible or not. These include accounts of how people related to one another, anecdotes about their reactions to particular events, stories about breaking safety regulations, criticisms of institutions, and so on. The accuracy of such tales cannot be verified, but they are all we have. I have made use of these memories in two ways. When the same story was recounted in two or more separate interviews, I have woven it directly into my narrative (signaling its source in the notes, of course). Stories I heard only once are generally quoted verbatim, sometimes along with comments on the nature of the conversation in which they occurred. Most people spoke to me on the condition that they would not be cited directly. I apologize to readers who find this frustrating. The bibliography offers a complete list of the people interviewed.

More importantly, I have included interviews because the tales I heard have shaped—perhaps in more ways than I realize—my understanding of life in today's technological France. From the engineers who decades later still express anger over the demise of the gas-graphite system to the neighbor of the Chinon nuclear plant who could not understand why anyone would care about her memories of its construction, these people have taught me a very personal lesson about how history shapes our understanding of the present, and how the present shapes our understanding of history. I have tried to convey a sense of this throughout the book, not only through the interviews but also through stories of my own research experiences.