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A Technological Nation

We are a people who easily get enthusiastic over large industrial projects, perhaps owing to tradition—for last century we were among the promoters of modern technological civilization—and doubtless also due to a natural admiration for work well done and a certain pride in being able to compare national achievements with those of other countries. . . .[1]

—Marcel Bleustein-Blanchet, advertising executive

As a gesture of friendship at the end of my second visit to the Saint-Laurent-des-Eaux nuclear site in 1990, the public relations manager there gave me a heavy embossed medallion attached to a key ring. In the foreground stand the site's four reactors; in the background, the château de Chambord, the Loire Valley's "paradigmatic" castle.[2] The Loire River swirls around the two images. "EDF" is engraved along the bottom edge of the medallion, together with a lightning bolt to symbolize electric force; the name of the site appears along the top edge. This souvenir conveys a clear message: France's nuclear reactors are contemporary châteaux, symbols of national glory equivalent in scale and style to the grandest historic monuments.

This preoccupation with linking modern technology and historical monuments began in the context of a postwar national identity crisis centered on anxieties about wartime losses, reconstruction, decolonization, and American dominance. State engineers, planners, and other technologists proposed solutions to these problems through industrial development and engineering prowess. They offered up visions of a new technological France and claimed a central role in shaping this national identity. In so doing, they portrayed themselves as leaders, "men of action" with a deep sense of public service, men who would save the nation from a stagnation induced by politicians and aging industrialists. Historicizing their achievements provided a means of asserting their

legitimacy: the past justified their leadership and affirmed their right to speak for the future of French national identity.

How did other political and cultural leaders respond to such claims? In the 1950s and the 1960s, social scientists, humanists, and some politicians expressed discomfort with sociopolitical visions offered by technologists. They feared that France would become a technocracy. Debates raged over the nature of technology and politics, and over the relationships between them.

I explore these debates here in order to provide a national context for what follows in subsequent chapters. In this chapter, I shall argue that much was at stake in debates about technology and politics—first and foremost, the question of who should have the power to define and construct France's future (and therefore its identity). An understanding of these stakes will help me make sense later of how nuclear technologists conceptualized and enacted the relationship between technology and politics. In the process of debating their role in the nation's sociopolitical order, technologists sought to create a hybrid notion of technology that deliberately and explicitly incorporated politics and culture. They did so by developing a trope (the notion of French technological radiance) and a set of practices (grouped under the general rubric of systems thinking) that would become common currency in the French industrial world. These would serve as important elements of the technopolitics of the French nuclear program. Examining the broader debates will also demonstrate that even though the nuclear program stood as the epitome of French technological radiance, it was by no means the only industrial effort that was subject to such interpretations in the postwar period.

Before focusing on the postwar period, though, I must provide a brief overview of state engineering in the nineteenth and early twentieth centuries. State engineers were a major subset of "technologists," a more general term for state experts of all kinds. Their history and ideology is important for understanding how they situated themselves after World War II, when all manner of technologists rose to prominence. I shall then turn to debates over the meaning of "technocrat" in this period. Next I shall look at how technologists' attempts to define (or redefine) their political and cultural role underlay their efforts to simultaneously describe a new technological France and define a specifically French technological style. Finally I shall look at how these efforts came together in the creation of multi-year plans aimed at modeling and shaping national development.

State Engineering before World War II[3]

Throughout modern French history, the engineers with the highest status have belonged to the state engineering corps, particularly the Corps des Mines and the Corps des Ponts et Chaussées (Bridges and Roads). In order to enter one of these corps, young men first had to attend the Ecole Polytechnique, the nation's most prestigious institution of higher learning, and then had to enroll in one of the more specialized engineering schools; the corps selected the top graduates of these schools for membership. Engineers who worked for private industry were known as *ingénieurs civils* and attended different schools. During the nineteenth century the two types of engineers increasingly came into conflict over issues ranging from design methods to professionalization mechanisms.[4] Despite the many professional gains achieved by civil engineers during these struggles, state engineers retained most of their social, technical, and political power. This power derived from both their institutional and their social backgrounds. Although the Ecole Polytechnique was a product of the Revolution, supposedly intended to provide meritocratic access to power, only those boys whose families could afford the school fees and the special schooling needed to prepare for the entrance exams could reasonably expect to attend. Then and now, the most common critique leveled at the school was that it provided merely another way for elites to justify and perpetuate their power.[5]

Deeply embedded in the system of state engineering lay an ideology of public service and leadership. The archetype of the state engineer was the *chef*, a strong, quasi-military leader. Thanks to his irreproachable morals and his irrefutably logical mind, he wore his considerable authority with ease and grace, and used it with fairness and restraint. This supremely male ideal emerged with particular force after World War I, when many lauded the heroic performance of state engineers.[6] In 1932, the civil engineer Georges Lamirand wrote:

> 'The engineer is a leader: he must 'serve and command' (p. 40), 'gain the sympathy of his men by his manner' (p. 50), 'look his men directly in the eye' (p. 55), and 'impress them . . . with the force of his mind and will' (p. 68). He must 'give the impression of physical superiority' (p. 55), which can be achieved through gymnastics and sports, and in short he must possess the virile qualities that make an officer: frankness, a firm sense of reality, courage, tenacity, and dedication to his work. . . . Finally, the engineer must 'know how to punish' (pp. 56–57).[7]

This archetype derived in no small measure from the figure of the *officier-ingénieur*, the young *polytechnicien* vigorously recruited by the military in

the interwar period.[8] Though most civil engineers could not attain top leadership positions in which to exercise such talents, many state engineers did. This ideal persisted during Vichy, when the Ecole Polytechnique was removed from military purview and placed under the tutelage of Jean Berthelot and his Ministère des Communications. Defining the school's new mission, Berthelot (himself a member of the Corps des Mines) wrote:

> The general aim of the Ecole Polytechnique is to educate leaders [*chefs*] for every branch of national activity that requires extensive scientific knowledge coupled with an extensive general culture [*culture générale étendue*].
>
> By means of a strong moral, physical, and intellectual education, students are prepared to become leaders in the corps, services, and companies which need them.
>
> The moral and physical education aims at developing within them the qualities of a leader: vigor, character, decisiveness, sports mentality, command aptitude, a taste for effort and responsibility. It should develop their personality in a disciplined [manner], imprint on them team spirit and a sense of community; in a word, [it should] give them a high sense of national purpose.[9]

Polytechnique ideals thus blended national pride, public service, and masculinity. The "sense of national purpose" identified by Berthelot had always formed an important part of how state engineers defined themselves. Designing for private industry was considered demeaning.[10] Instead, state engineers' commitment to public service supposedly guaranteed that their canals and railways served the nation, not private profit—for example, by determining which transportation routes would best serve the largest number of citizens and ensuring that private companies did not skimp on construction.[11] After World War II some state engineers perpetuated this animosity toward private industry, resituating it in a new political and institutional context.

State engineers used this ideology of public service and leadership to cultivate a particular style of engineering knowledge, design, and practice. Good leadership required "polyvalent" knowledge: the state engineer had to be a generalist as well as an expert. This justified the Ecole Polytechnique's highly theoretical curriculum, since theory was supposed to give graduates the broad perspective required to lead properly. Once out of school, many state engineers conceived of their large-scale projects as monuments to the glory and eternity of the French nation. Engineers measured and quantified the value of public service. They plugged this value (rather than numbers generated by market-based exchanges) into the economic calculations of their state projects. For example, quantify-

ing the usefulness of a stretch of rail to the industries and towns it served enabled Ponts engineers to argue against parochial or private interests in the name of the national interest. The Déclaration d'Utilité Publique, which officially certified the public usefulness of proposed projects, epitomized such calculations.[12]

State engineers sought not just to serve the nation, but also to build it. Theodore Porter notes that the Corps des Ponts et Chaussées "aimed to unify and administer the French territory, and even to civilize the French peasantry."[13] Ponts engineers expected to accomplish this mission through their designs and practices. The famous Legrand star, for example, had tracks that went from Paris to the six corners of France along straight lines, thereby trying to encompass and unify the French nation with the utmost spatial economy. Victor Legrand himself, meanwhile, saw the railroad as the "instrument of national civilization."[14]

Scholars[15] have observed that, historically, state engineers' understanding of their social role has bound them together more than their expertise: their group has identified less as a profession than as a social category. Consequently, some researchers have questioned whether state engineers really were (or are) engineers in the technical sense at all.[16] Terry Shinn has argued that the work of state engineers was "almost totally lacking in scientific and engineering content: the attributes that mattered were social and political."[17] Eda Kranakis, however, disputes such conclusions on two counts. First, she argues, the public works design and construction projects of nineteenth-century state engineers clearly included large amounts of technical work. Second, she notes, the emergence of large-scale technological systems increasingly required both state and civil engineers to perform a variety of different kinds of tasks, and defining engineering as a narrow set of technical tasks offers too simple a view of what it means to be an engineer of any kind.[18]

Ample work in the history and sociology of technology supports this argument.[19] Clearly, engineering is a heterogeneous activity. In this respect French engineers are no different from others. Consider Antoine Picon's description of Ponts engineers in the interwar period:

> [They] refuse the opposition between technology and humanistic culture, technology and language, technology and society. For them, the ideal of a technique mastered by a fully efficient technology [is] often accompanied by an implicit or explicit social project, destined to reconcile man with his mechanical environment. In the minds of the boldest ones, such a reconciliation would strongly resemble an assimilation of the social to the technical. Why not make society function like a big, scientifically regulated factory?[20]

Yet this example also hints at a more unique characteristic of French state engineers that will be encountered repeatedly throughout this book: their frequent *willingness* to admit the social (or political, or cultural) nature of their work. Porter explains this by analyzing the nature and basis of state engineers' authority in the nineteenth century. Faced with pressures from local politicians concerning the location of roads and bridges, for example, Ponts men did not (as American engineers might have) devise a rigid set of rules by which to make decisions. Such rigidity would have been "inconceivable," because it would have undermined their status and power as an elite.[21] Instead, they derived power from their commitment to public service and their social standing, more than from their scientific training. In the words of one Ponts engineer, "There are many ingenious formulas to calculate the traffic volume on a planned route as a function of the population served; but to apply them with discernment requires taking account of the social, economic, and moral state of the population, and that is the greatest difficulty."[22] Only a broad education and a strong moral sense could possibly lead to such "discernment."

To put the matter somewhat differently, state engineers did not so much *derive* legitimacy from their technological achievements as the other way around. That is, their position within the state *conferred* legitimacy on their technologies. That position fluctuated over the course of the nineteenth and twentieth centuries, and so did the success of their technologies. State engineering flourished in the early nineteenth century. By the 1880s, however, economic liberals dominated crucial ministries; they curtailed deficit spending, and with it the ambitions of state engineers to plan and build the nation.[23] Between the two world wars, state engineers (and other technologists) became interested in national economic and industrial planning, but their projects met with limited success. During World War II such men also participated in the Vichy government and (less visibly) in the Resistance.[24] Many of them remained involved in state institutions after the war, when state engineering came into full bloom.

State Institutions after World War II

World War II led the French to question the foundations of their social, political, and economic life. Despite other profound differences, the dominant political groups of the Liberation period agreed on a few fundamental issues. They blamed France's abysmal military performance during the war on the economic "malthusians" who had run the nation and its industries throughout much of the Third Republic. Because

these men had tried so hard to preserve the status quo, the economy had stagnated and French industries had fallen far behind their German counterparts. Leaders feared that France had declined—perhaps irreparably—from its former status as a great nation.[25] Anxiety about technological backwardness was one manifestation of this fear.

Most agreed that the remedy for these problems lay in rethinking the role of the state in directing the economy (in general) and in directing industrial, scientific, and technological development (in particular).[26] By engaging in and promoting investments aimed at modernizing and expanding industry, the state would accomplish the dual aim of resuscitating the economy and restoring France to its rightful place in the ranks of great nations. Of course, considerable disagreement existed among communists, socialists, centrists, and Gaullists over the long-term role of the state in French society. But enough consensus emerged among these diverse political groups to create or reform a number of new state institutions.[27]

These institutions covered a wide spectrum of activities. The Ecole Nationale d'Administration was founded to produce modern managers for the state. The Centre Nationale de la Recherche Scientifique, founded just before the war and stagnant during Vichy, was redesigned to cover a broad spectrum of scientific activities and expected to make recommendations on science policy.[28] The Commissariat Général au Plan (Planning Commission, often referred to simply as the Plan) was created to plan reconstruction and modernization through a program of nationwide production goals and coordinated industrial development.[29] The new Commissariat à l'Energie Atomique aimed to develop atomic research and technology. Finally, amid considerable political controversy, the electricity, coal, and gas industries were nationalized. The restructured state claimed to serve the French people rather than private interests. After decades of debate, the nation would finally modernize.

This profusion of new and reformed institutions proved congenial to a growing class of state experts. Issuing primarily from the *grandes écoles*, this group included state engineers, economists, and professional administrators. Their ideology of public service, polyvalent knowledge, and masculine meritocratic leadership dovetailed perfectly with the prevailing view that state institutions should take primary responsibility for directing national reconstruction and modernization. Joining the chorus denouncing the protectionist practices of traditional French businessmen, these men poured into the top ranks of ministries, the Plan, nationalized companies, and other state institutions. Experts could thus bolster their ide-

ological claims to public service with the alleged disinterestedness of the nation-state: their background and their chosen institution would doubly qualify them to speak for the nation. From this position, they vigorously forged their visions of a French technological identity. During the Fourth Republic (1947–1959)[30]—a time of considerable political turmoil, marked by twenty changes of government—the most successful and visible of these efforts occurred primarily in nationalized companies such as Electricité de France and in state agencies such as the Commissariat à l'Energie Atomique. The Fifth Republic (1959–present) provided political support and leadership for such efforts, which gained correspondingly in momentum, visibility, and prestige.

What Is a Technocrat?

The important role played by state experts in shaping new ideas about the nation did not escape the attention of their contemporaries. Quite the contrary: as the euphoria of liberation gave way to the hardships of reconstruction, private industrialists and opponents of domestic policies from both ends of the political spectrum began to accuse state experts of undemocratically imposing their will on the nation. The word "technocrat," fairly neutral before the war, became a derogatory epithet—in part, probably, as a result of the specter of expert involvement in Vichy.[31] At the same time, "technocrats" attracted the attention of social scientists and humanists as an identifiable group to be analyzed and critiqued. Debates sprang up over the meanings of "technocrat" and "technocracy." At the root of these debates lay passionate defenses of a separation of technology and politics. For social scientists and for stronger opponents of state experts, "technocrat" designated someone who had breached a boundary, who had moved from his area of expertise into the domain of political decision making. The dangers inherent in breaching this boundary were considerable; first and foremost among them was the capitulation of democracy to technocracy.

Because "technocrat" became such a loaded term in this period, I will treat it as an *object* rather than a category of analysis. When I need to designate state experts as a group, I will use the term "technologist." This word is my translation of *technicien*, a more neutral and polite term used by all sides in these debates. Like its derogatory cousin, "technologist" often referred not just to state engineers but to any expert or high-level bureaucrat involved in state administration. (There were contests over this meaning too, but these were not as heated.) I will follow this usage,

because—as we shall see when we look at the leaders of the CEA and EDF in chapters 2 and 3—it often does not make sense to distinguish between engineers and other types of technologists when discussing their positions in the upper levels of state institutions.

What was technocracy, and what relationship did it subsume between politics and technology? According to one organizer of a 1956 conference on "Politique et Technique," such questions had come to dominate problems in political science by the mid 1950s.[32] Technocracy, speakers at this conference said, entailed the replacement of politicians by experts—not just engineering experts, but also experts in finance and administration who engaged in quantifying practices. Some, like the eminent writer André Siegfried, saw this replacement process as a quasi-inevitable result of technological civilization:

> . . . is it not normal that we should be pulled toward technocracy? The primacy of our material preoccupations demands this, for the standard of living depends on technology: the quantifying spirit, the geometrical spirit in machine civilization has become dominant. With the expert replacing the politician, it has even invaded a domain where the spirit of finesse should continue to reign. These transformations were inevitable, but perhaps they pulled the State too far down the road of a potentially oppressive technocracy. The defense of the individual, of liberalism, must find new positions.[33]

Social scientists echoed these anxieties. Technologists were eroding traditional political power, and this erosion posed a grave danger to democracy. While in theory power remained in the hands of elected officials, in practice those officials no longer played any significant role in policy making. State planning offered a striking example: plans were devised by state experts, while elected officials, who had neither the time nor the qualifications to understand the calculations, merely approved the budget without questioning the plan. "Government by opinion," one speaker noted, "is giving way to the power of initiates who have the secrets of technology, or who simply know its rules."[34] Most conference participants did not think this change resulted from a deliberate takeover strategy on the part of technologists. Rather, they felt it emanated from the increasing complexity and scale of technological society. Nonetheless, the overall trend seemed clear. Democracy, the essence of the French republic, was threatened: crucial decisions were being made by an elite who had not been elected to do so.[35]

The technocrat figured as a villain across the spectrum of party politics. On the extreme right, the populist Poujadiste movement accused technocrats (as well as other intellectuals and mainstream political leaders)

of oppressing ordinary French citizens with modernization, planification, large corporations, and the growing state. "You, Man of Science, for whom do you work?" Pierre Poujade railed in a typical display of inflammatory rhetoric. "If you are neither a nut or a sadist, does it make you happy to see your work crush men?"[36] The left too feared technocracy, though it used somewhat different language to describe its dangers. At the "Politique et Technique" conference, the Confédération Général du Travail militant Pierre Le Brun warned:

> A State in the service of Technology that would itself serve Capital would be a technocratic State, a State that . . . would tend to *govern men as though they were things*. . . . Fascist corporatism, which we experienced in France from 1940 to 1944, is also, in its negation of class conflict, a form of technocracy and it is no coincidence that so many technologists and technocrats sat in the Vichy government. . . .[37]

Technocracy, continued Le Brun, could become a form of dictatorship that completely subjugated the wishes of the people. In political circles, castigating technocrats had become another way to criticize the government by playing on old fears about the encroaching power of the state.

Beyond the arena of party politics, discourse about technocracy also expressed anxiety about the apparently relentless advance of technological civilization. For example, many intellectuals feared that without any deliberate human agency, technological change and the lure of material goods had conspired to alter the very structure of social and political relationships. Would technology go so far as to make politics irrelevant? The fact that the Fourth Republic prospered economically despite the lack of strong political leadership suggested that politicians had indeed become unnecessary. Such a situation posed special dangers for political scientists, of course: one of them worried that on the day when technology could resolve all human problems their discipline would become superfluous.[38]

These anxieties did not fade after 1958, when Charles de Gaulle returned to power after a twelve-year hiatus. True, de Gaulle *announced* that he had no intention of leaving serious decision making to experts. Gaullists had lambasted "technocrats" on a number of occasions, blaming them for the disorder of the Fourth Republic: "Each ministerial crisis appealed to 'experts': a squad of interchangeable high functionaries in the ministry of finance. Always the same ones. Regardless of what color the Chancellor of the Exchequer was, they were there, always with a plan in their pocket: each time, the plan was identical to the preceding one and consisted of priming the financial pump."[39] Once Gaullists came to power in the Fifth Republic, however, such rhetoric appeared to have

been a matter of expediency. De Gaulle believed in a strong state, national planning, and large-scale technological projects. Powerful leadership, he felt, had to rise above party politics. He accordingly appointed several state experts with no background in professional politics to his ministerial cabinets. His regime breathed new life into the flagging Commissariat Général au Plan by appointing Pierre Massé—*polytechnicien*, economist, and former EDF director—as High Commissioner of Planning. The general himself called upon the French people to consider the plan produced by the commission their solemn and urgent duty, dubbing it "the ardent obligation."[40]

Debates about the nature of technocracy intensified during the first decade of the Fifth Republic. In 1960 the political scientist Jean Meynaud published *Technocratie et politique*, in which he described the history of technocratic ideology and accused the French state of becoming increasingly technocratic. The technocratic mentality, for Meynaud, was "that state of mind which makes us conceive of technological achievements as the supreme evidence of humankind and that invites us to expect everything from scientific progress."[41] He offered a broad-ranging list of those who, by virtue of their technical competence and influence on public life, ranked as actual or potential technocrats: bureaucrats, mathematicians, military officers, professional consultants, scientists, and more.

Meynaud located the intellectual foundation of technocracy in an unlimited faith in the value of scientific analysis. The end result of technocratic action was the "abdication of the politician in favor of the technologist."[42] Numerous leftist critics claimed this had occurred twice already: in 1940 with the institution of the Vichy government, and again in 1958 with the Gaullist overthrow of the Fourth Republic. Ultimately, Meynaud agreed. He judged technocratic ideology to be little more than an apology for the technologist and a justification of the desire to reduce politics to technology.

Meynaud particularly suspected that ideology's exaltation of the technologist and his supposed ability to take a *vue d'ensemble*—a systems view. When paired with the alleged moral qualities of the technologist—such as a highly developed sense of public responsibility—this ability supposedly enabled men to make choices in the general interest. "In the extreme case," wrote Meynaud, "this is about possessing qualities that allow [technocrats] to direct valid social choices."[43] Meynaud found this a highly idealized portrait: men possessed of the technocratic mentality frequently did not have such an elevated moral sensibility. Uncertainties abounded in any kind of decision making, and technologists were no

better qualified to deal with ambiguity than politicians. Furthermore, any kind of decision, no matter how "technical," necessarily incorporated political considerations. Most ridiculous of all were the cyberneticists who proclaimed the arrival of a "governing machine" that would ultimately mechanize political decision making. For Meynaud, the advance of technocracy heralded the weakening of democracy.[44]

Meynaud's analysis was representative of the writings of many social scientists. Popular representations painted the technocrat as a man steeped in abstract reasoning, focused only on Paris and evincing complete ignorance of the provinces, a productivity maniac, a bad Frenchman who drank whisky and Coca-Cola instead of wine, and a Jew. The portraits painted by social scientists and humanists were less racist and hysterical, but barely more flattering in tone. Technocrats were men who proclaimed the irrelevance of all ideology, called for the introduction of operations research in political decision making, argued that France had to find a middle ground between Russian rationality and American efficiency, and vehemently denied being technocrats.[45]

Social scientists and humanists found technocrats most threatening when they breached the boundary between technology and politics. These intellectuals deemed the maintenance of this boundary crucial to the proper and decent functioning of society. When Jean Meynaud acknowledged that technical decisions had political dimensions, he did not mean, as today's social scientists might, that technology and politics *could not* be separated (much less that the very process of design was political). Rather, he meant to make his own political statement: namely, that elected officials should be presented with a range of technical options so that *they* could make final decisions. Democracy and justice, in other words, demanded a clear demarcation between technology and politics.

Technologists defended themselves against their accusers in a great variety of forums. Some wrote books ostensibly aimed at the educated lay reader. Others made speeches to alumni associations. Still others wrote in the popular publications of the new ruling elites, such as *Le Monde* and *L'Express*. Taken together, these defenses had several overlapping aims: to assert the legitimacy of technologists' place within the ruling elite, to elucidate the specific nature of technologists' contributions to that elite and generally establish their identity, and to enroll the technological rank and file—including engineers and *cadres* (mid-level managers)—in their visions of a new sociopolitical order.[46]

Technologists adopted two strategies in their defenses, contradictory on one level but eminently compatible on another. They first denounced

the negative connotations of "technocrat" and attempted to salvage a positive meaning for the term. This consisted of arguing that "technocratic" modes of action, while accused of being authoritarian, in fact fitted perfectly well within the democratic process. The second strategy involved articulating an identity for technologists that opposed the identity of politicians. On the surface, this consisted of affirming separate and opposing identities for the two social groups. But in arguing that technologists were superior to politicians, this approach ultimately militated for a conflation of technological and political means of action. Let us examine each strategy in turn.

Alfred Sauvy (a *polytechnicien* and the director of the Institut National d'Etudes Démographiques) had a chance to defend his kind at the 1956 "Politique et Technique" conference. The pejorative sense of the word "technocrat," he said, had emerged unjustly. All technologists did was propose ideas for reforming the nation, and ideas were part of the democratic process.[47] Sauvy vigorously defended the notion of disinterestedness, scornfully dismissing businessmen and lobbyists who denied its validity:

> From the point of view of certain private interests, disinterestedness is a laughing stock, a monstrosity. At the very least it is an object of suspicion. When concern with the general interest opposes a private interest, the first reaction of the defenders of that interest is often, if not "who pays?" then at least "in the name of which private interests are these ideas proposed?" Then, if they do not receive a satisfying answer, the classic attitude is to object that these are the views of a theoretician, that they are abstract ideas. In the end, if these epithets do not suffice to condemn the adversary in the eyes of the audience, the last resort is to call him a "technocrat."[48]

While Sauvy admitted that the defenders of the general interest did not always communicate and negotiate as much as they should, this was largely because such men didn't have any forums where they could express themselves. Developing more and better channels of information could easily remedy this situation. How absurd, he exclaimed, that French citizens were more suspicious of the "technocrat" who defended the public interest than they were of industrialists who defended only their own private interests!

Sauvy thus argued that the ideals of the disinterested expert were perfectly compatible with democracy and dismissed the word "technocrat" as nothing but a petty insult. Others, however, attempted to re-appropriate the word and restore a positive meaning to it. In a book titled *Plaidoyer pour l'Avenir* (Plea for the Future), Louis Armand (*polytechnicien*, member of the Corps des Mines, onetime head of the Société Nationale des

Chemins de Fer, professor at the Ecole Nationale d'Administration) and his co-author concluded that "it is not being a 'technocrat' in the insulting sense of the term to want to base oneself on realistic data, to seek to understand [these data], and to finally attempt to synthesize them. This is being a man who loves life and wants to figure out what he can do to love it even more and to ensure that others love it."[49] Thus, far from inhuman or mechanical, the technocrat was full of passion. Technocracy, said the enthusiast Dominique Dubarle, was "exercising power inherent in scientific . . . and mathematical technology in order to [ensure] the good operation of society and the success of large social entities: large companies, nations, tomorrow perhaps all of humankind."[50] Technocracy contained within it the power to transcend the petty boundaries of national politics. But only true technocracy had such transformative powers. Polytechnique professor Maurice Roy attempted to define the "true" technocrat in expressing his desire that his school would continue to "produce authentic technocrats and at the same time avoid, under the banner of progress, inventing and training 'supertechnocrats' deprived of true and serious knowledge of the technologies in question."[51] For this *polytechnicien,* then, financial and administrative experts did *not* count as technocrats in the best sense.

The civil servant Jean-Louis Cottier also wanted to strip "technocracy" of its negative connotations. He found technocratic thinking eminently compatible with Christian humanist thinking, which in turn provided the moral basis for any technocracy. Technocracy was anything but anti-democratic—indeed, people from all social classes could be technocrats: ". . . engineers from the *grandes écoles,* industrialists who are self-taught or trained by family traditions, workers whose value makes them stand out from the ranks . . . , military [men] who are good at command. . . . These men participate in politics as technologists."[52] In order for this moral, democratic technocracy to function properly, technologists needed a sense of history and human society. Engineers had to study the influence of technology on history. By understanding the "laws" linking the evolution of science and that of civilization, technocrats could better construct the future. Thus informed by humanism, technologists *could*—contrary to the claims of their detractors—build a more human, moral, and democratic world.

Such attempts to salvage a positive meaning for "technocracy" did not work. Striking evidence for this failure appeared in a 1967 article published by Louis Armand in *La Jaune et La Rouge,* Polytechnique's alumni magazine. The article compared "technocrats" and "technologists." The former, said Armand, were graduates of the Ecole Nationale d'Administration and

reigned over juridical and administrative domains; the latter were Polytechnique graduates and reigned over technological and industrial domains. Claiming that he wanted to explore the common ground between the two groups, Armand situated himself at their intersection by noting his affiliation with both institutions. But his description of the differences between the two groups made clear that his loyalty lay with the technologists. They were oriented toward the future. They might be idealists, but they were neither ideologues nor demagogues. While they believed in profits for their employers, they paid little attention to personal profit, and they were more attracted by professional recognition than by social rank or salary. Furthermore (and this held particularly significance for Armand, a strong supporter of the European union), technologists felt comfortable with their counterparts in other Western nations: they had a natural tendency toward international cooperation and wanted the whole world to benefit from their work. Technocrats, by contrast, focused only on immediate problems. They tended heavily toward *dirigisme*—a word that raised the specter of Vichy and total state control. They relentlessly pursued political power, constantly seeking to rise through the administrative ranks. Since their expertise consisted in elaborating legal and administrative texts whose purview was necessarily restricted to the nation, their outlook was narrow. Worse, they voiced automatic suspicion for anything European, which they felt threatened France's national sovereignty.[53]

This unflattering portrait of technocrats represented a clear attempt to distance those with technical training from that epithet. Technologists retained all the virtuous characteristics of previous definitions of technocrats, leaving administrators looking self-serving and power-hungry. But even though Armand had abandoned his efforts to rehabilitate the word "technocrat," he retained his convictions that technologists should occupy positions of power. Indeed, only this could save France from permanent second-rate status, for ultimately technology "is at the foundation of all that can ensure, if not total independence, which is no longer accessible for a country of our size, then at least sufficient means to enable us to play an active role in the federations of the future that will replace the Europe of borders."[54]

Armand's article brings us to the second, parallel strategy that technologists used to counter accusations against them: articulating an identity that explicitly opposed that of the politician—or, more accurately, the politician as seen by the technologist-engineer. In the pages of *La Jaune et La Rouge,* politicians emerged as corrupt, dishonest, and ineffective. One

Polytechnique alumnus defined the contrast with particular eloquence in a speech entitled "The Cardinal Virtues of the High-Class Engineer":

> Do we want the best of our engineers to participate, through their acts, their pens, and their words, in making our economy healthy again? Well then! we must immunize them, from their very first steps, against the disease known as political thinking of which Machiavelli was the champion. . . . The Florentine did not hesitate to claim that the individual should sacrifice to the State not just his fortune and his life, which is very good, but also his honesty, which is despicable. . . . In the twentieth century, . . . a democracy cannot accommodate long-standing deception, and I cannot conceive that economic recovery could occur without the country being fully aware of the difficulties to surmount and having full confidence in the sincerity of its guides. [55]

Democracy—a cardinal virtue of the social order about which everyone could agree—could not be implemented by politicians and their political values. The heirs of Machiavelli would only lead the nation into further chaos. Instead, France needed heroes like Galileo and Pasteur. Such mentors could teach boys to defend truth and rigor under the direst of circumstances, turning them into fine, upstanding young men who would "restore our economy and give France the place it deserves in Europe." The alumnus continued: "Let us pray, my dear comrades that, in the expert hands of our imperturbably devoted teaching personnel, and with the help of its cadre of officers whose enthusiasm is infectious, our old establishment can still shape men who, thanks to their talents and their virtues, will have the Glory of accomplishing, thanks to their culture of Science, the task that the Nation demands of them!"[56] In contrast to the corruption and decadence of politicians, the eternal, disinterested values of the Ecole Polytechnique would thus guide the nation.

Not all technologists felt this need to attack the political class in order to articulate a distinctive identity that would naturalize their participation in running the nation. Some—like Armand and his co-author in *Plaidoyer pour l'Avenir*—defined the difference as one of method and thought process. The problem with politicians—elected officials as well as prefects or ministers—was their inability to think synthetically and systemically. This ability constituted the great strength of technologists, and their most important difference from politicians.[57] Allowing technologists to produce and direct organized systems would not render politicians superfluous, but it would render ideology "obsolete."[58] Thanks to the systems thinking and building of technologists, politicians would no longer need ideology to demonstrate the validity of a policy. Good policies would now emerge from rational rather than ideological choices. Thus systems think-

ing both defined and legitimated the participation of technologists in public life.

Another strand of efforts to elucidate a distinctive technological identity appeared in the portrayal of technologists as supremely masculine. The technologist was virile, decisive, and forward looking. He was, in one of Pierre Massé's favorite expressions, a "man of action."[59] Politicians, by contrast, were not men of action—or at least not very efficient ones. According to Jean Barets, "the political man of the Republics . . . , the product of chance, [is] badly prepared for the awesome task of a man of State, ignorant of international and economic problems, duped by his own ease of expression. He will be vanquished by facts."[60] It followed that only technologists, who had a true mastery of "facts," could be real "men of action." The striking durability of this masculine archetype shows in the title of a recent eulogy to a former head of the CEA: "Pierre Guillaumat, man of action." Citing Guillaumat's role in providing Israel with military nuclear technology, the writer compared him to James Bond: "You could see the shadow of a super 007, far away and inaccessible: Pierre Guillaumat."[61]

The virtues of the man of action included honesty and directness. In Massé's experience, some politicians did possess these attributes—men who laid their cards on the table and engaged in rational conversation. With them, he could talk "man to man."[62] But such politicians were rare. Technologists, however, as men of action, truly understood the merits of frank discussion.

Contrary to the image that political detractors painted of the cold, hard technocrat, men of action were not without heart. Indeed, another remark by Barets showed a passionate desire to procreate and nurture—actions that, indeed, could come directly from the male technologist, completely bypassing any female assistance: ". . . in the literary mind, the love of man is merely a platonic love, [a love] which does not create human life. The technologist loves man with a more carnal love and wants to continue to nurture the being whom he loves. He will therefore try to protect [this being]."[63] Technologists were thus the virile, passionate protectors of mankind (and presumably of womankind as well). Love spurred them to action. Sometime this action occurred behind the scenes, but it was always in a good cause. Politicians and writers did not act—they wrote, they talked, they waffled, but they did not act. Action made technologists masculine and therefore powerful.[64]

Clearly, technologists as well as humanists, social scientists, and political leaders found it vital to enact a boundary between technology and

politics. But the boundary had different meanings and locations for the two groups. For non-technologists, the boundary upheld one of the foundations of democracy. Its transgression therefore signified the collapse of the social order. The boundary was thus located in the domain of practice: technologists should not behave like politicians, and technological methods should not be applied to political decision making. For technologists, the boundary was located primarily in the domain of identity. The relevant difference was, above all, one between themselves and politicians. In constructing this difference, technologists adopted extremely narrow definitions of politics. Politics could mean the implementation of classic ideological stances such as communism, socialism, or liberalism. Or it could refer to the activities of politicians, caricatured as corrupt, indecisive, irrational, manipulative, and Machiavellian.

"Politics" in the sense of classical ideology and corrupt machinations may have been "other" at one level of technologists' identity discourse.[65] But at a deeper level lay the implication that, because of their values and knowledge, technologists were ultimately better equipped to pursue at least some of the activities in which politicians engaged. Now stripped of connotations of ideology and corruption, politics took on a broader meaning, becoming part of what technologists did and should do. At this level, technologists sought to erode what they claimed was an outdated boundary between technology and politics.

The Future of France

One important site for the erosion of the alleged boundary between technology and politics was in the discourse about the role of technology in the future of France. This discourse attempted both to describe what a future technological France would look like and to define a specifically French form of technological and industrial development. General forms of these descriptions and definitions constituted a relatively mild erosion of the alleged boundary between technology and politics: they proposed that technological achievement replace more traditional measures of national power and prestige. Discussions of how to attain such futures, however, attacked the boundary much more aggressively. Shifting from goals to means meant searching for ways to shape the future and control destiny. Systems thinking—both qualitative and quantitative—loomed large in this drive to control destiny, constituting an important means for technologists to blur the technology-politics divide and define and defend their own role in shaping France's future and identity. In order to under-

stand this function of systems thinking, though, we must first examine how technologists related technology and Frenchness.

The fundamental premise of discussions about a future technological France was that, in the postwar world, technological achievements defined geopolitical power. A typical article stated that "the possession of industry, especially heavy industry, appears to be a necessary element for respect and independence."[66] Technologists who had sometimes vainly insisted on this equation during the Fourth Republic found ample political support for it once de Gaulle returned to power: "We are in the epoch of technology," declared the general on one occasion. "A State does not count if it does not bring something to the world that contributes to the technological progress of the world."[67] For de Gaulle, technological prowess could be particularly important in helping France combat the crisis of grandeur brought on by the decolonization of its empire. Technologists happily agreed that technological development could provide the basis for a new relationship between France and its former colonies. Writing just a year after the Algerian crisis that had brought de Gaulle to power, Jean-Louis Cottier saw tremendous potential for this new way of conceiving geopolitical relationships: "In 1958, destiny knocked on the door. . . . In came the technocrats who would build the Franco-African industrial community. In them, the science of engineers is united with the will of captains. The new French strategy, French peace, will be brought to the world."[68] At the same time, France's former African colonies could remain in a sense French by providing the raw materials so essential to France's energy independence—particularly oil and uranium.[69]

Even worse than losing the empire, however, would be the economic and cultural colonization of France by the United States.[70] Indeed, technological achievement as the standard of geopolitical power did not mean that technological pursuits all over the world were identical. The loss of cultural specificity posed the greatest danger of adopting this standard. Even those French who found the United States fascinating dreaded the prospect of a thoroughly Americanized France.[71] The Groupe 1985, a collection of technologists convened by Pierre Massé in 1964 to think about the long-term future of the nation, issued a clear warning: "The first unexpected challenge is the intellectual and cultural survival of an original and individual France. Indeed this scientific civilization will increasingly tend to attenuate national specificities and deformities. From now on our presence in the world depends on our ability to imprint our mark on this civilization by means of significant contributions from French technology and French science."[72]

What made a technological or scientific project French? A difficult question to answer. Indeed, most technologists avoided addressing it directly, concentrating instead on listing and celebrating French achievements. At a 1959 press conference organized by the Conseil National des Ingénieurs Français, one prestigious engineer enumerated the accomplishments of French technology over the previous decade. French engineers had excelled in numerous domains: coal, electricity, steel, nuclear research, railways, aeronautics, building, and more. The ultimate proof of French prowess came when other nations consulted French engineers. For example, the Israelis had asked French engineers to help them design urban transportation systems; in gratitude, they named one of the terminals in Haifa "Paris."[73] Paris in Israel: what better evidence of the "radiance of France"? The pages of *La Jaune et La Rouge* were filled with praise for French technological achievements, succinctly expressed in titles such as "French aeronautics, a matter of pride and hope," "'The Caravelle': a national triumph," and "The radiance of France from the builder's scientific and economic and viewpoint."[74] In 1960 the explosion of France's first atomic bomb in the Algerian desert—triumphantly announced in a press conference at the Ecole Polytechnique—showed the "entire world the value of French technologists and considerably reinforc[ed] our country's position."[75] Two years later, the new terminal at Orly Airport filled this role: ". . . we deemed it indispensable that an undertaking of this size, destined to be seen by the entire world, should give everyone, inside as well as outside, an example of what we can do in France."[76]

Language provided another means of defining a French technological style.[77] The dominance of the United States seemed particularly challenging here, largely because of the "delay that French technology suffered with respect to American technology during the last war."[78] American words threatened to colonize French technical language. According to one group of *polytechniciens*, this posed several problems: these terms were difficult to pronounce, they sounded ugly in French, and they threatened the precision of the French language. In 1954, to guard against the wholesale invasion of American terminology, these men founded the Comité d'Etude des Termes Techniques Français, which was dominated by *polytechniciens* but which also included other engineers, linguists, university professors, and delegates from professional technical associations. This committee met monthly to find equivalents for foreign technical words—especially those that sounded particularly horrible in French. Monthly reports went to institutions and prominent industrialists

for comment, after which the committee formalized its proposals and tried to get them adopted by engineering schools and the technical press. In essence, the committee saw itself as a kind of linguistic immigration officer: "Upon entering a country there is a service that sorts immigrants in order to ensure that only the useful ones enter; similarly, we must filter foreign words as soon as they mingle with French vocabulary."[79] Demoting American terms from colonizers to immigrants made them significantly more manageable. Meanwhile, it was felt, technologists should fight to reinstate French as the world's *lingua franca.* In a 1962 radio interview, the director of the CEA's research center in Saclay remarked that the English language was "not very rational," since the same word could have different meanings when used by the Americans or the British. Much better to use French, "which is a stable, . . . solid language, and which still allows for all the nuances needed to deal with the most modern science and technology. . . .We should teach the greatest possible number of foreigners [at least] a modest French."[80]

Technologists also attempted to elucidate what was—or should be—specifically French about French technology. Most of these efforts appealed to a sense of history or tradition. Tradition, it appeared, could define or describe Frenchness fairly unproblematically. Placing modern accomplishments in direct historical lineage with accepted traditions would therefore make them demonstrably French.

One traditionally French quality was a refined esthetic sensibility. "The beautiful," noted the Groupe 1985, "is a traditional export of France."[81] Technological achievements did not have to be ugly; modernity could be beautiful.[82] The time of hideous industrial landscapes had ended. Modern technology—especially in France—"engenders . . . its own beauty, [the beauty] of large dams and artificial lakes . . . , [the beauty] of large bridges. . . , [the beauty] of large buildings where lines, materials, and light play with each other . . . , and even [the beauty] of the metal towers of high-tension power lines."[83] Nor did this beauty have to come at extra expense: "Caravelle [the airplane] is both a technological success and an esthetic success, but its beauty comes as a surplus: it results from lines and materials, not from additional cost. . . . Similarly the beauty of large dams resides in the harmonious marriage of the object and its natural setting."[84] Cultivating an esthetic dimension to industrial projects would not only assert the Frenchness of French technology; it would also enhance the prestige that the nation could derive from its technological achievements. Even when beauty did add to the cost of a project, the supplement remained small in relation to its benefits: ". . . beauty

brings income for tourism (it is important not to disfigure sites with inadequate equipment), it brings prestige because it represents a considerable attraction, even when there is no commercial profit. The CEA's installations, which receive numerous foreign visitors, would certainly gain nothing by being hideous, and the esthetic of certain nuclear reactors, whose cost is insignificant with respect to [the cost of the] equipment, does more for the radiance of France than would ten times as many millions spent on propaganda."[85]

Through beauty, tradition could legitimate modern technological achievements as being truly French. And the relationship worked both ways. France was a nation rich in tradition, but this tradition no longer sufficed to define the glory—indeed, the radiance—of the nation. Armand made a point of this in *Plaidoyer pour l'Avenir*: ". . . the wealth of the setting—churches, castles, rivers and their embankments, towns which each have their own personality . . . —should mean that France would continue to be a crucible of ideas. Yet all that subsists in France in the way of tradition—in the countryside as in the army—will only have real value and will only be able to radiate if the nation as a whole is solidly of our time."[86] Hence the other side of a symbiotic relationship: just as tradition was necessary in order to make French technology truly French, modernity was necessary in order to make France truly France.

The nation's nuclear achievements epitomized these dialectics between tradition and modernity and between national radiance and technological prowess. Consider, for example, a 1957 promotional film commissioned by the Ministry of Foreign Affairs and entitled "Le Grand Oeuvre: panorama de l'industrie française."[87] The film opens with a view of the sprawling Versailles castle and the words of Jean-Baptiste Colbert to Louis XIV. "Sire," Colbert declares, "the grandeur of a state rests on its arts and manufactures." The next 40 minutes recount, in epic style, French postwar technological development. Viewers see canals, coal mines, oil refineries, petrochemical plants, railroads, and airplanes. The narrator continually reminds his audience of the connection between technological prowess and national grandeur: "Airports are part of the infrastructure necessary to a great industrial nation." "What would France be without its railroads?" The country's industrial growth is attributable in part to thousands of heroic workers laboring "elbow to elbow in the mechanical fraternity," but mostly to the engineer—"the man of industry *par excellence*." Spiffy young *polytechniciens* talk energetically in the Jardin du Luxembourg, just outside the Ecole des Mines. The film continually affirms the connection between history and modernity: the Alsace, which

once made dyes, now prints cloth; Lyon, which used to manufacture silk, now produces synthetic fabrics. At the end of the film, these themes coalesce in the depiction of the burgeoning nuclear program. We learn that the construction of Marcoule, France's first large-scale nuclear site, has "mobilized all of French industry." We see one of Marcoule's heat exchangers making its way by truck convoy through an old village filled with amazed peasants. Finally, we see two nearly completed reactors. The narrator intones: ". . . the latest great accomplishment of the century of the atom, the future's answer [at this point the film switches to a shot of the Eiffel Tower] to this other great symbol of French industrial grandeur, sketched in the Parisian sky." France's postwar industrial achievements thus fitted into the nation's historical teleology, nuclear technology its apotheosis.

Technologists envisioned a future France whose power would rest on technological prowess yet whose technological achievements would remain distinctly and identifiably French. The type and degree of nationalism in this discourse varied greatly. Some shared de Gaulle's vision of a strong, independent France; others argued that henceforth France could be strong only by associating itself with a larger European community. Such differences led to differences in the technopolitics pursued by technologists. But either way, the goal seemed clear: France had to become a technological nation. Its future depended on planning a wise route to this goal.

The Mentality of the Future

In order to attain this goal, most technologists argued that the French *mentalité* had to change. This refrain dated from the early postwar period. In those years, advocates of state planning had blamed French defeat on petty industrialists who had clung tenaciously to the status quo and had refused to invest in new technologies that could have made France strong. While the most egregious material problems had been corrected by the mid 1950s, advocates of state planning still found much to complain about in the French *esprit*. For example, one former planner reminisced about an interaction between Etienne Hirsch, Haut Commissaire du Plan in the 1950s, and Monsieur de Wendel, the elderly, well-respected head of a steelworks. Hirsch had invited de Wendel to sit on the steel production commission of the Second Plan. De Wendel was puzzled, and replied: "But Mr. High Commissioner, what is this about? After the war you explained to us that we had to make a big effort to modernize the steel industry. We listened to you, we did it, we took risks . . . now we are modern!

So what could you possibly want to discuss?" Exasperated, Hirsch replied: "But Mr. de Wendel, modernity is not a definitive state! You made an effort to make up for a delay and modernize certain installations, but this effort will never be exhausted once and for all!"[88] The point of this anecdote, which opposed the old-style industrialist (the very figure who had supposedly caused France's downfall and who represented private industry's alternative to and antithesis of the technologist) and to the modern planner, was clear: the listener was supposed to be amused that the old man did not realize that modernity was not a physical condition, but a state of mind.

This idea that modernity began with a change in attitude pervaded the discourse of technologists throughout the 1950s and the 1960s. Many reproached the French for not thinking big. Armand located the roots of the French obsession with smallness in the nation's revolutionary tradition, which he interpreted as the revolt of the small against the large—of the artisan and the bourgeois against the landowner. This theme of smallness, he argued, dominated the mentality of the non-industrial middle classes (and a big part of Poujadiste discourse): "A 'small job,' a small shop, a small house, a small garden . . . no worries, a small game of cards, and above all no complications. . . . (But one day a big defeat!)"[89] The biggest reproach of the technologists, however, centered around the French conception of and approach to the future. The French could no longer stumble blindly into their future; they had to learn how to control their destiny. This involved cultivating *une attitude prospective.*

The notion of *la prospective* originated with the formation of the Centre International de Prospective. Though most of those involved would have identified with the label "technologist," a few were also humanists.[90] The Centre was intended to provide a place and a publication (the journal *Prospective*) for systematic and systemic reflection and action oriented around three related poles: "human problems" such as employment and education, the relationship between Western and other civilizations, and the consequences of new developments in science and technology. The Centre forbade itself from conducting "any political activity"—meaning corrupt ideological machinations or affiliations with political parties—and made a point in its publications of lambasting "ideological" modes of reasoning.[91] Above all, the Centre aimed at cultivating *une attitude prospective.*

What was this attitude? It was one turned toward the future, especially the far future. It differed from short-term forecasting, and it had to be cultivated by more far-sighted individuals. Gaston Berger, the president of the Centre, explained this using a military analogy:

It would be dangerous for a combat officer to be associated with peace negotiations because his role is to fight even while peace is being discussed. But it would be unforgivable for [national] leaders not to dream of peace while making war. In the adversary of today they must already see the colleague, the client, the friend of tomorrow. . . . It even happens fairly frequently that short-term actions must be taken in a direction opposed to that revealed by a study of the long term. Those who implement such actions must pursue them with vigor, but at a higher level, responsible leaders must calculate the importance of these actions and situate their exact position in events as a whole.[92]

In other words, "responsible leaders"—reminiscent here of the *chef* or the "man of action"—had to take *une attitude prospective.* This attitude was essentially systemic: it involved defining a goal and figuring out how human, technical, and economic factors could be synthesized into a plan of action. Ultimately, its advocates argued, this attitude would enable men to "control their destiny" rather than "submit" to it.[93]

Many highly placed technologists—Louis Armand, Pierre Massé, and François Bloch-Lainé among them—advocated *l'attitude prospective.* They took it to mean applying qualitative systems thinking to problems that were at once technological and social. Armand sought to define *la prospective* for national transportation systems, a subject he knew intimately. The issue for the future of transportation, he argued, was no longer maintenance but coordination—not just within subsystems like the railways, but also between subsystems. Airlines, railways, and roads should be coordinated to provide optimal transportation routes for travelers and goods. The current chaotic state of affairs, in which these subsystems competed with one another, merely demonstrated the "need for governments to apply notions of political economy which are the domain of operations research."[94]

Like modernity, *la prospective* was above all a state of mind. Taking *une attitude prospective* involved seeing life as a "continual invention."[95] It demanded intimate knowledge of "large new technologies" [*grandes technique nouvelles*], of which the two most important were atomic energy and cybernetics.[96] It was an activity for an "elite"[97] composed of "men of action"—"men who not only have a taste for moral or philosophical meditation, but also a concrete knowledge of men and the experience of command and responsibility."[98] The action in which men should engage involved synthesizing "all the means at the disposal of modern society in order to know and to predict, to organize, and to decide."[99] Like the other men involved in the Centre International de Prospective, Berger placed a heavy emphasis on real-world experience: "We do not seek to

operate a synthesis of knowledge and writings, but a synthesis of lived experience . . . only doctrinaires—inefficient but formidable—start with abstract ideas completely cut off from reality."[100] This experience provided a non-ideological foundation for action based on *la prospective.*

The central figure at the heart of *l'action prospective* was the engineer—not just any engineer, but an engineer who could take a *vue d'ensemble.* Such a systems thinker could master his destiny. He combated the defeatism of intellectuals: "If the myth of Sisyphus expressed our true condition, our engineers would have already discovered the means of using the regular fall of the boulder and Sisyphus, freed from repetitions, would devote himself to other tasks."[101] Invention provided the foundation for men to build their destiny; as such, the material world had spiritual value.[102] Berger evoked the myth of Faust to demonstrate this point. In the end, he said, Faust found fulfillment not through the gifts of the Devil but by working for other human beings. For this, God saved him from the Devil's clutches. "And what does this mean? This means that man had been a magician and became an engineer, but an engineer in the service of others. What is the magician? He is the one who uses spiritual forces for selfish goals. What is the technologist? He is the one who uses his work, his pain, his intelligence to bring to men and to others the things they need. Moving from magic to technology is not staying on the same level; it's substituting generosity for egotism."[103] Imbued with *une attitude prospective,* the engineer—leader, man of action, and systems thinker—could shape human destiny. This was "decidedly" not technocracy; it was simply good sense.[104]

What, besides a more rational, prosperous, and powerful nation, would the application of systems thinking produce? Armand put the answer very simply in an equation: "Technology + Organization = Culture."[105] While technological change could have disastrous effects, these could be averted by the application of heterogeneous, systemic organization. "Instead of dividing oneself to combat the noxious effects of technology through action inside companies, each firm, each industrial company must admit that progress supposes a larger discipline to which each must submit. This organization is indispensable to ensure the downfall of accusations levied against 'inhuman' technology."[106] The essence of all such action involved overstepping traditional boundaries, particularly those between technology and a certain kind of (presumably non-ideological) politics. In the words of another advocate of *la prospective*: "If the modern world demands an increasingly large number of specialized technologists and researchers, it is necessary that among and next to these a certain

number of young men be able to dominate their technologies in order to participate in the definition and implementation of general industrial policy. For this, they must be or become more than just technologists."[107]

Ironically, the qualitative systems approach that Armand thought would combat accusations of inhuman technology was precisely what many non-technologists found threatening. Jean Meynaud ridiculed Armand's equation, and was even more outraged when it appeared that even the members of the literary-minded Académie Française admired and trusted Armand enough to elect him. Armand interpreted this election as "the entrance of technology, flags flying in the wind" into the Académie.[108] Clearly, the attempt of Armand and others to trespass into the territories of politics and culture by imagining and implementing heterogeneous systems was exactly what social scientists like Meynaud found threatening.

La prospective essentially consisted of a qualitative approach to systems thinking: by taking into account human and cultural factors in their inventive efforts, engineers and other "men of action" had the means to set goals for the future and to trace out trajectories for attaining those goals. Though some advocated specific methods for delineating those plans—particularly the techniques of operations research—even they kept their contributions to the journal *Prospective* quite general. This was not the case, however, for the Plan.

The Plan

The Commissariat Général au Plan produced the ultimate instrument for shaping the future and destiny of the nation, the ultimate effort to constitute and define a large-scale system: the plans.[109] In the plans and their planners, the various themes examined thus far come together. The planner epitomized the technocrat—or the broad and forward-thinking technologist, depending on one's perspective. Architects and advocates of the plans often held them up as a quintessentially French achievement—the ultimate marriage of certain select traditions and modernity. Making the inevitable reference to Descartes, one enthusiast noted that "the effort toward increased rationality that the French plan represents conforms to one of our best national traditions."[110] Planners themselves promoted the plans as instruments not only of national cohesion and internal economic development, but also of national power. Consider the introduction to the fourth plan:

> . . . going beyond individual destinies, [the national goals of the fourth plan] define themselves as survival, progress, solidarity, [and] radiance. They consist of ensuring our defense by combining the modernization of the military with a reduction in its personnel, of giving research the material power necessary to ensure the full participation of the French spirit in the great scientific and technological enterprise of this century, of giving regions and less favored groups—be they the aged, repatriated soldiers, employees, or low-income farmers—concrete proof of a solidarity indispensable to national cohesion, and finally of pursuing our aid to the less-developed nations of the third world, especially those French-speaking African States which decided to keep special ties with our nation.[111]

Technological radiance and post-colonial geopolitics thus framed the fourth plan. Given such lofty goals, serving the Plan was not only an "ardent obligation" but potentially a quasi-religious experience: "inasmuch as the plans have become a necessity, all reticence is abnormal, even stupid. The only logical and efficient recipe is to make planification a psychological force of progress and solidarity. Serving the plans, participating in them at different levels, can feed the transcendence of each one [of us]."[112] Thus the plans could furnish a means for enacting the spiritual dimension of the material world. A quintessential manifestation of *la prospective,* the plans' very existence would turn the nation into a system.[113]

The plans would systematize the nation by providing information. Left to their own devices, private industries or organized sectors of the economy would, in the disastrous manner of the prewar period, pursue independent policies conceived from the sole point of view of the industry or sector in question. They would have no way of knowing how their actions affected other industries or sectors, nor would they know how the actions of others affected them. This ignorance might well lead them to make faulty decisions, not just in terms of the national interest, but potentially also in terms of their own interests. By providing decision makers with increasingly detailed maps of the infinite interconnections that bound the nation's economy together, successive plans would make possible a new kind of decision making: one that was not only more rational and efficient, but also more systemic. Indeed, it would ultimately be in everyone's best interest to work toward the national goals set by the plans (for the plans were not merely descriptive, but also prescriptive), even if in the short term these goals asked individuals to make decisions that appeared to go against their immediate interests. The whole would be bigger than the sum of the parts, and the parts would benefit in consequence. Hence describing and prescribing the system were also, in a sense, supposed to create the system (assuming, of course, that the actors

operating within it paid attention to the maps and prescriptions provided by the planners; assuming, in other words, that they accepted the notion of themselves as actors in a system).

More complex and sustained systems thinking in the Commissariat Général au Plan began with the fourth plan. The methods for elaborating the first three plans had been primarily qualitative, and even the most fervent admirers of state planning conceded that those plans had mattered primarily for psycho-cultural reasons, serving to change the *mentalité* of the French by articulating a dynamic, modern future. In contrast, the fourth and fifth plans—under the impulse of linear programming enthusiast Pierre Massé—were developed using a combination of qualitative and quantitative methods. As such, they pursued national-scale systems thinking far more intensely.

The first three plans had used material indices (such as industrial equipment) and simple economic indices (such as productivity and efficiency) in order to set goals for national economic and industrial performance. In contrast, the fourth plan sought to develop dynamic models that would describe the economy—and the social and material relations that drove it—as a whole. The economy was composed of overlapping heterogeneous "subsystems." These included diverse sectors (such as agriculture, industry, commerce, and transportation), geographic regions of the nation, economic constructs (such as balance of trade, consumption, savings, and investment), and socio-economic relationships (such as employment and the labor market). These subsystems interacted in complex ways. With the help of the mathematical services of the Ministère des Finances and the Institut National des Statistiques et des Etudes Economiques, planners aimed to model these interactions as closely as possible—even while viewing such models as necessarily imperfect because they could only incorporate statistically describable relationships and interactions.

Though they fell short of building a single model for the entire nation, planners did produce a set of models that together described the national economy as a heterogeneous system composed of technological and economic artifacts, individual decision makers, and social relationships, and driven by the interactions among these various components. Using these models, they defined an "optimum" growth rate. (This process of using models to define optima would become important in the technopolitics of the nuclear program, where it would derive legitimacy from its use in national planning.) They then turned the growth rate and parts of the models over to the modernization commissions. Convened separately

for each plan and not composed of expert planners, these commissions studied specific industrial, economic, geographic, or cultural sectors. On the basis of information they received from the expert planners, the commissions drew up tentative plans for their sectors. Finally, the expert planners collected these subplans and modified them in order to fit them into a system both described and constituted by the final plans.[114]

Intended to cover the period 1962–1965, the fourth plan outlined policy directions for a broad swath of French economic, industrial, social, and even cultural life. First and foremost came the need to develop scientific and technical research: ". . . the fate of a people is increasingly determined by the energy it deploys in opening new routes to knowledge, which is the very source of its radiance and the indispensable condition of the [continuous] renovation of its technologies."[115] Beyond this, the fourth plan set growth and development objectives for the sectors of the economy defined by its models, recommending for example that the nuclear industry seek to develop several different types of designs for power plants. Pointing to increasing international competition, it recommended that large industrial establishments pursue efforts to merge and to specialize. It set goals for urban development throughout the nation, recommending the destruction of dilapidated buildings, the construction of wide roads, and the creation of parks and sporting facilities in city centers. It introduced the idea of regional planning, and it outlined schemes for the modernization of rural areas.

In addition to outlining material development, the fourth plan promoted cultural harmony through technological and institutional means. A second television station would contribute to "increasing the information and cultural development of the population and to spreading the radiance of France beyond its frontiers."[116] Meanwhile, the construction of cultural centers throughout the nation would enable "culture" (which remained undefined) to "remedy that which often seems discordant and inhuman about technological civilization, . . . to penetrate the daily life of men and especially to become . . . as immediate a concern as hygiene and stable employment."[117]

The fourth plan thus represented an attempt to chart the future of the nation on every possible front. In theory, the national system that it conceived was open and unbounded. Even if some parts of the system could not be described quantitatively, and even if planners did not yet understand the precise mechanisms through which some of the subsystems or components interacted, ultimately no aspect of national life lay outside the whole. In greater or lesser detail, labor policy, industrial growth,

urban development, technological change, investment, and cultural enrichment could all be related to one another and planned for the greater good of a new, modern France. The modernity of the nation could be described, in some instances measured, and in all cases enhanced. And, sweeping as the fourth plan was, the fifth plan covered even more ground (particularly in the domain of regional planning) and used even more elaborate quantitative methods.

Clearly, these plans were hybrids of technology and politics in the broadest sense of both words. Indeed, the architects of the plans saw matters in precisely these terms. In a report written to promote the diffusion of the fifth plan's programming methods, one technologist wrote of the "simultaneously technical and political nature" of the plan's "elaboration process":

> On the political front this process is a mechanism for determining preferences, that is to say [a means of developing] social awareness and [making] political choices about goals and means. On the technical front, the goal of the process is to establish coherence. . . .[118]

Throughout its entire course, the planning process wove together technical and political methods: ". . . the kind of variables involved in the technical work [and] the determination of their values or of the relationships between them are themselves tied to explicit, or more often implicit, political choices. This web of political choices and technical work is woven during the preparation of the [fifth] plan. . . ."[119] While no one went so far as to argue, as we might, that the technical and political aspects of the process were indistinguishable, it seemed clear to all those involved that they were at least closely related, and furthermore that a close relationship was necessary for the success of the plans.

In a sense, taking a systems approach constituted an attempt to naturalize the erosion of the alleged boundary between technology and politics. Conceiving of the nation as a system and arguing that all its heterogeneous components were interrelated implied that all these components could be planned. In other words, all components—technological, regional, cultural, economic—fell within the purview of the planners.

The enrollment of an extremely heterogeneous group of people into the planning process provided a key means of enacting this erosion. While the group of expert planners remained small and select, the modernization commissions included a great variety of people: industrialists, labor union representatives, bankers, regional administrators, architects, urban planners, even a few artists and writers. Their participation was

meant to ensure the democratic character of the plans. It was also intended to promote compliance by increasing the investment of different social groups in the plans.

In a sense, the Plan as a whole attempted to enroll the entire nation in a broad program of sociotechnical development. Because the plans were not coercive, they could not impose an agenda on industrialists, workers, regions, banks, or flows of money. But they could attempt to persuade the nation to follow their lead. Their very existence was one form of persuasion, and the High Commissioners for Planning engaged in other forms by visiting politicians, regions, and industries to promote the plans. Witness, for example, how Massé described his job two decades after retiring:

> My profession was to send a message that would not falsify the truth, but that would be accessible to labor union members, politicians, [and] public opinion. I had to convince the Government to adopt my plan project, convince the Economic and Social Council to emit a favorable overall opinion, [and] convince Parliament to vote it [into effect]. I repeat the word 'convince' three time because this was an essential part of my job, carried out for seven years with a respectable measure of success. . . . In sum, I had a responsibility of a political nature that went beyond the mission of the experts.[120]

Here, politics was not ideological but persuasive, an essential part of making a technological nation.

*

In debating and enacting the relationship between technology and politics, technologists used a central trope—the radiance of France—to articulate and legitimate their place in postwar French society. This trope exuded historical referents, from the shining monuments of the Sun King to the glorious days of the French empire. By the same token, it encapsulated the crisis of national identity faced by France in the postwar period. Radiance was what France had lost in its wartime occupation and defeat and would continue to lose through the process of decolonization. And so radiance, that quintessential quality of Frenchness, was what technologists offered the nation.

Language, tradition, and esthetics would make technologies truly French, thereby performing the double operation of legitimating technology as an expression of national identity and preserving French uniqueness through the painful process of modernization. Thus embodying Frenchness, these technologies in turn would restore and enact French radiance throughout the world. Technology and Frenchness would shape each other.

Evoking the radiance of France in discussions over modernization represented an effort to generate agreement over technological development. Almost everyone could agree on the desirability of French radiance. In appropriating this trope, technologists hoped to generate similar support for technological prowess. They also sought to become the legitimate leaders of modernization more generally, portraying themselves as decisive "men of action." In the process, they blurred not only the boundaries between technology and (French) culture but also those between technology and politics.

For many social scientists, humanists, and politicians, the erosion of the boundary between technology and politics threatened the very foundations of democracy. Technologists, however, presented it as necessary to social and economic progress on all fronts. Systems thinking provided an ideal means for naturalizing and enacting this erosion. If heterogeneous elements were related to each other in identifiable, describable, controllable ways, and if technologists could predict and control these systems, then they could engage in politics better and more reasonably than could politicians. Such systems thinking was composed of a series of qualitative and quantitative practices—*la prospective*, planning, optimization—which came to constitute the basic toolbox of state technologists.

When arguing with social scientists, pleading for a modern future, grandstanding in *La Jaune et La Rouge*, or sitting on planning commissions, technologists generated a set of concepts and practices that they could mostly agree about. Matters grew considerably more complex when it came to enacting the technopolitics they advocated so enthusiastically. They agreed on the ideal of a technologically radiant France, but they did not necessarily agree on the best route toward that ideal.

2

Technopolitical Regimes

Before I began interviewing engineers about their involvement in the development of nuclear power, I expected our conversations to be dry, technical affairs in which these men would describe their small corner of reactor design and indignantly deny that their work had political or social components. My expectation arose from two sources. First, much scholarship argues that scientists and engineers expend a good deal of energy denying the political, social, or cultural, dimensions of their activities. Donald MacKenzie demonstrates this point particularly forcefully in regard to the engineers involved in the development of nuclear missile guidance in the United States.[1] Second, many American commentators argue that nuclear technology has been "depoliticized" in France. By this they mean that parties across the political spectrum agree that the nation should pursue both nuclear power and atomic weapons, and that there is little or no public debate about these choices.[2] Anticipating, then, that direct attempts to address the political aspects of technological work would induce suspicion and mistrust, I resolved to begin my interviews by asking about the "scientific and technical" decisions in which my informants had participated. I hoped that a discussion of technical details would lead, discreetly and indirectly, to comments about the political and social aspects of nuclear engineering.

My first appointment was with a man who had been a project engineer for six gas-graphite reactors. By the time I met him, he was a high-level manager with an enormous, sumptuously furnished office in EDF's headquarters. I tried hard not to feel intimidated as I sat down in front of his vast, polished wood desk. In hopes that challenging gender stereotypes would counterbalance the disadvantage I felt as a young woman interviewing a much older male expert, I had worn a suit and tie. I quickly established my technical credentials, reaffirming (as I had already explained in the first paragraph of my query letter) that I had a degree