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Why Compare?

Biotechnology politics and policy are situated at the intersection of two profoundly destabilizing changes in the way we view the world: one cognitive, the other political. This unique position makes the project of using the life sciences to improve the human condition anything but straightforward. It also makes biotechnology a particularly apposite lens through which to compare the triumphs and tribulations of late capitalistic technological democracies.

On the cognitive front, the shift is from a realist to a constructivist view of knowledge. Years of work on the social construction of science and technology, and the contingency of similarity and difference judgments,[1] have taught us to be skeptical of absolutist claims concerning objectivity and progress. Scientific knowledge, it is now widely accepted, does not simply accumulate, nor does technology invariably advance benign human interests. Changes in both happen within social parameters that have already been laid down, often long in advance.[2] In the field of environmental regulation, for example, concepts of risk and safety, methods of compiling and validating data, ideas of causation and blame, and (crucially for biotechnology) even the boundary between "nature" and "culture" have all been shown to reflect deep-seated social assumptions that rob them of universal validity.[3] The methods with which policymakers carry on their business similarly cannot be taken as neutral, but must be seen as the result of political compromise and careful boundary maintenance, favoring some voices and viewpoints at others' expense.[4] The criteria by which one measures policy success or failure are likewise products of negotiation; in applying them, one implicitly adopts contingent, locally specific standards of reliability and validity. The special

authority of scientific claims is in competition with other representations of reality diffused through the global media, and scientific expertise is subject to appropriation by multiple, diffracted social identities and interests.[5] Any attempt to compare the performance of national policy systems today must take these complexities into account.

On the political front, the shift is toward a fracturing of the authority of nation-states, with consequent pressures to rethink the forms of democratic governance. State sovereignty is eroding under the onslaught of environmental change, financial and labor mobility, increased communication, the global transfer of technical skills and scientific knowledge, and the rise of transnational organizations, multinational corporations, and social movements.[6] Supranational concerns, such as the demand for free trade or globally sustainable development, are gaining political salience,[7] but they are at the same time encountering resistance from tendencies toward greater local autonomy based on particularities of culture and place.[8] As a result, the "old" politics of modernity—with its core values of rationality, objectivity, universalism, centralization, and efficiency—is confronting, and possibly yielding to, a "new" politics of pluralism, localism, irreducible ambiguity, and aestheticism in matters of lifestyle and taste.

These flows and movements have attenuated the connections between states and citizens, calling into question the capacity of national governments to discern and meet their citizens' needs. Yet we live in a time when knowledgeable citizens are more than ever demanding meaningful control over the technological changes that affect their welfare and prosperity. Many therefore see this epoch as a proving ground for new political orders whose success will depend, in part, on our learning to live wisely with our growing capacity to manipulate living things and our equally growing uncertainty about the consequences of doing so.

There is little question that genetic engineering, along with the cognitive, social, and material adjustments made to accommodate it, will form an essential part of the politics of the twenty-first century, just as it did of the political history of the preceding three decades. Attempts to deploy biotechnology for the public good, and to ensure democratic control over it, touch the political and cultural nerve centers of industrial nations in the global economy. These efforts are *political* in the sense that they centrally concern the production and distribution of societal benefits and risks; they are *cultural* in that, by intervening in nature, biotechnology forcefully impinges on social meanings, identities, and forms of life. Comparison among national and regional debates surrounding biotechnology should therefore help us identify and make sense of the wider political realignments that are taking place around us at this moment. Comparison may even help us decide which courses of action we wish to follow, as individuals or as political communities.

But how should such a project be organized? What should we compare, using what methods, and with what ultimate hopes of illumination?

Comparison, particularly in the policy field, has historically been driven by a faith in the possibility of melioration through imitation.[9] Analysts assumed that they could objectively evaluate which agency, nation, or political system was "doing better" at implementing particular policy goals; such findings then were supposed to assist policymakers elsewhere in deciding which course of action to follow. While one should not denigrate this practical ambition, one should likewise not take its feasibility for granted. With growing awareness of the culturally embedded character of both knowledge and policy, there are reasons to be skeptical of unproblematic learning from others' experiences. The insights gained from comparative analysis suggest, indeed, that neglecting cultural specificities in policymaking may be an invitation to failure within any political community's own terms of reference. Comparative studies of science and technology policy today need a different justification than simply the propagation of improved managerial techniques. Rather than prescribing decontextualized best practices for an imagined global administrative elite, comparison should be seen as a means of investigating the interactions between science and politics, with far-reaching implications for governance in advanced industrial democracies.

But if deeper social and political understanding is our goal, what conceptual tools should we bring to the task of comparison, and how should these differ from past approaches? This chapter lays out the case for a new kind of comparative analysis—one that retains nation states as units of comparison but is organized around the dynamic concept of political culture, rather than the more static categories of political actors, interests, or institutions. My aim is to explore the links among knowledge, technology, and power within contemporary industrial democracies and to display these links from the standpoints of those situated within particular cultures of action and decision. This approach illuminates how political culture plays out in technological debates and decisions—most particularly how it affects the production of public knowledge, constituting what I call the civic epistemologies of modern nation states. The methods I adopt for this purpose owe as much to the history and sociology of knowledge and the anthropology of technological cultures as they do to comparative politics, policy studies, or law. Interpretive methods, I hope to show, are especially well suited to investigating the complex reception of novel science and technology into a nation's political life.

I begin the chapter with the theoretical considerations that will guide my comparison of biotechnology debates in Britain, Germany, and the United States. I then discuss the organization of the study, including the reasons for selecting these three countries as cases for comparison and biotechnology as the lens through which to compare them. I conclude with a brief outline of the remaining chapters.

CHAPTER 1

Beyond State and Structure: Theoretical Considerations

Comparative analysis is a relative newcomer to the study of social engagements with science and technology. As little as twenty years ago, the comparison of national policies significantly implicating technical questions—on issues such as public health, pharmaceutical drug regulation, industrial and occupational safety, and environmental protection—was still in its infancy. Up to that point, cross-national research on the politics of science and technology was constrained by a number of unspoken assumptions that cast doubt on the utility of comparison.

Reasons for the initial neglect included, to begin with, a firm belief in the universality of science. Political systems might differ, but science was held to be everywhere the same. The influential American sociologist Robert K. Merton spoke for this viewpoint when he represented "universalism," or the invariability of knowledge across political and cultural domains, as one of the core norms of science.[10] Also militating against expectations of cross-national variation was the widely accepted thesis of technological determinism, which holds that technology's inner logic, founded on its material characteristics, bends human institutions to suit its development trajectories.[11] Economic determinism provided an analogous argument from the social sciences, suggesting that, even if national policies initially diverge, competitive pressures in an increasingly interdependent global marketplace will eventually overwhelm such differences.

These ideas resonated in the field of political science, where the dominant school of thought held that technically complex decision making takes its color more from the nature of the issues than from features of national culture or politics. Policymakers everywhere, so the reasoning went, would be compelled by the same scientific, technical, and economic considerations; policies would therefore converge, and little insight would be gained from comparing national approaches over time. These views are still represented in some contemporary political writing, but this book argues that, in its narrow focus on decision outcomes and its failure to problematize the foundations of knowledge, such work misses important differences and regularities among contemporary cultures of democratic politics.[12]

Comparative analysis came into vogue in the 1980s as an instrument for advancing well-recognized and widely appreciated social objectives. In a world increasingly committed to economic and political integration, government and industry (if not always the noneconomic organs of civil society) shared an interest in lowering trade barriers by harmonizing regulations. Comparative research was seen as a useful aid to this project: as a means of highlighting areas where policies and values remain significantly divided, thus paving the way for negotiation and cross-national agreement. The capacity of policy institutions emerged as an important topic of comparison

in studies of technically grounded regulatory fields such as environmental protection,[13] where success depended on the will and ability of state authorities to monitor and enforce compliance with complex legal obligations. Comparative study, according to advocates of transnational capacity-building, provided helpful lessons in how to improve the effectiveness of administrative institutions.

In this first wave of comparative analysis, policies were assumed for methodological purposes to be discrete and singular, with ascertainable causes and determinate consequences. A great advantage of this method was that it offered built-in criteria for comparison and evaluation. The policy process could be parsed into separable stages (for example, agenda-setting, legitimation, implementation, evaluation, and revision) that followed each other in linear succession and could be compared from one political context to another.[14] Since impacts were taken as clearly marked and objectively measurable, questions about the relative performance of states in meeting their goals also seemed unproblematic. States and citizens, at least within similar political systems, were presumed to want the same goods: health, safety, jobs, patents, new drugs, higher agricultural productivity, a cleaner environment, and so forth. In this intellectual framework there was nothing awkward about asking which political system produces the most responsive policies, affords the most protective standards, fosters the most innovation, fuels the most economic growth, or most effectively resolves political conflict. Only in the light of empirical research did these presumptions have to be reconsidered and sharply modified.

The First Wave Breaks: National Styles of Regulation

In the early 1980s several studies of health, safety, and environmental regulation in Western countries put to rest the notion that policy strategies and outcomes are uniquely determined by economic, scientific, or technological considerations. Regulation, it emerged, displayed distinctively national characteristics, leading to observable differences in the timing, priorities, forms, and stringency of interventions.[15] Scientific evidence was shown to carry different weight in different policy environments, its interpretation conditioned by homegrown traditions of legal and political reasoning and habits of deference or skepticism toward expert authority. Cultural influences seeped into the very heart of technical analysis. Confronted by ostensibly the same research results, governmental agencies in one country concluded that a product or activity posed no risks to health or the environment, but in another held that it was unacceptably hazardous and should be banned or strictly regulated.[16] When decisionmakers reached broadly similar policy endpoints, they often did so through different routes of reasoning and public justification.[17] Patterns of interaction between regulators and regulated parties, as well as the

reliance on particular policy procedures and discourses, appeared firm enough to warrant the label "national styles of regulation."

Contrasts between U.S. and European approaches to managing risk seemed especially pronounced. Researchers were struck by the open and adversarial processes of rulemaking in the United States, the frequent resort to litigation, and U.S. agencies' significantly greater reliance on formal, quantitative measures of risk, costs, and benefits. Such systematic divergences invited explanations based on differences in the structure of political institutions. Comparative studies, like much other political analysis of the period, initially looked to the state for explanations, and to the relatively fixed "opportunity structures" it provides for political action.[18]

In the U.S. case, it took little prompting to see that the regulatory landscape is molded to an extraordinary degree by institutions that invite public expressions of skepticism and distrust. A constitutionally ordained separation of powers not only facilitates rivalry between Congress and the executive branch but also authorizes the courts to review the basis of administrative rules. Low entry barriers to the courts and an activist judiciary provide generous opportunities for interested parties to challenge decisions contrary to their immediate interests.[19] Citizens' capacity to take issue with, and hence to deconstruct, claims made by the state is strengthened through laws that require open meetings and disclosure of relevant technical information. At the same time, the relative dearth of vertical hierarchies and horizontal networks of cooperation impedes the kinds of informal negotiation and consensus-building that are found in European (and, outside the Western tradition, Japanese) policy formation.[20] All these entrenched attributes of politics heighten the vulnerability of U.S. policymakers, supplying plausible reasons for their distinctive approach to rationalizing policy decisions.

The argument from national political structure was particularly effective in explaining U.S. agencies' hankering for objectivity based on numerical calculations. Operating in a fishbowl of transparency, with significantly less protection from civil service traditions or legal insulation than their European counterparts, American regulators were not free to justify their actions by simply invoking delegated authority or superior expertise; they had to establish through explicit, principled argument that their actions fell within a zone of demonstrable rationality.[21] Numerical assessments of risks, costs, and benefits provided compelling evidence. European regulators, by contrast, seemed generally better able to support their decisions in qualitative, even subjective terms. Expert judgment carried weight in and of itself as a basis for action, the more so when backed by negotiation among relevant parties; there was on the whole less need to refer to an exogenous method, model, or logic to support policy decisions.[22]

These variations, moreover, were not accidental but rooted in longstanding practice, as the historian Theodore Porter documented in his comparative

study of social accounting methods.[23] Already by the mid-twentieth century, experts of the U.S. Army Corps of Engineers had begun to insist on the objectivity of the cost-benefit analyses with which they justified flood-control projects. Whereas British actuaries and French railroad engineers admitted that their cost-benefit calculations reflected professional judgments, Corps engineers stoutly maintained that their assessments were not so compromised: *their* numbers were not subjective estimates but reliable representations of reality.

Time, however, has helped expose problems and puzzles that reduce the appeal of explanations based on state structures as basic determinants of national policy choices. The issues are both theoretical and empirical. The theoretical dilemmas reflect most importantly the rise of poststructuralist thought and the attendant difficulty of taking entities such as "science," "state," or "society" for granted as stable units of analysis. All these concepts have to be seen instead as historically situated, contingent, dynamic constructs, whose form and fixity are as much in need of explanation as they are available for explaining other developments. That states remain reasonably constant in their institutional structures, for example, let alone in their modes of action and self-legitimation, cannot simply be assumed as given. The analyst has to show how such continuities are maintained, if indeed they are, and why transformative political opportunities are either embraced or avoided by ruling institutions. For comparative analysts, this means that state structures must be regarded as both dependent and independent variables; similar conclusions hold with respect to science, technology, and society, the other macroformations of importance to this comparative study.

Support for this more fluid way of thinking about "social kinds" such as the state comes particularly from the field of science and technology studies (S&TS).[24] More than most branches of the social sciences, S&TS concerns itself with the nature and power of the categories and objects by which we organize our knowledge of the world.[25] Central to the S&TS enterprise has been to ask how societies produce authoritative knowledge and functioning technological artifacts. Through such investigations, it has been possible to demonstrate that the products of the sciences, both cognitive and material, embody beliefs not only about how the world *is*, but also how it *ought* to be. Natural and social orders, in short, are produced at one and the same time—or, more precisely, coproduced.[26] The apparent firmness of the devices with which we make sense of our existence, then, is maintained through more or less purposive action by identifiable actors. Accordingly, to understand how social entities such as "the state" or natural entities such as "the gene" function in the world, one has to ask how diverse actors use and understand the concept, how it is articulated through formal and informal practices, where and by whom it is contested, and how it reasserts itself in the face of challenges to its integrity or meaning.

Put differently, explanations based on variables such as national styles of regulation run into difficulty by failing to ask why some social structures or processes are seen as more deterministic than others. Why are certain features of the world taken as given or independent, while others are assumed to be shaped and directed by, hence dependent on, those fixed parameters? The structuralist literature on social movements, for example, commonly attributes the strength and effectiveness of activists to differential opportunity structures provided by state institutions; similarly, following John Kingdon, students of political agenda-setting have suggested that new items emerge from the interaction of contingent events and agile social entrepreneurs with relatively unchanging frameworks of politics and policymaking.[27] Yet social theorists from Michel Foucault to the political sociologist Theda Skocpol[28] have shown that social actors can make or remake the opportunities for intervention, often using knowledge as an instrument for modifying existing possibilities.[29] Social structures, in other words, are not immutable; they change in the very process of enabling actors to use them.

Recent work on social movements has engaged with active processes of meaning-creation that frame problems for collective action, build communal identities, and allow actors to mobilize against perceived injustices. To quote one distinguished team of converts:

> We come from a structuralist tradition. But in the course of our work on a wide variety of contentious politics in Europe and North America, we discovered the necessity of taking strategic interaction, consciousness, and historically accumulated culture into account. We treat social interaction, social ties, communication, and conversation not merely as expressions of structure, rationality, consciousness, or culture, but as active sites of creation and change. We have come to think of interpersonal networks, interpersonal communication, and various forms of continuous negotiation—including the negotiation of identities—as figuring centrally in the dynamics of contention.[30]

Political analysis that denies this kind of agency to activists operates with a much reduced, mechanistic model of human behavior. It overlooks the potential for altering the terms and conditions of political debate and overestimates, as a result, the invincibility of the status quo.[31]

Empirical findings from the first wave of comparative policy studies also point to deficiencies in structuralist and state-centered modes of explanation. Over the past thirty years, for example, industrial nations have often converged on which health, safety, and environmental problems merit legislative or regulatory attention, but there is much less uniformity in how the issues are characterized and which solutions are deemed most suitable for resolving perceived problems. Biotechnology is no exception. Although it has called forth roughly similar cycles of regulatory attention in Europe and the United States, biotechnology has given rise to quite different national discourses of

risk and safety, naturalness and artificiality, innovation and ownership, constitutional rights, and bioethics.[32] To account for these divergences, we must ask how policy problems were construed in different political cultures. What did biotechnology mean to the actors opposing, advocating, or seeking to manage its further development? Once we turn to this interpretive domain, we quickly discover that the attribution of meaning to new technologies cannot be accounted for in terms of structured variances in national styles of regulation. Binding differences come about without overt action by political leaders or, as noted earlier, by any deterministic guidance from science, technology, bureaucratic organizations, or the invisible hand of the market.

A further empirical challenge has to do with shifts in the articulation of policy objectives, both within nations and across them. Political structure, with the provisos noted above, does predictably well at accounting for continuities such as those captured by the concept of national regulatory styles, but it is dismayingly helpless before questions of change. Why, for example, did the focus of environmental policy change from pollution control in the 1960s to prevention in the 1970s, sustainability in the 1980s, and precaution in the 1990s? Why did U.S. policy in the 1980s display greater concern for chemical risks than policies anywhere in Europe but then shift to greater complacency with regard to biotechnology just a decade later?[33] Where, more generally, do new policy ideas come from, who are the agents of their dissemination, and how are they institutionalized and reembedded into existing political arrangements? Questions such as these call for a dynamic exploration of political discourses and actor coalitions that extends beyond the formal power centers of the state.[34]

Revisiting Political Culture

All of the foregoing suggests that culture—more particularly political culture—matters in shaping the politics of science and technology. For the purposes of this study, political culture refers to systematic means by which a political community makes binding collective choices. The term encompasses institutionally sanctioned modes of action, such as litigiousness in the United States, but also the myriad unwritten codes and practices with which a polity supplements its formal methods of assuring accountability and legitimacy in political decisionmaking. Political culture in contemporary knowledge societies includes the tacit, but nonetheless powerful, routines by which collective knowledge is produced and validated. It embraces institutionalized approaches to reasoning and deliberation. But equally, as we shall see, political culture includes the moves by which a polity, almost by default, takes some issues or questions out of the domain of politics as usual. An important part of this book's argument is that political authority in the management of science and technology derives not only from the formal and informal rules

of political practice, but also from less explicit cultural commitments to forms of legitimation that fill out the routines of what we think of as normal politics.

The analysis of political culture seeks to capture the stabilities in social practices and meaning making while getting below the bland surfaces of formal politics and decision making. Yet the skeptical reader may question whether the transfer of explanatory energy from "state" to "political culture" solves anything or only muddies the analytic waters. After all, while states and their organs are relatively easy to locate, with boundaries demarcated by physical space and formal practices, culture is a notoriously slippery concept, and anthropologists have struggled long and hard against using it in a reified, uncritical, totalizing, even patronizing manner.[35] Can we avoid these difficulties in operationalizing a cultural perspective on politics and, if so, by means of what categories?

We must, to begin with, use the term culture judiciously in this context, not invoking the analyst's labeling prerogative mechanically or asymmetrically (culture as the marker of the other, not of ourselves[36]); we need always to ask how actors within a culture make sense of their own confusions and predicaments. As a "social kind" in its own right, political culture must be seen not only as resilient and resistant to change, but also as constructed, flexible, and subject to renewal. The comparative strategy of this book is geared toward making just such a reading of political culture more tractable and analytically useful.

We should not underestimate the difficulty of this project. Particularly troubling for analysis is the recognition that systems of knowledge and belief about the natural world are not built independently of the social worlds within which they are embedded. Evidence from many quarters points to a subtle and multidimensioned process of coproduction, in which problems of society and problems about nature are simultaneously addressed and resolved.[37] So, at the dawn of the scientific revolution, seventeenth-century English gentleman-scientists like Robert Boyle, a founder of Britain's Royal Society and pioneer in studying the properties of air, devised ways of conducting and publicly reporting their experiments that furthered not only new regimes of fact-finding but also new regimes of governance. As practices of "witnessing" science, such as peer review, gradually took hold, there was an associated move away from absolute monarchical power and the divine right of kings toward a more democratic politics, in which citizens gained standing to evaluate the performance of those in power. The practices of science and of liberal democracy flourished together.[38] In time, new systems of classification, counting, and standardization developed to sustain the modern nation state, with its far-flung economic and military enterprises, its need for centralized administrative control, and its ever-recurring quest for credible and demonstrable successes.[39]

The continual interpenetration of political choices or commitments and the production of reliable knowledge raises obvious difficulties for comparison. One difficulty has to do with the analyst's own standpoint. Lele tribesmen in Africa,[40] sheep farmers in the north of England,[41] and expert U.S. regulatory agencies[42] all determine what is risky in their environments in accordance with specific, situated needs for order and meaning; each chooses to label some things as dangerous and ignore others that visitors from other worlds might find "objectively" more so. Where, then, is the Archimedean point from which we can begin to assess the performance of alternative systems of governance? A second problem concerns the pinpointing of causes for purposes of explanation. The framework of coproduction suggests that the state's instrumental goals, the knowledges and practices adopted for achieving them, and the applicable standards of credibility and legitimacy are all constructed together through a unitary process of ordering the world. How, then, can we presume to explain outcomes in terms of distinct and independent causes? In William B. Yeats's beautifully apposite metaphor, how can we know the dancer from the dance?[43]

Clearly, there is a need for new methods and new conceptual approaches. The field of comparison has to be more creatively mapped and explored than in earlier studies that looked primarily at clusters of similar policy actions, with identical, context-free life-cycles, and tried to identify their alleged causes and consequences. To understand how policy domains are carved out from the political sphere and rendered both comprehensible and manageable, we must employ analytic categories different from those of decision makers operating within the policy process. We need a conceptual language that can grapple with both continuity and change, while rejecting some of the rigidities of structure.

Framing

A good way to begin is by asking how issues are framed for public action in democratic societies. Erving Goffman's path-breaking sociological work showed that there is nothing intrinsic or externally determined about how people organize their experiences or how they choose to imagine the causes and effects of particular phenomena.[44] Goffman's approach has been augmented by a rising interest across the social sciences in the narrative, discursive, and textual dimensions of human behavior, which in turn has opened up a rich seam for the interpretation of political action.[45] From this perspective, the regulation of science and technology, whether to further innovation or control risk, can fruitfully be seen as a kind of story-telling by communities situated in particular times and places who are attempting to deal with unsettling or disruptive changes in their environments.

Stories told in the policy arena attempt to order and make sense of complex experiences; they enable people to take meaningful action and so reduce

their feelings of helplessness and alienation. The intersubjective, or communally held, cognitive frames constructed in this process, often embedded in material objects and routinized social practices, impose discipline on unruly events by creating understandable causal relationships, identifying agents of harmful behavior, and finding solutions that convey a sense of security and moral order. Of course, "real" disruptive events happen all the time, such as the birth of the cloned sheep Dolly in Scotland or the destruction of the World Trade Center in New York, and theories of framing do not deny those realities. Rather, framing allows us to see that events do not in and of themselves dictate the pathways along which public responses will move—nor even necessarily provoke any political action.[46] Events first have to be set within an interpretive context that allows them to function as a starting point for deliberation or concerted action: so Dolly's birth announcement became a challenge for "bioethics," and the September 11, 2001, attacks were cast as grounds for a "war on terror."[47]

Framing policy problems is an intensely social activity, as Goffman and other analysts have argued;[48] yet as frames embed themselves in social behavior and material culture, they fundamentally alter people's perceptions of what is real in the world around them. The sociologist Joseph Gusfield offered an instructive, policy-relevant example.[49] Years of "random" car accidents that killed mostly people in their teens and early twenties were at one point reinscribed on the U.S. national consciousness as the "problem" of "drunk driving." New coalitions of distraught mothers and other accident victims began to push for legislation to curb what, until that moment, had been dismissed as random tragedies, permitting no mandatory social correctives.

The ensuing reframing was not preordained to happen, nor did it have to happen in exactly the way it did. To illustrate some of the contingencies of framing, we can revisit Gusfield's account of drunk driving with insights gained from a theory of sociotechnical systems, *actor-network theory*, which sees technology as a heterogeneous network of human actors and nonhuman actants.[50] As the frame of social awareness shifted from random accidents to drunk driving, the automobile emerged, if only for a moment, from its casing of enameled steel as a thing of many parts, tied to various hard and soft components—objects, actors, rules, practices—in a complex (and hazardous) network of road transportation. As if endowing its users with x-ray vision, the frame of drunk driving permitted society's movers and shakers to detect all kinds of once invisible nodes in the network where intervention now seemed possible in the interest of saving lives: raising the drinking age; penalizing innkeepers and even private party-givers who allowed drinkers to go on the road; mandating seatbelt use; reducing speed limits; and requiring cars themselves to be engineered with new safety features such as airbags and antilock brakes. These heterogenous elements were pulled together through a messy period of social experimentation, producing a new regime of automobile safety regulation.

In contrast to the notion of political agenda-setting, which takes for granted the shape of political issues, framing implicitly makes room for the contingency of social responses and the partiality of the imaginative space that is carved out for political action in any society. Not every culture that looks at a set of events necessarily frames them in the same way. Things within the frame for one group of actors (such as innkeepers, party-givers, and speed limits in Gusfield's case[51]) may fall outside the frame for others, even if all have accepted drunk driving as a policy priority. Selectivity is inevitable in the construction of frames, but so too, we will see, is cultural conditioning. Framing in this way usefully occupies a middle ground between the contingent and the determined.

Sociological in its origins, the idea of framing has moved into wider worlds of political analysis, some with specific resonance for this study. A raft of disciplinary specialties, from social movements theory to cognitive psychology, have taken on board that representations matter as much as whatever we may choose to call reality in shaping social behavior. Political inquiry correspondingly has expanded to include both the making of powerful representations and their effects on public attitudes and actions. In one working out of these ideas, the comparatist Juan Díez Medrano has argued that national differences in attitudes toward European integration reflect how citizens in various member states frame the idea of Europe.[52] Medrano conceives of framing largely as a cognitive process and is concerned primarily with how European nationals speak about integration. He uses the concept of *cultural preoccupation* "to encompass very general beliefs, symbols, and images as well as more concrete topics of discussion in a particular society."[53] While interviews and survey data can be used to identify some of these recurrent discursive and cognitive elements, the problem for S&TS scholars interested in framing is more complex. The durability of frames, too, has to be accounted for. To explain the cognitive and political staying power of frames, we need to know about the diversity of materials with which they are constructed, how they achieve taken-for-granted status, and what happens to make frames change.

Frames offer rich resources for interpretive analysis, but they are also potentially treacherous instruments. Frames may overlap, for instance, with the "same" object, action, actor, or relationship occupying a position in more than one but carrying quite different meanings and entailing different normative obligations in each. Thus, the human embryo may be represented as a person-in-the-making in the informal practices of an in vitro fertilization (IVF) clinic or an "adoption agency" that "places" it for implantation.[54] At the same time, it may be denied personhood under laws governing abortion or compensation for personal injury. Such slippages, if widely perceived as contradictions, may produce incentives for reorganizing collective understandings of kinds and categories into new, more coherent and encompassing

frames. Framing, in short, provides an effective way of accommodating the solidity as well as the interpretive flexibility of the worlds in which policy gets made—a feature that will emerge with great clarity in the comparisons that lie ahead.

Boundaries

Genetic engineering threatens or calls into question many of the categories that have been accepted as foundational in the ordering of societies, both ancient and modern. These include the fundamental divisions between nature and culture, moral and immoral, safe and risky, god-given and human-made. The molecularization of the life sciences, which enables us both to "read" and to manipulate characteristics beneath the visible surfaces of living entities, poses particular challenges to principles of governance based on older orderings and classifications. The grand project of mapping and sequencing the human genome, hailed as the holy grail of genetic science, has revealed that the lowly mustard weed has almost as many genes as we do.[55] We can import genes from spinach into pigs, from jellyfish into rabbits, and from fish into tomatoes; the technique of xenotransplantation allows cells from genetically altered pigs or chimpanzees to be inserted into biologically compatible humans. We can contemplate altering the human genome so as to produce enhanced human beings, with characteristics that today would be regarded as out of the ordinary, even superhuman. What, then, is nature, and what is being human?

The process of rebuilding order from confusion on points like these requires that problematic entities or behaviors be fitted if possible on one side or the other of conceptual divides that societies take to be foundational. The divisions that matter to a culture must not be allowed to break down. They are essential to maintaining cultural integrity, as anthropological studies incessantly remind us. Sociologists use the term "boundary work" to describe the creation and maintenance of essential social demarcations.[56] Boundaries are everywhere at play in the world, exercising enormous influence on thought and action, although they are produced in many cases through processes that are all but invisible even to the most energetic participants. Lawyers, for instance, make and remake the boundaries between acceptable and unacceptable behaviors while claiming to "find" these demarcations within the law. A major function of policymaking for the life sciences is to create and maintain boundaries that correspond to people's preexisting ethical and social sensibilities concerning the products of biotechnology.

How risky is it to admit into society biotechnological products that ambiguously straddle cognitive and social boundaries? Bruno Latour has argued that the urge to "purify" the "hybrid" networks of our high-tech world—for instance, the genetically engineered mouse or the ozone hole—into metaphysically pristine categories of the natural and the social is essential to

maintaining order. He sees the nature/culture divide as so basic to modernity as we understand it that he terms it "constitutional."[57] The sociologist Zygmunt Bauman, too, attributes to modernity's "gardening instinct" a relentless desire to root out ambivalence in all its forms;[58] nature/culture hybrids that cross the conventional boundaries of moral thought represent but one challenge to this thirst for purity and order. Approaching similar problems as a cultural anthropologist, Mary Douglas argued that judgments about purity and danger are linked to the need for stability in social structures, whether against foreign invasion or within the hierarchy of groups. Work in the sociology of science, however, has also called attention to products of science and technology that come to occupy a valued social or moral position precisely because they resist being disambiguated: as "boundary objects," they serve as repositories of multiple meanings.[59] Legal terms often perform this function, as for example in international law, where a concept like "sustainable development" gains adherents through its very ability to accommodate diverse viewpoints and interpretations.

Indeed, perhaps the most influential form of boundary work in contemporary societies is done by legal institutions as they try to sort the infinite variety of human actions and their consequences into finite and pragmatic conceptual categories.[60] Should animals with altered genes be regarded as inventions for purposes of patent law? Should embryos be seen as persons, property, or some sort of hybrid, partaking of the properties of both? Should people be allowed to "own" their tissues and cells once scientists have extracted them for research purposes and given them independent existence as "immortal" cell lines? But politically significant boundary work also takes place in a multitude of more specialized forums that are less transparently in the business of boundary maintenance than legislatures or courts, such as expert advisory committees, parliamentary commissions, ethics review boards, and nongovernmental organizations.[61] The functions, processes, and methods, as well as the achievements, of boundary work will form important dimensions of comparison in succeeding chapters.

Institutional Reasoning and Discourse

Institutions have traditionally played a starring role in comparative analysis. Governmental bodies, in particular, as the organs through which policy is formally articulated and implemented, are the places one turns to first for evidence of political mobilization and policy change. Usually, the focus is on what institutions do rather than how they do it, or how they think,[62] but with growing interest in the political role of ideas—their origins, power, and dissemination—institutions have attracted renewed attention as sites for interpretive analysis. This is reflected in the work of the new institutionalists, who recognize the capacity of institutions to embody meaning, create social

relationships and symbolic orders, and "set the limits on the very nature of rationality."[63] A concrete result of this shift is the need to look at the political and policy discourses used by institutions as objects of analysis. In a book about biotechnology, the discourses of risk assessment, bioethics, and intellectual property law have special relevance as instruments for framing issues, ordering new knowledge, and (re)allocating power. How these discourses vary across national lines and actor groups becomes part of the agenda of comparison.

Because genetic engineering transgresses some of the most deeply entrenched categories of Western thought, the institutions that promote and regulate biotechnology are particularly likely to be involved in the production of novel ideas, norms, and meanings. Religious, moral, practical, and aesthetic ideas, according to the anthropologist Clifford Geertz, must be "carried by powerful social groups to have powerful social effects; someone must revere them, celebrate them, defend them, impose them."[64] Biotechnology touches on all these kinds of ideas, as well as on scientific ones, which Geertz (perhaps because he was writing about Indonesia, but perhaps also because he was unconsciously reproducing modernity's foundational nature/culture divide) did not explicitly include in his list. Nor did he expressly mention the counterforces of reaction that are likely to be set loose by powerful new ideas when actors seek to defend or impose them.

Clustered around genetic engineering in each country, we find not only celebratory institutions (mostly those of science, industry, the mainstream media, and the state), but also institutions (mostly *not* those of the state) that fear, doubt, question, or decidedly oppose the workings of the new technologies. Between these poles stand an array of public and private institutions whose task is neither to praise nor to blame biotechnology but more cautiously to deliberate on its management. The claims, beliefs, discourses, and actions of all these institutions, and the strategies by which they acquire and maintain legitimacy, will constitute another important strand in our comparison.

Actors' Identities

In a book dedicated as this one is to understanding how natural and social orders are coproduced, and how cultural commitments are rewritten on changing terrain, the emergence of new social identities and the actors who embody them attracts particular interest. We expect to gain insight into how societies cope with the novelty of science and technology by observing changes in existing actor categories, such as "expert" or "ethicist," that expand social roles or alter their meanings. In the context of biotechnology, relevant new actors include not only institutional presences such as IVF clinics and expert advisory bodies, but also professional groups such as bioethicists, and social actors such as surrogate mothers and patients' organizations. An unexpected actor

category consists of what we may term "liminal agents"—like the pre-embryos and supernumerary embryos discussed in chapters 6 and 7 that channel the flow of politics no less effectively than the humans who speak for them. The visibility and influence of each actor type varies from country to country, as do their institutional resources and opportunities to participate in political debate. Identifying relevant actors and reflecting on the basis for their political standing is another dimension of comparison, indeed an essential one if we are to produce a meaningful ethnography of political culture.

The point here is not to duplicate the analytic style of social movement theorists, who also study the identity-shaping roles of political actors, but to supplement that work with a more fine-grained reading of cultural responses to developments in the life sciences and technologies. Not all societal adjustments rise to the level of protest movements nor arise from below, as in the formation of group resistance; to the contrary, many salient adjustments in actors' identities, with profound consequences for the day-to-day conduct of society, occur *within* elites, in the courts, the expert bodies that advise parliaments and presidents, and the professional classes that control much of the meaning making in advanced industrial societies. These are the groups, then, that can be observed enacting and performing some of the continuities of culture, with significant implications for convergence and divergence across national polities.

The Field of Comparison: A Topography

Two axes of comparison structure the remainder of this book. It is, to begin with, a comparison of three advanced industrial states: Britain, Germany, and the United States. The European Union also requires attention, both as a source of autonomous biotechnology policy initiatives and because two of the selected countries are EU member states. In important ways, however, much of the politics of biotechnology has been driven even at the European level by national rather than supranational concerns. The book's design reflects this recognition. The second comparative axis cuts across several sites of debate within the field of biotechnology politics and policy, encompassing developments in agriculture as well as biomedicine. A brief word on the selection of the three countries and a slightly longer reflection on the use of biotechnology as a lens for comparison are now in order.

Nations of Choice

The comparative method works best when the entities to be compared are different enough to present interesting contrasts, yet similar enough for the variations to be disciplined. The similarities among the science policy

cultures of the three countries chosen for this study—Britain, Germany, the United States—are considerable and easily stated. All are economically and technologically advanced democratic nations, with long records of public sponsorship of research in biomedicine and the life sciences. All subscribe to neoliberal policies of privatization in the delivery of goods and services, although in each country support for market values is counterbalanced by other collective goals and interests. More specifically, commitments to free scientific inquiry and progress through technological innovation are offset in each national context by basic concerns for human dignity and autonomy, nondiscrimination and equality of opportunity, and the preservation of nature and the natural. In each country, too, well-organized representatives of civil society, serving both corporate and public interests, are in constant dialogue with governmental bodies on the appropriate directions and means for steering biotechnology.

Statistical information on public support for biotechnology in the three countries is more difficult to provide. The absence of a precise definition for "biotechnology" and the lack of international standards in data collection stand in the way of exact comparisons. Nonetheless, the Organization for Economic Cooperation and Development (OECD), a body dedicated to harmonizing trade and regulatory policies among the world's wealthiest nations, has compiled data that point to some interesting cross-national convergences and divergences. Table 1.1 compares selected indicators for Britain, Germany, and the United States. These show consistently high public expenditures in all three countries, but with the United States leading in the race to commercialization, as indicated by the number of field trials of genetically engineered traits in crop plants and in patent applications for biotechnology.[65]

The differences among the three countries may be less obvious, but they hold considerable interest for a study aimed at illuminating divergent models of democracy at play in the early twenty-first century. There is, to start with, the empirical observation that Britain, Germany, and the United States have responded to biotechnology with different assessments of what is acceptable or unacceptable, and different legislative, judicial, and policy instruments for correcting the perceived threats. That these reactions to some extent contradict earlier national responses to environmental risks only adds piquancy to the comparative project.

Despite their structural similarities, the three countries differ importantly in their legal and political traditions, with substantial implications for the conduct of politics. Particularly noteworthy are differences in the formality and pervasiveness of legal processes, the approaches to administrative decision making, the methods of engaging with expert advice, and the means of incorporating public perspectives into policy. Table 1.2 summarizes these basic contrasts. There are, as well, reasons to believe that the three countries vary interestingly along the dimensions of comparison outlined above: framing,

TABLE 1.1
National Profiles of Biotechnology

	Country		
Indicators	*Britain (population: 59.5 million)*	*Germany (population: 82.1 million)*	*United States (population: 272.9 million)*
Total public funding for biotechnology, 1997 (million PPP$)	705.1	1048.2	
R&D biotech/R&D overall, 1997	7.8%	6.7%	
Percentage of total venture capital investments, 1999	~6	~18	~5
Percentage of total scientific publications (1998)	9.3	6.0	23.9
Number of U.S.-issued biotechnology patents (2000)	299	373	5,233
GMO field trial-traits, 1995–2000	162	123	5136

Sources: Brigitte von Beuzekom, *Biotechnology Statistics in OECD Member Countries: Compendium of Existing National Statistics*, STI Working Papers 2001/6 (OECD, 2001); "Origin of US Biotechnology Patents," *Chemical and Engineering News* 79, 44 (October 29, 2001): 56.

TABLE 1.2
Comparative Political Systems

	Britain	*Germany*	*United States*
Legal tradition	Common law; unwritten constitution	Civil law; written Basic Law	Common law; written constitution
Administrative style	Informal	Formal	Formal
Expert engagement	Informal; consultative	Formal; negotiating	Formal; technical
Public participation	By invitation; limited to recognized social interests	By appointment; party and institution-centered	Self-generated; open to interested and affected groups

boundary work, institutional reasoning, and actor identities. A comparison along these lines is therefore likely to be specially productive from the standpoint of increasing our theoretical understanding of science, democracy, and political culture. The empirical studies in later chapters will put these intuitions to the test.

CHAPTER 1

The Lens of Biotechnology

Modern biotechnology did not spring full-blown from an instant of brilliant scientific inspiration. Nor did it instantly reveal its political potential. The collection of techniques dubbed "biotechnology" gradually took shape over many decades of research on the processes by which genetic information is stored and transmitted in living organisms.[66] The political and moral tensions surrounding biotechnology cannot be separated from the fact that there are two distinctive registers in which they can be discussed: that of pure science, harking back to the discovery of the structure of DNA, and that of industrial production, with its associations of efficiency, commodification, and control. In this section, we look first at the major steps in the evolution of biotechnology from university to industry, and then at the salient political themes that have grown up around the industrial and commercial uses of the life sciences.

The Birth of an Industry

Biotechnology is founded on molecular biology and the possibilities it offers for regulating organisms through planned genetic manipulation.[67] The word "gene," so central to biotechnology, was coined in 1909 by the Danish botanist Wilhelm Johanssen. He wanted a "little word" for the hereditary units that determine the characteristics of organisms in accordance with the principles of inheritance outlined by Gregor Mendel in the 1860s.[68] The word needed a physical structure, and eventually a mechanism, to achieve its operational power. The most important step in this evolution was the 1953 discovery by James Watson and Francis Crick of the structure of deoxyribonucleic acid (DNA),[69] the basic genetic material of almost all living organisms.[70] So simple and elegant was their model that it captured the scientific and popular imagination unlike any discovery since the breakthroughs in atomic physics more than a generation before. It was greeted as a revelation, uncontaminated by any of the messiness, false turns, or dead ends of routine scientific practice. Crick's own reflections testify to the role reversal by which DNA gained greater power to shape the human imagination than the men who elucidated its structure: "Rather than believe that Watson and Crick made the DNA structure, I would rather stress that the structure made Watson and Crick. After all, I was almost totally unknown at the time, and Watson was regarded in most circles, as too bright to be really sound. But what I think is overlooked in such arguments is the intrinsic beauty of the DNA double helix. It is the molecule that has style, quite as much as the scientists."[71]

A DNA molecule, "as every schoolboy knows,"[72] looks like a double helix—two long, intertwined strands composed of four nucleotides. These are the bases adenine, guanine, thymine, and cytosine, usually abbreviated as A, G, T, and C, which are attached to a uniform "backbone" of sugar and phosphate molecules (see fig. 1.1). The key to the "stylishness" of DNA is the

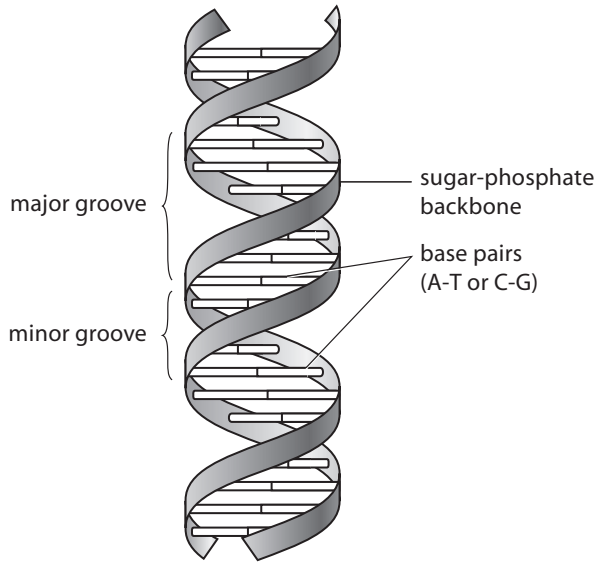

Figure 1.1. Structure of DNA (design by A. P. Jasanoff)

paired relationship of the four bases. For chemical reasons, adenine bonds only with thymine (A = T) and guanine with cytosine (G = C). Accordingly, the sequence of bases on either strand of a DNA chain automatically provides the corresponding information about the other strand; an A on one strand is always paired with a T on the other, and similarly a G with a C.

The brief paper in which Watson and Crick first described these findings contained a sentence whose verbal restraint was inversely proportional to its future economic and ethical significance: "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material."[73] This may have been studied nonchalance, although Crick attributed their initial refusal to say more to Watson's fear of being wrong about the proposed structure. Whatever the motivation, the remark proved prescient. DNA replication was soon shown to work by the unwinding of the two chains and the use of each half to guide the formation of a parallel chain. Because the position of each base on the new chain is fixed in relation to its opposite number on the old one, the process results in the creation of two identical copies of the original, with the base pairs lining up in exactly the same order on each.

The double helix was the product of pure university science, the brainchild of two gifted young men tinkering with a model in Cambridge University's famed Cavendish Laboratory and building on work done by other researchers using different tools to study DNA's structure. In this case,

though, consequences for medicine and industry followed very quickly. First came the discovery that DNA chains could be cut at specific sites with the use of compounds called restriction enzymes, and that they could also be joined together by using enzymes called DNA ligases. Cut fragments consist at each end of unpaired bases forming "sticky ends," so called because they easily pair with their complementary bases. Twenty years after the decoding of the structure of DNA, two Stanford University scientists, Stanley Cohen and Herbert Boyer, perfected and patented a technique for systematically cloning, or reproducing, specific lengths of DNA.[74] Their method involved taking DNA fragments obtained through the use of restriction enzymes and inserting them into circular molecules of nonchromosomal bacterial DNA known as plasmids. These hybrid (or recombinant) plasmids could then be reinserted into *Escherichia coli* (*E. coli*), a bacterium widely used in scientific research, where they would replicate stably (see fig. 1.2). Subsequent developments made it possible to transfer biologically active foreign DNA into many different host environments, including plants and higher animals.

States, industry, and scientists themselves very soon recognized the economic potential of a new biotechnology founded, at the subcellular level, on the techniques of genetic engineering and, at higher levels of organization, on cell and tissue culture techniques. Biotechnology was targeted by the mid-1970s for a wide range of commercial applications, although progress was slower than expected. Nearly thirty years later, products still had not reached the market in very large numbers, but hopes for economic regeneration through biotechnology remained undimmed in states seeking to maintain positions of global dominance in a second, science-driven industrial revolution.[75]

In industry and university laboratories, genetic research divided into two streams, labeled "red" for biomedicine and "green" for agriculture and environment. Under the green heading, biotechnology was put to use in producing new viral pesticides and plant varieties resistant to pests, herbicides, and other environmental stresses. Biotechnological methods were used to engineer commercially desirable traits into farm animals, such as higher milk yield in cows, leaner meat in pigs, and a higher volume of edible flesh in fish. These manipulations often involved cross-species transfers of genetic material, resulting in "transgenic" organisms that could not have been produced through traditional breeding. Genetically engineered bacteria were experimentally created to serve a variety of environmentally beneficial functions, especially in the field of bioremediation. Overshadowing all these in media attention was the announcement in February 1997 that a sheep, facetiously named Dolly (for the American country and western singer Dolly Parton), had been cloned months earlier from an adult cell taken from another ewe.[76] From one perspective, this event was just another step in a long history of animal breeding; from another, it suddenly opened a window onto the disturbing possibility of intentionally producing replicas of human beings.[77]

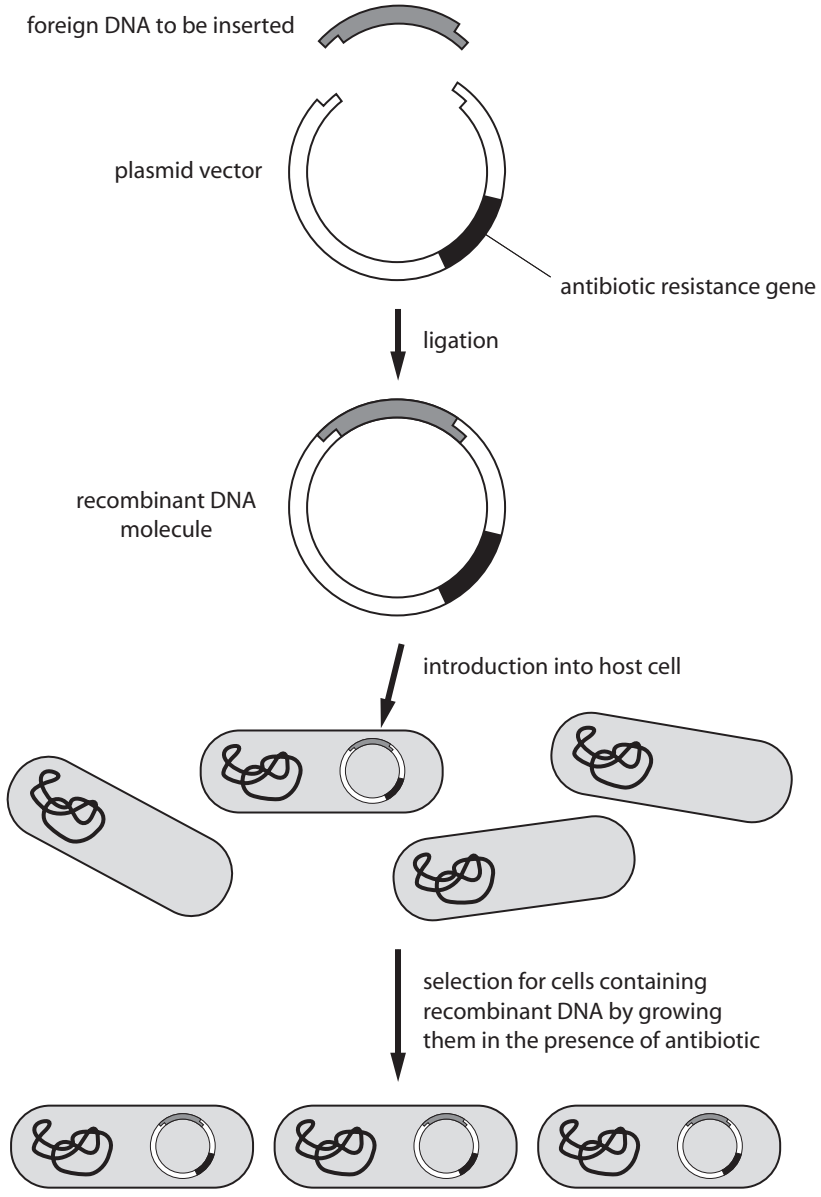

Figure 1.2. Recombinant DNA Technology (design by A. P. Jasanoff)

Working on red biotechnology in the meantime, pharmaceutical companies quickly seized on the possibility of creating genetically engineered substitutes for scarce therapeutic agents, such as insulin for the treatment of diabetes and human growth hormone for congenital dwarfism. Techniques for mapping and sequencing genes, and eventually the whole human genome, laid the foundation for a promising market in diagnostic tests; work also began on individually targeted "designer molecules" for therapeutic purposes, rekindling the perennial hope of cures for cancer, autoimmune diseases, and various genetic disorders. DNA typing, a method of identifying people through characteristic "fingerprints" obtained from samples of bodily fluids, emerged as an invaluable tool for law enforcement and paternity testing. In related moves, techniques from molecular biology were applied to create human embryos outside the womb, opening the way to in vitro fertilization, embryonic stem cell research, and (especially after the birth of Dolly) possible reproductive human cloning. Let us turn briefly now to the political themes that have been articulated around these developments.

Scientific Advances, Social Anxieties

If chemistry and physics underwrote state power through the twentieth century's two great conflagrations, it now seems biology's turn to define new roles for government. Life itself, as Michel Foucault compellingly argued, has become the new preoccupation of states, and the resulting biopolitics gives citizens a new arena on which to demand and contest the exercise of state power.[78] Certainly, there is no lack of public interest in the breakthroughs that biology promises. As the human conquest of nature chalks up new victories, those natural forces that remain outside human control seem increasingly more arbitrary and pointless. Who would not prevent if they could the devastating epidemics, the crops that fail, the pain of infertility, the unfairness of hereditary disease, the assaults of cancer, the decay of memory and reason, and the sadness of untimely death? These persistent troubles threaten the well-being of even the most prosperous modern societies. If collective defense and welfare goals remain intransigent problems, as the "war on terror" clearly demonstrates, then the mood of the moment seems all the more hospitable to state-supported advances in the life sciences, which promise citizens fulfillment on an intimate, personal scale, through longer, healthier, more liberated lives for themselves and, in time, their genetically tailored children.[79]

The life sciences for their part stand poised to serve both state ambition and private desire. Biology enjoyed its share of patronage even before the middle of the past century,[80] but the discovery of the structure of DNA and the astonishing cascade of developments in genetics and molecular biology in succeeding decades provided the basis for a much closer alliance between

science and the state. It seemed that a whole range of social problems could be rewritten so as to take advantage of scientists' growing capacity to manipulate the molecular foundations of life. Genetic engineering promised a new efficiency in meeting global targets for medicine, agriculture, environmental protection, and public health that had frustrated generations of idealistic social engineers and their disappointed clients. In wealthy nations, improved genetic understanding was also seen as holding the keys to threatening behavioral problems, such as violence, addiction, and madness.[81] Advances in biological knowledge seemed to add point and meaning to the modernist project of rational, science-based problem solving at a moment when doubts about the goals and instruments of modernity were increasingly in evidence.[82] Biological science and technology projected a confident ability to take much that is mysterious, elusive, particular, and problematic in the human condition and bring it within the realms of order, prediction, uniformity, and control. The life sciences in short presented themselves as ideal instruments to states in late-modern crises of legitimation.

On a personal level, biological intervention holds out hopes for individualized medicine, conferring cures for currently incurable conditions. More enticingly, the notion of design has begun to permeate talk and imagination through such terms as designer genes, designer molecules, and even designer babies. Designs on nature—once thought to be the prerogative only of a divine creator—seem now well within the reach of human capability.

Yet, there are cross-currents that make this moment seem less propitious for a scientific and technological revolution of wide-ranging proportions. The prospect of tinkering with the human genome disturbs deep-seated notions of the integrity and inviolability of human nature. Questions of responsibility are yet more troubling. Pledges of progress sit uneasily with publics who have grown weary of unfulfilled promises, cynical about the good intentions of states, angry with the continuing gap between rich and poor, and newly conscious of the constructed and value-laden character of scientific knowledge.[83] While biologists celebrate their achievements in the laboratory and the field, and governments burnish their credibility in science's reflected glory, intellectuals, artists, and many ordinary citizens view the genetic revolution with much more contained enthusiasm. Biological hazards have captured the public imagination and fostered a kind of "genetic anxiety" comparable to the "nuclear fear" of an earlier time.[84] Some cite archetypal myths and contemporary disasters—Prometheus, Frankenstein, Nazi eugenics,[85] ozone depletion, climate change, "mad cow disease"—to argue that human foresight and institutions are doomed to lag behind human ingenuity in tampering with nature's secrets.[86] Others deplore the reductionism of the genetic vision of life and the associated dangers of heightened state control, diminished human dignity, and inevitable inroads upon the mystery

and diversity of life.[87] Still others see the alliance among Western science, capital, and the state as the recipe for a new colonialism that will again appropriate indigenous resources and threaten the ecological and economic survival of the developing world.[88]

These tensions between the perils and promises of genetic engineering have created the testing ground on which we can observe the politics and policy of mature liberal democracies differentially at work. New theaters of action have opened up in which governments have had to put new administrative routines in place: not only to secure public funding for biotechnology, but also to assess its hazards, monitor its development, create markets for its products, and encourage ethical and responsible use of biological research. The threat of biological warfare acquired fresh reality after the post–September 11, 2001, anthrax attacks and the still unproven charges against Saddam Hussein's Iraq. In sum, life after the double helix has disclosed many missing elements in the governance of biotechnology and wide gaps among state, citizen, expert, and corporate perceptions of the risks, benefits, and moral ambiguities surrounding the life sciences. Normative problems inevitably follow. Whose views should control the governance of biotechnology? Are governmental attempts to steer biotechnology stifling or setting free new forms of democratic self-expression? How should we evaluate the performance of different nations with respect to governing biotechnology? Will the experiences of wealthy nations serve as model or warning with respect to science and social order in a globalizing world?

In subsequent chapters, I trace the trajectories of these concerns within the legal, political, and policy systems of Britain, Germany, the United States, and, at a supranational level, the European Union. Comparisons will cover the formal principles and processes of law and regulation, their application to specific cases, the practices of debate and dissent, and the formation of institutions and expert discourses by which states and publics assess the risks and benefits of biotechnology. Cases selected for these purposes are drawn from green as well as red biotechnology, even though the two areas have come to be associated with somewhat different scientific debates, ethical concerns, and political questions. The nature of biotechnology and the politics surrounding it justify this inclusive approach. Fundamental to *all* recent advances in biotechnology is a set of ideas and techniques that have reshaped people's understanding of what life is and helped in important ways to frame political thinking about the life sciences. Civil society responses to biotechnology accordingly cut across sector-specific policy concerns. Likewise, the institutional and political changes that beg for cross-national analysis encompass both major domains of industrial application. From a theoretical standpoint, then, more is to be gained from a cross-sectoral comparative strategy than by allowing the scope of analysis to be governed by the contours of specific policy domains.

Sites of Reflection: A Schematic Roadmap

My objective in the remainder of this book is to explain as fully as possible why new developments in the life sciences were differently received into three national political systems, and what the implications of these stories are for the future democratic control of biotechnology. Prospects for supranational harmonization, both at the EU level and globally, will be deduced to some extent from the comparison of national cases. In keeping with constructivist and coproductionist understandings of the relationship between science and politics, or natural and social order, I will be interested throughout in comparing the framing and bounding of issues for decisionmaking, their uptake into governing institutions and their discursive regimes, and their impact on actors and social identities.

In this spirit, chapter 2 describes three "controlling narratives" that framed the course of policy development on genetic engineering in the three countries. These narratives characterize biotechnology as (1) a novel *process* for intervening in nature, (2) a source of new *products* for the benefit of humans and the environment, and (3) a state-sponsored *program* of standardization and control carrying profound implications for human dignity and freedom, and raising questions of constitutional significance. This chapter reviews the historical and social origins of these three competing narratives and seeks to understand why they were differently received and institutionalized within each national political system.

Chapter 3 takes up a central methodological problem confronting a comparative analysis of the United States with individual European nations: what to do about the role of the European Union. The problem looms large partly because the EU established itself during the period of this study as an independent presence in policymaking for science and technology, including biotechnology. Equally important, though, the EU's own political identity was concurrently under negotiation, so that policymaking for biotechnology became one of the channels through which the EU sought to constitute itself. This "problem" actually offers a theoretical entry point for looking at European biotechnology policy through a coproductionist lens. Periods of emergence during which new social and scientific orders are put in place offer a particularly rich site for examining the interplay and mutual reinforcement of scientific and social possibilities.[89] In this respect, key episodes in the formation of European biotechnology policy shed light on the construction of Europe itself.

Chapters 4 to 8 carry out something akin to a "multisited ethnography"[90] of three national political cultures as they each adjust to the ethical, legal, and social challenges posed by biotechnology. I use the term "ethnography" analogically here, mainly to suggest that political culture, like culture in general, has to be sought at varied sites and in successive episodes of enactment and

performance, rather than as codified once and for all within static institutions or regulatory traditions. My method, however, is geared less toward conveying the descriptive thickness of individual events in the manner of Clifford Geertz, or to "following" objects, persons, and discursive trajectories in the manner of Bruno Latour or George Marcus, than to capturing important regularities in episodes of political challenge and democratic legitimation. Whereas current anthropology is often preoccupied with movement and flux, I am interested in the self-perpetuating normative commitments that give societies a claim to coherence and solidarity even in the face of shocks and change. The developments compared in these chapters accordingly meet most or all of the following criteria: they provoked substantial public debate and usually drew forth a discernible policy response at the national level; they gave rise to new institutional arrangements; they altered the existing terms of normative discourse or introduced new elements into it; they were associated with the formation of new or altered social identities.

Chapter 4 looks at the release of genetically modified organisms (GMOs) into the environment and the associated development of new approaches to regulation and risk assessment. This chapter shows that early attempts to settle the debate on environmental safety reopened under the pressures of commercial use, but controversies about genetically modified crops followed different national trajectories. This history helps to illuminate the transatlantic divergence between the U.S. insistence on "risk assessment based on sound science" and the EU nations' concern for "precautionary" policy. Chapter 5 considers the legal and political wrangling over the safety of genetically modified foods. Discursive differences between the U.K. and U.S. cases form the chapter's primary focus, with particular attention to the nature and organization of expertise developed to deal with food risks. Chapter 6 looks at the advent of new reproductive technologies based on in vitro fertilization and the initial steps taken by each nation to ensure that assisted reproduction is kept within the bounds of "the natural." In chapter 7 we revisit the consequences of these regimes in response to techniques such as cloning and research with embryonic stem cells; questions considered more or less settled for a decade were suddenly reopened as citizens and governments discovered unsuspected ethical quandaries lurking behind the naturalized façade of assisted reproduction.

Chapter 7 also builds a bridge to chapter 8 in that these two chapters deal, respectively, with the role of bioethics and patent law in regulating advances in biotechnology. In each domain, new institutions and formal concepts emerged side-by-side with new technological capabilities; changes in ethics and law not only facilitated public deliberation but also served governmental attempts to support genetic research and development. The instrumental role of these professional discourses in framing biotechnology policy (for example, by foregrounding some issues for concern and backgrounding

others) is of particular interest. More specifically, chapter 7 examines how the notion of "bioethics" itself was interrogated and recast in each country within new institutions dedicated to promoting biotechnology. Chapter 8, by contrast, explores how existing legal institutions addressed the novel property claims constituted by and for the life sciences and considers how these developments helped to reinforce cultural conceptions of human agency, dignity, and personhood.

Chapter 9 looks at universities as crucially important sites in leading the revolution in the life sciences, but also—increasingly—as experiment stations for a new social contract between science and society. Reviewing national policies for technology transfer from universities to industry, the chapter asks how the entente between the university's historical commitment to interest-free inquiry and its new enrollment into commercial and industrial projects affects the relationship of knowledge to democratic politics.

Chapter 10 reflects on the implications of this cluster of developments for the widely perceived crisis of modernity in advanced industrial states.[91] The chapter's primary contribution is to theorize the role of science and technology in the formation of democratic political culture. The chapter argues that democratic theory in the era of the knowledge society must actively take on board the involvement of citizens in the production, use, and interpretation of knowledge for public purposes. To advance this aim, the chapter develops the concept of *civic epistemology* and compares how it has been actualized in the three countries.

Chapter 11 returns to the book's central normative questions. It asks how democratic institutions on the two sides of the Atlantic have responded to the problems of risk, ethics, and human agency raised by developments in the life sciences and biotechnology. A critical issue is whether the politics of biotechnology has reinforced the familiar modernist paradigm of scientific rationalization and control or whether one can discern here signs of a novel postmodern accommodation, founded on more fluid and less hierarchical (in short, more overtly experimental) relations among science, society, and the state.