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Introduction: Rewriting Life, Reframing Rights

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We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.

—*U.S. Declaration of Independence*, July 4, 1776

The Palimpsest of Life

Two encyclopedic bodies of writing—one social, the other scientific—define the meaning of life in our era. Encompassing, respectively, law and biology, these intertwined, mutually supporting, indeed coproducing textual projects frame the possibilities, limits, rights, and responsibilities of being alive—most especially for the species we call human.¹

Law from ancient times has been a matter of wording. “In the beginning was the word”: first God’s word and then our own secular texts, collectively agreed on. Legal writing makes visible the rules of action and behavior that human societies accept as controlling; it is the legibility of the law, in short, that makes it intelligible and thereby enforceable throughout a society that submits to the constraints of civilization. From the code of Hammurabi and the Ten Commandments of Moses to the laws of Manu and the edicts of the Emperor Ashoka, from Magna Carta to the French Declaration of the Rights of Man and the American Declaration of Independence, emerging communities have signaled their solidarity by promulgating new, legally binding texts. Since the earliest recorded histories, writing or inscribing the law has been a political enterprise, and rulers have taken great pains to ensure that people will read the law and learn how to comply with its authoritative mandates.

Textuality in the life sciences is of much more recent vintage. Compared with five millennia of law writing, the association of biology with written texts occupies a blink in time, but its implications for human

rights and entitlements have been no less momentous. The textual phase of the modern biological sciences began in 1953, with the discovery of the structure of DNA (Kay 2000; Keller 2000; Watson and Crick 1953). This was the revolutionary moment when it became possible to represent the basic matter of life with permutations and combinations of just four letters of the Western alphabet: A, T, C, and G. Those letters, of course, stand for structures a great deal more complex. Adenine (A), thymine (T), cytosine (C), and guanine (G) are the names of four chemical compounds, called *bases*, which bond in pairs along the sugar-phosphate backbone of the now-familiar DNA double helix. Separated, each strand becomes a template for generating its precisely ordered partner: unwound and repartnered in hospitable biochemical environments, a single segment of DNA gets remade as two identical helices, thereby supplying the mechanism of replication that had puzzled students of heredity for decades. The sequence of bases, the length of the strands, the relative stability or instability of bonds, and many other factors of developmental and environmental biology affect the transformation of DNA into the wild profusion of living organisms known in nature. Yet the elegant simplicity of the four letters, capable in principle of generating untold varieties of new life, enables a discourse of information and rule following that makes biological heritability converge in salient respects with the normative functions of the law (Kay 2000, 1993; Kevles and Hood 1992; Lewontin 1993).

Advances in biological knowledge and technique may in the future dilute the impact of the “book” of DNA. Knowing life may some day become more a matter of tinkering with it than reading it. Synthetic biology—a focus of rising scientific, political, and economic attention since the turn of the century—promises gains by designing and engineering life rather than by decoding its informational content. Through the construction of novel biological parts and the instrumental use of natural biological materials, synthetic biology redirects the understanding of life into distinctly material channels. Both scientists and policymakers see enormous potential in the turn to engineering (Keasling 2005; Specter 2009), and the entrepreneur J. Craig Venter’s early experiments to create life’s smallest units aroused enthusiasm while also raising eyebrows (Hotz 2010). Synthetic biology’s building projects, however, derive their blueprints from the world of imagined configurations opened up by the texts of DNA.

This collection of essays is located in the overlapping spaces created by a half-century of rewriting life in genetic sciences and technologies and the centuries-old texts of law that represent one of the most durable monuments of human culture. It is impossible today to understand the ethical

debates surrounding the life sciences without looking deeply into the evolving relationships among biology, its technological applications, and the law. This is not, as is sometimes thought, a one-way relationship, with science always leading the law. Even when biological advances seem most surely to be putting new issues on the agenda—as, for example, in conflicts over the moral status of human embryonic stem cells or the ownership of novel biological materials—powerful legal norms lie barely concealed beneath the surface, conditioning the very terms in which those debates are formulated (Jasanoff 2001). The constant, mutually constitutive interplay of biological and legal conceptions of life, the former focusing on life's definition and the latter on its entitlements, is a fundamental feature of scientific and technological societies; it exemplifies the coproduction of *is* and *ought* in modern times (Jasanoff 2004).

The frictions and ambiguities recorded in the palimpsests of law and science become concrete when biological knowledge is translated into material form—that is, into tangible, working components of biotechnological systems. Throughout this collection, we see questions raised by new entities, objects, techniques, and practices that embody genetic understandings of life, but whose legal and social meanings are far from clear at the moment when scientific work first conceives of them or, through material transformations, brings them into being. Conversely, we encounter quite different articulations of what societies value about “Life, Liberty and the pursuit of Happiness” as diverse legal institutions and cultures struggle to make sense of biological claims, materials, and practices that destabilize the law's well-made conceptual categories.

This book argues that periods of significant change in the life sciences and technologies should be seen as constitutional or, more precisely, *bio*-constitutional in their consequences. Revolutions in our understanding of what life is burrow so deep into the foundations of our social and political structures that they necessitate, in effect, a rethinking of law at a constitutional level. At these moments, the most basic relations between states and citizens are reframed through changes in the law (Jasanoff 1987, 2001, 2003, 2005). Reframing begins with redefining human life but segues into redefining the obligations of the state in relation to lives in its care. Just as the translation of DNA to RNA to protein has been called the central dogma of molecular biology, so safeguarding the lives of citizens can be regarded as the central dogma of the constitutionally regulated state. Put differently, the first duty of any state committed to the rule of law is to take responsibility for its people's lives; indeed, the legal philosopher H. L. A. Hart (1961) defined the “minimum content of natural law” as that content

which assures the survival of the society that the law seeks to regulate. Radical shifts in the biological representation of life thus necessarily entail far-reaching reorderings in our imagination of the state's life-preserving and life-enhancing functions—in effect, a repositioning of human bodies and selves in relation to the state's legal, political, and moral apparatus.

Such transformations do not happen all at once, or coherently. The ongoing work of constitution making during a scientific revolution is patchy, slow, and unpredictable, but we can piece together its emerging outlines and principles by looking closely at specific locations in which law, the life sciences, and biotechnologies have entered into conflict or conversation. These range from highly focused controversies about the rights and duties of living entities (e.g., what are the legal rights of stem cells; what new rights attach to DNA typing?) to abstract issues of democratic legitimacy (e.g., if the definition of life is itself in flux, how should the state construe its responsibilities to preserve life; and how should it deal with moral uncertainty and conflict?). Through snapshots of legal developments in North America, Europe, and India, this book seeks to capture the dynamics of the contemporary bioconstitutional moment as it is unfolding in real time and globalized space.

Our use of the label bioconstitutionalism to describe these aggregated movements was itself the result of incremental observation and analysis. We did not begin with this term in mind but concluded, over several years of exchange and mutual provocation, that it captures much of what is salient in today's life-law interactions. These essays, the result of the authors' thinking together, are grounded in the field of science and technology studies (STS), but with wide-ranging implications for bioethics, law, and political theory. STS research is often criticized as insufficiently theoretical and deaf to normative problems (Jasanoff 2004). We show to the contrary that investigations of biological and legal change are inseparably linked to fundamental questions about justice and social order. The book as a whole offers a programmatic way of looking at the nexus of law and science, taking on board the influence of science and technology on basic categories of legal thought, and vice versa. Individual chapters can be read as stand-alone pieces that exemplify this broader project; they also illustrate varied approaches to studying the interoperability, as it were, of biological knowledge and constitutional norms.

Substantively, the authors investigate cross-cutting transformations in law and biotechnology that are altering how human societies think about what it means to live and to be human, and what rights and values attach to human-ness or to living. We consider how the law responds when new

biological constructs cross conceptual boundaries that the law previously took to be natural—for instance, boundaries between life and nonlife, human and nonhuman, individuals and collectives, and predictable and nonpredictable risks. As these lines blur, we see corresponding instability in legal thinking about the rights, duties, entitlements, and needs of living entities. The chapters display the struggles and realignments involved in attempts to restore epistemic and normative order under uncertain circumstances.

Theoretically, the book opens new ground on four interrelated fronts: in legal scholarship, science and technology studies, comparative politics, and bioethics. For constitutional scholars, our approach offers new ways of reading the relationship between science, technology, and the rule of law, with greater sensitivity to the value-ladenness of novel biological entities and practices. For academic students of science and technology, we map the major intersections between life sciences, biotechnologies, and the law, interpreting these through the lens of coproduction and teasing out their normative implications. For theorists of legal and political culture, the essays illuminate distinctive features of national (and in some cases supranational) politics, public reason, and decision making that inflect the legal treatment of life in the post-DNA era. For the still young field of bioethics, these essays open wider horizons by showing how ethical principles are not neutrally applied to biotechnology's cornucopia of novel entities and practices, but are instead reformulated and redefined through ongoing processes of ontological clarification.

We first offer a brief history of the intersections between the texts of life and the texts of law that have given rise to questions about rights, entailing the reframing moves flagged in the title. Next, we situate our distinctive view of constitutionalism against a backdrop of legal thought, juxtaposing constitutionalism in its conventional senses with the *bio*constitutionalism that the authors explore, often in cross-cultural perspective. A consistent theme is the impossibility of any form of deterministic analysis of relations between law, science, and technology: changes in biological understanding do not ineluctably shape the law; nor do law and ethics prescribe inviolable limits to scientific and technological advances. Chapter summaries round out this introduction.

Life under Law

In a monumental corpus spanning the histories of madness, sexuality, and other forms of socially controlled behavior, Michel Foucault developed

the influential concepts of biopower and biopolitics. Observing that the contemporary state exercises power not by commanding the deaths of dissidents but by regulating the bodies and lives of consenting subjects, Foucault spoke of “an explosion of numerous and diverse techniques for achieving the subjugations of bodies and the control of populations” (1998, 40). The harsh characterization of human subjects as nothing more than subjugated bodies, absorbed into the amorphous mass of the population, softened in Foucault’s later writing. His followers too see the governance of lives as more of a two-way street—exposing subjects to state classification and control to be sure, but also creating scope for new forms of voluntary association facilitated by shared biological characteristics. Using terms such as biosociality (Rabinow 1992) and biological citizenship (Petryna 2002; Rose 2006), social theorists of the genetic era have sought to capture, and to some degree celebrate, the opening up of agency from below. Heredity, they argue, no longer equals destiny as in the bad old days of state-sponsored eugenics (Kevles 1985; Kevles and Hood 1992). Instead, genetic texts and instruments offer individuals a chance to retranscribe their own solidarities and destinies with newly acquired knowledge and technologies.

All such possibilities for self-fashioning play out on terrain already occupied by law. Concerns about the need to regulate the disruptive potential of biological manipulation were apparent almost from the moment when genetic engineering became feasible in the 1970s. There was a recognition that recombinant DNA techniques cross species and organismic boundaries, and that these crossings and hybridizations may pose significant legal problems. With time, it became clear that genetic technologies transgress more than one kind of boundary, with implications for many different domains of law. Thus, early worries focused mainly on the safety of genetically modified organisms and translated largely into matters of administrative and regulatory concern. Subsequently, several additional boundaries gained prominence: between life and nonlife, with associated issues of commodification, ownership, and property law; between human and nonhuman, entailing questions of the moral status of biological constructs; between individual and group rights; and between uncertainty and predictability, implicating the custodial responsibilities of states for the societies they govern.

In the United States, where the new biotechnology was first invented, themes of biopower and biopolitics were relatively slow to emerge. Instead, a polity already attuned to nuclear and chemical hazards assimilated genetically modified organisms into familiar imaginaries of risk and

regulation (Jasanoff and Kim 2009). Precisely snipping bits of DNA from one organism and transposing them into others, using enzymes as molecular “scissors,” promised to endow living things with valuable new traits, but the process also raised fears that the resulting entities might escape from the contained environment of the laboratory and play havoc with human health and the environment. Scientists were among the first to raise the alarm. The February 1975 Asilomar Conference on Recombinant DNA (rDNA), convened by the Stanford molecular biologist and future Nobel laureate Paul Berg, outlined regulatory principles for governing rDNA research (Berg et al. 1975). That conference, memorialized simply as *Asilomar*, became the twentieth century’s iconic example of scientific self-regulation, the antidote to Los Alamos. It was, however, an achievement based on a narrow framing of biosafety (Jasanoff 2005). Participants focused mainly on risks to lab workers and surrounding communities, and on producers’ liability for possible harms. The principles they drafted were aimed primarily at containing the spread of novel organisms through biological and physical means. Absent from the agenda at this dawn of regulation were challenging questions about how to classify the entities created by gene splicing, how to manage the impacts of industrial biotechnology on agriculture and species diversity, and who should set limits on the purposes, ambitions, and scope of genetic interventions (Gottweis 1998; Jasanoff 2005; Wright 1994).

Legal imaginations and horizons widened significantly in the 1990s. The launch of the federally funded Human Genome Project (HGP) in 1990 drew renewed attention to the informational content of the genetic code and stirred up debates about privacy, stigmatization of genetically marked persons or populations, and the misuse of genetic data by employers, insurers, and law enforcement agencies. Scholars and journalists wondered aloud whether ethical principles and legal rules would evolve in time to keep the new scientific discoveries in check. Committees were charged with evaluating the ethical implications of research funded by the National Institutes of Health (NIH), the chief grant-making arm of the U.S. government for biomedical research. James D. Watson, codiscoverer of the structure of DNA and first director of the HGP, responded to these swirling anxieties with an off-the-cuff promise to commit 3 percent (later 5 percent) of project funds to examining the Ethical, Legal, and Social Implications of genome research. That endeavor, institutionalized as the ELSI Program, served as a model for later national and international initiatives.

The middle of the decade ratcheted up public concern. In 1997, researchers at the Roslin Institute in Edinburgh announced that they had

cloned a sheep from cells taken from the mammary gland of an adult ewe, the first time that a genetically identical, mammalian offspring had been asexually generated from a parent animal. Dolly the sheep, jestingly named for the voluptuous country music singer Dolly Parton, lit a fuse of ethical anxiety laid decades ago. The scientific term *clone* carried uncomfortable baggage outside the laboratory. Dystopic fantasy films such as *Boys from Brazil*, about the Nazi doctor Josef Mengele's plot to rule the world with an army of Hitler clones, and *Clonus*, in which human clones were bred to supply spare organs for the wealthy, had circulated in popular culture since the 1970s, veneering scientific potential with moral dread. The possibility of creating identical copies of nonhuman mammals morphed easily into nightmare visions of industrially manufactured, intellectually subjugated, enslaved human beings, like the subhuman populations rolling off the assembly lines in Aldous Huxley's 1932 novel *Brave New World*.

Succeeding years saw an explosion of public doubt ranging far beyond Asilomar's fixation on the containment of rDNA risks. As biomedical practices raced to convert therapeutic visions into reality, it became clear that the textuality of the genetic code was not simply a metaphor but also an enabling instrument. In effect, the code had rendered life programmable, or subject to design: it seemed increasingly probable that humans and other living things could be selected for, or actively engineered with, designer traits to make them longer-lived, more athletic, endowed with particular forms of beauty, or otherwise attractive to designers' imaginations. Suddenly, how far humans should go in enhancing their own genetic constitution arrived at the forefront of academic reflection (Buchanan et al. 2000; Fukuyama 2002; Kitcher 1996; Sandel 2007). While scholars debated whether some essence of human-ness should be left untouched, pragmatic minds turned toward correcting perceived genetic errors with techniques enabled by genetic research. An early, controversial instance was the creation of "savior siblings," selected as embryos through a technique called *preimplantation genetic diagnosis*, to serve as tissue donors for existing children with incurable genetic illnesses. Permitted in some countries² and prohibited in others, the practice of testing and selecting artificially created human embryos to treat their own close kin underscored both the instrumental potential of the genetic code and the lack of legal and ethical clarity surrounding its possible applications.

That no rules were in place to regulate such interventions only confirmed for many the reality of the law lag: the claim that scientific and technological innovation inevitably proceeds at a more rapid clip than legal rule making, so that the law is doomed to lag behind the frontiers of

science and technology (Jasanoff 2008). That view, however, misconceives the immanence of the law. True, the arrival of novel entities or practices often requires a fine-tuned specification of existing principles to deal with new contingencies. But law is always already present as a conceptual and cultural resource, governing responsible human behavior and conditioning the terms in which people imagine the normative organization of their worlds. We return to this point following a brief review of constitutional thought in relation to biological change.

Bioconstitutionalism: Rethinking Ontologies and Rights

From the earliest days of genetically based biomedicine, legal and policy analysts saw possible contradictions between constitutional guarantees and advances in biotechnology. Prospects of genetic testing and gene therapy fed worries about information privacy and discrimination through the creation of a genetically stigmatized underclass with reduced access to employment, health care, insurance, and other social goods (Silver 1997). Privacy and due process were debated in connection with the widespread adoption of DNA typing as a forensic technology (Kevles and Hood 1992); those questions intensified as states and private institutions went about establishing “biobanks” as repositories of personal genetic information (Häyry et al. 2007; Hindmarsh and Prainsack 2010). Questions about the limits of inquiry arose in connection with germ-line gene therapy, xenotransplantation, and the creation and patenting of transgenic animals. Dolly’s birth spurred renewed reflection on the implications of mammalian cloning for human dignity, reproductive freedom, the right of governments to ban or restrict scientific inquiry, and conflicts between science and religion.

Unifying this first generation of constitutional thought was an underlying certainty, or taken-for-grantedness, about the nature and meaning of rights. Constitutional rights are typically seen as among the most stable elements of national legal systems: to be held as far as possible sacred, and to be defended against erosion by vigilant lawmakers or watchdog organizations such as the American Civil Liberties Union (ACLU). It is accepted in broad terms that we *know* what privacy is, what it means to do research without constraints, or when a search or seizure is too intrusive and unwarranted. The challenge is to discern when rights are under stress, including from new technologies, and must be reasserted. Such certainty about the nature of rights, however, depends on definitions of the nature and needs of the human subject that are typically neither questioned nor

reexamined. Instead, classical constitutional thinking operates with a tacit understanding that human-ness is held constant by nature (biology), and that the law needs to respond only when those highly valued, enduring, and natural human entitlements are threatened by technological intrusions.

Such conservatism comes at a high price. To begin with, posing constitutional questions within an impacts framework feeds the perception of the law lag, because the law seems continually to fall behind in its efforts to define, preserve, and protect the rights that constitutions guarantee. And decoupling the talk of rights from the actualities of scientific research and development limits the scope of legal and ethical analysis. Scant attention is paid, for example, to the law's treatment of new biological entities and their incorporation into regimes of rights (Stone 1974)—for example, in disputes about the moral status of stem cells, the patenting of novel life forms, the ethics of producing human-animal chimeras, or the classification of transgenic species. More generally, analytic weaknesses arise from attempts in constitutional jurisprudence to make do with notions of human identity, liberty, property, and nature that predate even the industrial revolution, let alone contemporary developments in biological, informational, and environmental sciences and technologies (Schauer 1998). Emergent rights vanish from the periscope of constitutional analysis. The assumption that rights have remained the same while the world has changed around them imparts a kind of rigidity to constitutional thought and contributes to the perception that the law is unduly resistant to change.

How then should legal scholarship develop a more supple framework for addressing the constitutional implications of epochal changes in science and technology? This book lays out several theoretical and methodological avenues. To begin with, we broaden the notion of *constitution* to include the full range of sites and processes in which individuals work out their biopolitical relationships with the institutions that regulate them. This expansive frame—we may think of it as constitutionalism with a small “c”—reaches well beyond the judicial interpretation of formal legal documents such as the U.S. Constitution. It extends the notion of a “legal text” to include not only written rules and opinions, but also the institutional practices that make up a constitutional order. It takes account of science's role in producing what the legal scholar Bruce Ackerman (1983) calls *constitutional moments*: moments of radical restructuring in state-society relations that may or may not be formally ratified through constitutional amendments.³ It also accommodates disparities among the world's written and unwritten constitutions, which vary greatly in their understandings of

the human as a legal and political subject, and hence in their elaboration of human rights. Under the rubric of constitutionalism in this wider meaning, we explore the kaleidoscopic ways in which definitions of individual and collective rights both influence and are transformed by changes in the biological status of the human (Jasanoff 2004, 2008).

Our understanding of constitutionalism with a small “c” underscores some parallel theoretical preoccupations in law and STS that this book helps identify, though fuller exploration of those commonalities lies beyond our present purposes. Just as STS research has located science in mundane activities—atheoretical, habitual, done by technicians and instruments—so some progressive legal thinkers have sought to democratize constitutional thought, finding it in the actions and resistances of the “the people themselves” instead of only in principled decisions promulgated by supreme judicial authorities (Kramer 2004). Just as STS analysts have deliberated on the appropriate balance of power between expert and lay understandings of knowledge and norms, so legal scholars have been wrestling with the proper relationship between professional legal reason and popular legal thought or “democratic constitutionalism” (Post and Siegel 2007; see also Aronson 2009–2010; Harding 2006; Waldron 1999). At a deeper level, both STS and legal theory are perplexed by shared questions about truth and finality that resonate throughout this volume: what counts as right, in knowledge and action, and who has the right to declare it so?

A second definitive step that this book takes is to move away from the framework of technological determinism that the law often adopts as its own. This theory attributes causal force to material technologies, so that changes in society are seen as results of ongoing changes in technology (Smith and Marx 1994). Technological determinism underlies many familiar assertions about modernity, for example, that automobiles dispersed people into the suburbs and fragmented families, television dissolved communal solidarities, and social networking technologies such as Facebook and Twitter increased personal and political freedom. Deterministic ideas are at play whenever the law is depicted as trying to bridge gaps and lags created by advances in science and technology. Most important for this book, determinism surfaces whenever technology is seen as infringing on and eroding well-established rights. Constitutional rights tend, at such moments, to be construed as passive guarantees instead of as active conceptual agents shaping the very meanings that we attach to technological artifacts and practices. We argue that it is important to be attentive to the reciprocal moments in which legal sense-making influences

biological categories—by placing entities on one side or the other of normatively meaningful divides such as natural-unnatural, living-nonliving, or human-nonhuman.

Much of contemporary bioethical concern with human rights is rooted in deterministic thinking. In the course of the genetic revolution, reductionism (sometimes labeled “geneticization”) became a major worry. The specificity of the genetic code invites redefinition of the most complex biological organisms and their developmental potential in terms of that code’s seemingly inexhaustible alphabet. From plants to animals to humans, genetic characterizations then become paramount: Bt corn, so labeled for its inserted insecticidal gene; the oncomouse, named for its genetically modified susceptibility to cancer; bearers of sickle cell, Huntington’s disease, or breast cancer genes, known to insurers and employers for those traits above all others (Duster 1990; Kay 1993; Keller 1992; Lewontin 1993). Although such critiques display an admirable understanding of the uptake of scientific representations into society, insistence on reductionism buys into the paradigm of technological determinism. Bioethicists, some have argued, contribute to the apparent inevitability of “geneticization” by focusing exclusively on the rights of persons characterized by undesired genetic traits (Árnason and Hjörleifsson 2007).

By contrast, bioconstitutionalism, as elaborated in this volume, stresses the irreducible contingency of life-law relationships and thereby helps restore normative agency to social actors. In this respect, bioconstitutionalism complements work in critical studies of the law. Legal theory has been hugely influential in bringing to light the contingency of legal rules, illuminating the hidden normative assumptions that underpin supposedly neutral legal rules and potentially influence rule-following behavior. Modern versions of legal realism have refocused the understanding of realism away from the indeterminacy of rules toward the often-disguised substantive choices embedded in even relatively determinate rules (Fisher, Horwitz, and Reed 1993; Fried 1998; Kysar 2010). Feminist jurisprudence exposes the gender-based assumptions that support dominant, male legal understandings (Bartlett 1990). The Critical Legal Studies movement stressed the ideological contingency of legal structures that may appear inevitable and natural (Kairys 1990; Kelman 1987). And with regard to constitutional decisions, legal scholars have questioned the neutrality and validity of the “baselines” against which we consider constitutional questions, contending, for example, that the distinction between state action and private action presupposes a state-created status quo that established the domain of the *private* in the first instance (Sunstein 1993).

Despite these turns toward reflexivity, legal scholars have not by and large grappled with the ways in which legal rulemaking interacts with the life sciences and technologies to build the concept of rights. Even at its most sensitive and reflective, legal scholarship tends to accept the separation between law-work and science-work, seeing the former as normative and the latter as epistemic; similarly, the notion that technological objects may have norms built into them is not widely acknowledged in legal scholarship, though standard in STS. Rather, law and science are seen most often as distinct “cultures” that clash when they meet in disputes over rules and policies (Goldberg 1994; Schuck 1993). An innocent positivism still marks much writing about science and the law, exemplified by a stream of work criticizing judges, juries, Congress, and even expert agencies for failure to abide by the standards of good science (Breyer 1993; Foster and Huber 1997; Huber 1991). Such critiques often accompany triumphalist and historically inaccurate accounts of technological progress, which represent the law not only as lagging, but also as an awkward impediment to human betterment through science and technology.

The separatist tendency prevails even though the historical record suggests that law and science have supported each other for centuries in patterns of mutual construction, stabilization, and reinforcement (Ezrahi 1990; Porter 1995; Shapin 1994; Shapin and Schaffer 1985). There has been relatively little systematic reflection on the ways in which modes of authorization in science and the law build upon, mimic, or incorporate one another (for exceptions, see Jasanoff 2005, 2008; Smith and Wynne 1989; Wynne 1982, 1988).

Cutting against the deterministic tendencies of much legal analysis, work in science and technology studies has consistently shown that the products of technoscience not only influence but also incorporate and reaffirm social values and institutional practices (Jasanoff 1995, 2004, 2008; Jasanoff et al. 1995). Nuclear power plants, smart bombs, ozone holes, computers, genes, Dolly, and the oncomouse do not merely appear in the material world; they also manifest particular ways of imagining futures, creating social order, and ratifying moral judgments (Bijker et al. 1987; Haraway 1991, 1997; Jasanoff and Kim 2009; Latour 1988, 1993; Latour and Woolgar 1979; MacKenzie 1990). Biological artifacts engage with and reshape our perception of rights and entitlements at many levels: by redrawing the boundaries between humans and nonhumans (Callon 1986; Latour 1993), by altering fundamental notions of human identity and difference (Epstein 2007; Haraway 1997; Rabinow 1992), and by disrupting settled understandings of the state’s biopolitical

prerogatives (Jasanoff 2005). These insights are consistent with the views of a handful of legal scholars working on the intersections of law and technology—for example, Lawrence Lessig (1997) on the architecture of information systems, James Boyle (1992) on intellectual property, Frederick Schauer (1998) on privacy and the Internet, and most recently Douglas Kysar (2010, chapter 7), whose sophisticated assault on the objectivity of cost-benefit analysis in environmental law calls attention to the need for new sources of ethics when genetic technologies are destabilizing the basic categories for classifying living things. Systematic conversation, however, has yet to occur between these convergent strands in law and STS. This book hopes to jump-start that exchange.

Within STS, Bruno Latour offered a suggestive articulation of the concept of bioconstitutionalism, though not using that term, in his influential 1993 monograph, *We Have Never Been Modern*. There, Latour called attention to the work that human societies do to “purify” their world of hybrid networks into seemingly distinct spheres populated by pure entities of nature and culture. He termed the resulting settlement “constitutional,” because it establishes the most fundamental cleavage in modern social experience: between what we make for ourselves and what is given to us by an independent nature accessible only through science. In reality, Latour argues, all of the things that define modern existence are mixed-up and hybrid, culture and nature churned up together. And yet people somehow go about unaware of this, as if categorical distinctions were simple and straightforward: “The smallest AIDS virus takes you from sex to the unconscious, then to Africa, tissue cultures, DNA and San Francisco, but the analysts, thinkers, journalists and decision-makers will slice the delicate network traced by the virus for you into tidy compartments where you will find only science, only economy, only social phenomena, only local news, only sentiment, only sex” (Latour 1993, 2). He might have added “only law.” In the creation and maintenance of such neatly bounded categories, and the resulting erasure of society from nature, Latour locates the constitutional dynamics of modernity.

Powerful as these insights are, they leave many questions unanswered—questions that matter to anyone wishing to make sense of new scientific and technological goings on, let alone to shape their use or meaning. Like any universalizing theory, Latour’s account of the modern is too abstractly metaphysical. It fails to account for the divergences one finds among articulations of the nature-culture boundary in different times, places, institutions, and societies. The mechanics of purification, too, remain largely

unexplored in Latour's schema. One wonders how preexisting normative commitments (including those embedded in constitutional law) affect the reordering of the hybrid products of technoscience into accepted categories of natural and social. Why, for instance, did Dolly's cloning induce no frissons of disgust, whereas the use of similar techniques to clone humans, create human-animal chimeras, make glowing rabbits or blood-stained petunias, or knowingly enhance human traits produces clamor and controversy? Finally, the regime of sharp demarcations set forth in Latour's modernity seems inconsistent with the fluidity, ambiguity, and cultural heterogeneity of technoscientific constructs noted by many STS scholars (Cambrosio et al. 1990; Haraway 1991, 1997; Jasanoff 2005; Latour 1987; Mol and Law 1994; Star and Griesemer 1989).

Latour's metaphysics dwells on the separation of the natural and social orders at the highest constitutive level: the creation of modernity's sense of orderliness. In the ongoing, mundane interactions of law and the life sciences, we encounter more what I have termed the "interactional co-production" of two already separated worlds struggling to name, define, and deal with novel ontologies that trouble their boundaries (Jasanoff 2004; also Testa, chapter 4, this volume). In the interactional register, we confront problems of normativity specific to legal regimes: what rights should humans have vis-à-vis new biological techniques that impinge on their lives; where should human agency, and the protections accorded to it, begin and end; when are humans entitled, as citizens, to participate in governing new forms of life; and who in any case should represent, or speak for, rights disrupted by advances in the life sciences and biotechnologies? These are among the concerns that we address.

The textual analysis of high court and appellate decisions—the staple of constitutional scholarship—offers at best a partial window on our concerns. Rights have to be seen as more than constructs discerned by judges trained in legal reasoning and articulated in legal language. For rights to have social meaning, they must become embedded in people's imaginations and understandings and worked out in their practical dealings with one another, with the products and processes of technoscience, and with governing institutions. A right in practice emerges not only at the moment when a court declares it, but also when people (and institutions) assume that they or others own the right and can assert it through their actions. Thus, there may be quasi-constitutional rights that no court has declared nor legislature decreed, but that are created (or constrained) through everyday practice and thought in technologically advanced societies. These

include, for instance, the right to say no to particular directions in research and development, through actions that the existing legal order may see as extralegal or even illegal. In relation to the life sciences, moreover, the stream of new objects emerging from the work of laboratories and clinics plays an unavoidable part in reframing rights: such objects may extend rights in new directions, as in the protections accorded to embryos and stem cells; or constrain rights people thought they had, as when a court decides that people may not own the tissues and cells taken from their bodies (Boyle 1992); or, to the contrary, that human genes may not be patented.⁴ Bringing these tacit normative presumptions to light, and illuminating the areas where disagreements lurk, will be important tasks of constitutional deliberation and cross-national comparison in coming decades.

To obtain a fuller picture of bioconstitutionalism, researchers have to dig below the level at which rights are explicitly recognized as being threatened or violated. Inquiry has to focus as well on what we view as the basic building blocks of rights: that is, on social commitments concerning what is worth protecting and why, for and against whom, through which kinds of social and institutional agency, by what means, to what extent, and through what processes. It is at this deeper level, that one may elucidate the impacts of science and technology on the very notion of rights—not only as these are formally construed by courts, but also as they are tacitly understood and worked out by scientists, lawyers, and policymakers (Jasanoff 1987, 1990); articulated in research practices (Duster 1990; Epstein 2007; Hilgartner and Brandt-Rauf 1994); hardened into material technologies, or built into professional discourses (Cambrosio et al. 1990; Jordan and Lynch 1999) and political practices (Gottweis 1998; Jasanoff 2005).

New genetic understandings and capabilities have affected notions of race, diversity, kinship, ethnic and social identity, normality, deviance, criminality, justice, and human uniqueness. Biotechnology has also created new forms of life, including plant genetic resources, embryos, stem cells, biobricks, and human-animal chimeras, along with claims of ownership and demands for state protection. Further, in an era of globalization, these developments have been caught up in changing definitions of state and of sovereignty, problematizing at one and the same time the meaning of rights and the political agents who are responsible for defining and protecting them. Shifts in the understanding of human nature, of distinctions between natural and unnatural objects, and of state prerogatives and obligations have opened up a wide array of constitutionally significant questions that the authors explore.

Emergent and Contested Rights

The theme of contingency is central to most of the contributions. In chapter 2, Alex Wellerstein takes direct aim at deterministic presumptions with a historical examination of California's notorious sterilization program in the first half of the twentieth century. California's enthusiastic embrace of sterilization is widely seen as working out a bad idea, namely, eugenics: the discredited theory that the fitness of a race can be secured through systematic barring from reproduction of its least fit members. Wellerstein shows the inadequacy of this explanation. Looking at sterilization practices in three California medical institutions, he argues that decentralized decision making, a characteristic of U.S. political culture, offers a better explanation of what happened in practice. California hospital administrators, who enjoyed enormous discretion, chose sterilization as a treatment method for idiosyncratic reasons. That incoherence also made for the technique's rapid disappearance when the state eventually centralized its administrative apparatus and removed treatment policy from local, individual control.

Subsequent essays explore the coming into being and constitutional ordering of new objects, new rights-bearing subjects, and new rights. In chapter 3, I use comparative analysis to explore why embryos and their derivatives have been treated differently in national bioethical deliberations. Sketching some of the connections between bioethics and biopolitics, I show how commitments to specific bioconstitutional arrangements influenced ethical choices in the United States, Britain, and Germany. Drawing on my observations as participant in a U.S. stem cell oversight committee, I trace how the committee's micro practices of line drawing and classification separate entities of moral concern from those that are not entitled to such deference. This process of "ontological surgery" serves as a basis for applying moral principles that appear neutral but are in reality consistent with particular preordained notions of constitutional governance in the United States. Here, as in other chapters, comparison makes visible the underlying cultures of observation and reasoning on which bioethical rules and rule applications depend.

Cross-cultural contingencies are explored again in chapter 4, Giuseppe Testa's study of the intricacies of cloning policies in the United Kingdom, Italy, and the United States. He compares three national approaches to dealing with clones derived from somatic cell nuclear transfer, bringing into relief differences in the epistemic underpinnings of legal order in the

three countries. Those differences, as Testa illustrates, resulted in different conclusions about permissible and impermissible scientific research, as well as what constitutes the public good in knowledge making and who is responsible for funding it. He analyzes the place of human life in three national sociotechnical imaginaries, showing how life itself is constituted in the practices of authoritative scientific and legal institutions. He demonstrates that, as in my own analysis, the line of demarcation between fact and value is respected in each national settlement, but where that line is drawn, and who draws it, differ across the three.

The next three chapters examine from different angles another of the book's central propositions: that biological technologies interact with the law to produce new subjects and new rights. Italy features again in chapter 5, Ingrid Metzler's analysis of the politics of human embryonic stem cell (hESC) research in that country. Whereas Testa and I focus on the creation and naming of new entities as sites of constitutional inventiveness, Metzler attends to the fate of stem cells as they are caught up in the dynamics of Italian constitutional politics. In part, the controversy she describes centers on the role of the Catholic Church in appropriating as "souls" within its jurisdiction the spare embryos already created in Italy, and then preventing other similarly ambiguous entities from coming into being. In part, it is about the different incorporation of rights into bodies—the speaking bodies of genetically ill activists and the silent "bodies" of hESCs. Curiously, the bodies who spoke autonomously for themselves failed to garner enough support to overturn Italy's highly restrictive assisted reproduction law in a national referendum. Metzler shows how political abstinence (people not going to the polls) reinforced the position of a church whose injunctions of sexual abstinence were seemingly too well heeded in a nation with a famously declining birth rate.

Leaving aside borderline entities such as embryos and stem cells, Jay Aronson and David Winickoff turn to a category of troublesome human subjects—convicted criminals—and ask whether and how new biotechnologies have affected their rights under the U.S. Constitution. In chapter 6, Aronson shows how the arrival of DNA profiling, with its special claims to infallibility, intersected with habeas corpus claims, especially in death penalty cases. He inquires whether a technological advance can trigger the recognition of a new constitutional right—in this case, a right to postconviction DNA testing. Analyzing case law up to the 2009 Supreme Court decision that drew down the curtain on such a right,⁵ at least for the moment, Aronson traces how a legal and a scientific debate developed together, each affecting the other. First, how foolproof is DNA

typing? Second, does constitutional liberty demand that an infallible technology of truth telling, a “revelation machine,” must be made available to criminal defendants? Cutting against liberal inclinations, the conservative majority’s 5–4 ruling that there is no constitutional right to a DNA test displayed, in a way, a coproductionist sensibility. The justices saw the reliability of the technology, the defendants’ legal strategies, and the norms of constitutional entitlement as too fluid to resolve with the bright line of a definitive constitutional settlement.

In chapter 7, Winickoff discusses how another new technology, the Combined DNA Index System (CODIS) database, forced U.S. courts to rethink their interpretation of the Fourth Amendment’s protection against unreasonable search and seizure. He argues that judicial imaginaries of technology—both the forensic DNA database and technology in general—played a central role in determining doctrinal choices across several courts. Confronted by new technology, courts construed due process against their own prior understandings of what is at risk and who is entitled to be protected. In this case, that process de- and reconstructed the previously naturalized category of felons. The technology of databasing forced courts to rethink the nature and rights of this group in relation to those of the general public. Do all human subjects belong to the same class for purposes of Fourth Amendment protection; that is, do privacy rights attach in the same way to all humans, irrespective of whether they have run afoul of the law? Or should courts recognize that, with respect to rights, people may need to be differentiated on the basis of the risks they pose to society? In showing how courts differed in their responses to this question, Winickoff also establishes the indeterminacy of rights at a time when bio and information technologies are producing unprecedented intrusions into human lives.

Rights, as several of the chapters argue, emerge and are held in place in different ways in different national settings. This is partly a consequence of differences in legal traditions and governance practices from country to country, but partly also of the informal ways in which rights are built into political life worlds, that is, into the collective experiences that tie citizens to their states and vice versa. This embeddedness of rights in political culture is further explored in the next group of chapters.

In chapter 8, Mariachiara Tallacchini discusses four national models for coming to terms with the risks and promises of xenotransplantation—in the United States, the European Union, Canada, and Australia. Each political system has grappled with questions such as who can be a transplant patient; who needs to consent; who needs to be protected; what is at risk;

and what rights patients and populations have in relation to one other and to the researchers responsible for their treatment. The questions may be the same across all political systems, but the answers vary. The differences Tallacchini observes are rooted in different underlying models of state-society relations: a public health model in the European Union that weighs risks to the individual against risk to populations; a citizen model in the United States that balances individual against collective rights; and a communitarian model in Canada and Australia that allows the state to take a back seat while citizens develop collective norms through state-sponsored participatory exercises.

On a geographically orthogonal axis, contrasting the global North with the global South, Kaushik Sunder Rajan asks in chapter 9 how the emerging transnational market in personalized medicine is intersecting with state sovereignty and individual rights. Through an ethnographic comparison of clinical trials in India and the United States, he suggests that the “sovereign” who defines the rights at stake is primarily the nation-state in India but primarily the market in the United States. Experimental subjects’ rights accordingly are defined and interpreted within a constitutional framing of state-society relations in India; by contrast, rights in the American case grow from a contractual framing of the position of the research subject as a potential consumer. Sunder Rajan explores the implications for bioethics in a regime (India) that bestows rights on citizens who are seen as subjects of a sometimes paternalistic state as opposed to one (United States) that confers rights on citizens who are seen as autonomous consumers of biomedical advances.

Current scholarship in science and technology studies rejects the idea that citizens are merely passive objects of the state’s top-down regulation of life, or biopower. The final three chapters develop a compelling argument that the life science and technologies are sites for the articulation of new forms of political agency that can make new political rights appear where none previously existed.

In chapter 10, Jenny Reardon introduces the theme of bottom-up agency with an account of struggles for authority between socially and scientifically constituted groups of genetic research subjects. She shows that people experience group affiliation from several different positions: for example, membership in acknowledged political or social communities; capacity to assert sovereignty; and subjective identification with a community (especially for indigenous people). Whatever the basis for their sense of community, members of social groups recognize that externally imposed biological definitions of groupness may detract from the rights they enjoy

through forms of group identification that have no genetic markers attached to them. Reardon demonstrates how contests over participation in research may pit these two notions of belonging to groups—the biological and the social—against one another.

In chapter 11, Robert Doubleday and Brian Wynne examine a series of encounters between UK citizens and the state at the turn of the twentieth century, centering largely on the introduction of genetically modified crops and foods into Britain. Citizens, they argue, initiated a form of “uninvited participation” through various types of direct and symbolic action, thereby redefining in effect the participatory rights that citizens should enjoy in the development of national imaginaries of agricultural biotechnology, innovation, and progress. Their chapter looks at counterpoised tendencies in this contested period of British politics toward opening up and closing down the possibilities for citizen engagement—the former representing the continuance of ancient monarchical practices of governance, the latter a potentially new reconstitutionalizing of the British subject in relation to the technoscientific state.

In chapter 12, Jim Dratwa takes a still wider-angled look at the construction of participatory rights with a close reading of the European Union as a political space committed to safeguarding the lives of its citizens through precautionary policy making. In his account, the European Parliament and Commission move from a bureaucratic-rationalistic mode of self-legitimation (based on technical risk assessment) to one that foregrounds technological uncertainty and positions European institutions, as opposed to those of member states, as the ones best equipped to govern the uncertainties of new technologies. Dratwa shows how the European Parliament’s textual invocation of “precaution” as a governing principle—in relation to biotechnology among other hazards—calls into being a particular vision of Europe, along with a European public that gives assent to governance (and thus acquires rights) at the European level. He demonstrates how European bodies, through linguistic and procedural choices, mediate among different national positions, thereby giving rise to an emerging, precautionary, European subjectivity.

Conclusion

Several decades of development in the life sciences and technologies have initiated wide-ranging interactions between scientific and legal, particularly constitutional, orders. Sometimes explicitly and formally constitutional, as in cases involving U.S. criminal defendants’ rights to genetic

information, and sometimes hidden beneath contestation over sovereignty or representation, as in U.S. diversity research, Indian pharmaceutical trials, and UK and EU participatory processes, new ways of knowing life through genetic texts have opened the way to rewriting principles of individual and collective rights. At the same time, a multiplicity of new, technologically created biological entities are raising questions about the relevance of already well-recognized rights to things derived from human bodies, things with the potential to become human, and things combining human and nonhuman characteristics. These developments add up to a hitherto largely undiscussed process of bioconstitutionalism that may fundamentally redefine the natural law-centered concepts of rights inherited from the democratic revolutions of the eighteenth century.

As is clear in the following chapters, two central questions for law and ethics continually resurface in the era of technologically manipulable life: who belongs to communities of moral concern, and who is responsible for taking care of life in those communities? For stem cells and chimeras, patients and prisoners, research subjects and consumers of genetically modified crops, ontologies, classifications, and rights have all been redefined through novel intersections between the texts of law and of life. The resulting multiplicity of readings—of entities, entitlements, and responsibilities—has put on the table new questions of stewardship and sovereignty. Nation states emerge in our accounts as prime sites for working out the constitutional challenges raised by these events. Denying any purely mentalist or static conceptions of national culture, we show through detailed empirical analysis how institutionalized values and practices shape the territories in which life itself gains meaning and constitutional norms are reworked. Morally, ethically, legally, and scientifically these are interesting times. Readers will find in the following pages more than mere tea leaves for reading our bioconstitutional future.

Notes

1. Here and in the volume as a whole, “coproduction” refers to the concurrent formation of natural and social orders in societies with substantial investments in scientific and technological innovation. The concept is widely used in science and technology studies to describe the complex linkages forged in modernity between facts and values, descriptive and normative, epistemic and material (for further discussion, see Jasanoff 2004).
2. Britain’s Human Fertilisation and Embryology Authority (HFEA), for example, approved the procedure, provided that prenatal screening also increased the selected embryo’s chances of being born disease-free. The House of Lords ratified the

HFEA's decision (*Quintavalle v. Human Fertilisation and Embryology Authority* [2005] UKHL 28).

3. Democratic constitutions were first imagined more than two hundred years ago by representatives of preindustrial, agrarian societies, situated mainly in Europe and North America. Since that time, innumerable changes have occurred in the organization of commerce and industry, among them radical shifts in transportation, communication, financial, agricultural, medical, and manufacturing practices. The society known to the lawyers, merchants, plantation owners, and politicians who drafted the Declaration of Independence and the U.S. Constitution no longer exists. Ackerman (1983) argues that constitutional law, too, has changed profoundly to meet the challenges of industrial development, but these changes have not always taken place through constitutional amendment—witness, for example, the wholesale transformation of administrative legal culture in the New Deal.

4. *Association for Molecular Pathology, et al. v. United States Patent and Trademark Office*, 702 F. Supp. 2d 181 (S.D.N.Y. 2010).

5. *District Attorney's Office for Third Judicial District v. Osborne*, 557 US (2009).

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