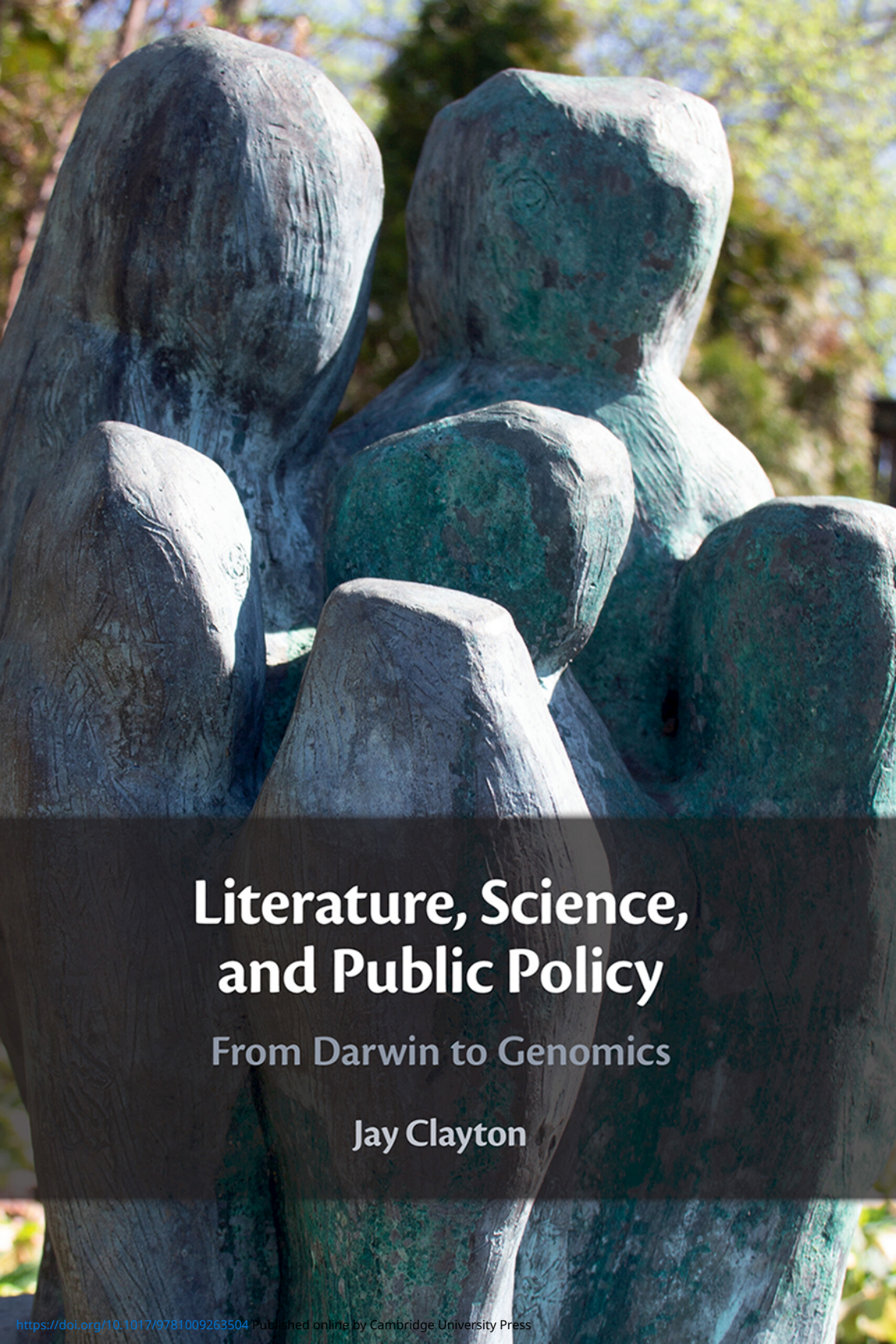

# Literature, Science, and Public Policy

## From Darwin to Genomics

Jay Clayton

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# LITERATURE, SCIENCE, AND PUBLIC POLICY

*Literature, Science, and Public Policy* shows how literature and literary study can help shape public policy concerning controversial scientific issues such as genetic engineering, cloning, GMOs, gene editing, and more. Literature brings unique insights to these issues, dramatizing their full complexity. Its value for public policy is demonstrated by striking examples in chapters that take us from the literary response to evolution in the Victorian era through the modern synthesis of evolution and genetics in the mid-twentieth century to present-day genomics. Outlining practical steps for humanists who want to train in the field, this book offers vivid readings of novels by H. G. Wells, H. Rider Haggard, Aldous Huxley, Robert Heinlein, Octavia Butler, Samuel R. Delany, David Mitchell, Margaret Atwood, Ian McEwan, Kazuo Ishiguro, Gary Shteyngart, and others who illustrate the important insights that literary studies can bring to debates about science policy. This title is also available as Open Access on Cambridge Core.

JAY CLAYTON is Kenan Professor of English, Communication of Science and Technology, and Cinema and Media Arts at Vanderbilt University. Author of numerous books and articles on topics ranging from Victorian literature to digital media, he is the recipient of the Susanne M. Glasscock Prize for Interdisciplinary Scholarship.

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*From Darwin to Genomics*

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*In memory of my brother Harold F. Clayton, sculptor of stone and the spirit, 1954–2015*

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PART IV GENOME TIME

# *Preface*

The germ for this book was planted back in the 1990s when I first noticed that novelists were growing intrigued with how our newfound power to alter the genome might change us. The prospect of being able to clone yourself or create designer babies opened up new perspectives on age-old philosophical questions. Who are we? What is the human? What are our responsibilities to others and to future generations?

Soon fiction in this vein began to increase. Although one could point to a trickle of novels and stories that concerned genetics in earlier decades – Ursula K. Le Guin's "Nine Lives" (1968) is a strong, early example – by the end of the 1990s, the stream had become deep and steady, a forceful current that swept up readers, critics, and prizes alike in its flow.[1] These novels ranged from horror stories, thrillers, and science fiction to dystopias, neo-Victorian novels, and every variety of "literary" fiction you can imagine – realistic novels, postmodernist works, fictional memoirs, family sagas, climate fiction, and more. C. P. Snow once famously lamented the separation between literature and science, remarking that novelists were "natural luddites" (22). Today, in the third decade of the twenty-first century, this part of Snow's diagnosis of the "two-culture" divide has clearly become obsolete.

The increasing prominence of novels that pose serious questions about the social and ethical implications of genetics leads to the main theme of this book: the potential for literary studies – and the humanities generally – to play a greater role in public policy than it has in the past. Once it would have been difficult to imagine literature or literary studies contributing anything to discussions of science policy. At the nadir of the two-culture split during the Cold War, the notion that literary approaches to culture could have anything of value to say about genetics would have seemed implausible. In the last few decades, however, things have changed. Science policy is now formulated in ways that allow a wide range of new actors to participate, giving the humanities a renewed opportunity to make their voices heard in the public sphere. This book will explain how. Each chapter highlights the kind of insights literary approaches can bring to controversies spawned by discoveries in the life sciences. Equally important, each introduces readers to some fascinating novels from the

nineteenth century to the present that confront the challenge of evolution, then genetics, and now genomics.

The germ for this book may have been planted in the 1990s, but the ground had been prepared earlier in conversations with a leading figure in genetics policy, my wife of forty years, Ellen Wright Clayton. To Ellen, I owe much of my knowledge about how science policy is formulated in today's world. Over time, reading her articles and those of her colleagues in the ethical, legal, and social implications (ELSI) community,[2] I learned a great deal about genetics and about the policy issues that arise in that field. Virtually every time a new breakthrough was announced, our household would shift into high gear. At breakfast, I would read in the *New York Times* or hear on NPR of a new genetic discovery, and my wife would go back to her bedside table to find the journal that had published the original study. That evening over dinner, Ellen would try out arguments with me – and later with our two sons as well – about who owned the DNA in leftover blood samples or whether states should mandate screening of all newborn infants for certain genetic conditions. Did doctors have a duty to tell a patient's relatives about a genetic abnormality even when the patient objected? Were they required by law to do so? Could a mining company deny employment to workers with a genetic predisposition for lung cancer? How about a pilot with a heart condition? Should an insurance company be allowed to cancel coverage as a result of genetic testing? Was there a slippery slope leading from cloning for therapeutic purposes to reproductive cloning? What did we think of genetically modifying children? How about genetically modified (GM) foods? Should people worry about the privacy concerns that arise from collecting DNA samples for health and ancestry testing? And, these last several years, where do we stand on CRISPR/Cas9 and gene editing?

One thing was a constant – we all found ourselves drawing parallels with novels like *Frankenstein* and *Brave New World*, or movies like *Blade Runner* and *Gattaca*, or television shows like *Orphan Black* and *Black Mirror*. It was clear that the way issues were represented in our culture had an impact on our attitudes and those of the public at large. News media and the internet played a huge role too. I remember Ellen rehearsing arguments in our living room before she went on the *MacNeill/Lehrer NewsHour* to talk about a divorced husband who had sued his ex-wife over custody of their frozen embryos. As the years went by, the importance of communicating her ideas to the public only grew more apparent. Her interview following a vaccine safety report was carried by over 700 news outlets worldwide. Reporting on her committee recommendations about chronic fatigue

syndrome (now often called ME/CFS) was almost as extensive. This kind of attention made me aware of something policy experts already knew – that public attitudes are a crucial part of the equation when policy questions arise.

Distortions of the science are an ever-present problem. The press notoriously raises undue hopes and exaggerated fears about genetics. To combat this problem, scientists are frequently exhorted to write clearly and speak with restraint about the nature of their findings, which unfortunately they do not always do. But accurate communication of scientific results will never be enough. Long experience has shown that media hype, internet memes, personal stories, cultural myths, fictitious monsters, dystopian novels, postapocalyptic tales, and literary slogans like "Frankenfood" and "brave new biology" will overwhelm any amount of careful language about the limitations of a particular research finding.

Awareness of the important role of culture in shaping attitudes about scientific research made me realize that the humanities should play a part in policy discussions. It takes training and a fair amount of practice in the art of interpretation to disentangle stimulating insights from exaggerations and red herrings. Understanding the science is important. But that is only the first step. The impact of culture on our thinking goes far beyond the question of whether a story gets the facts right. Cultural representations convey multiple meanings, communicating beyond their explicit message in imagery, metaphor, characterization, point of view, genre, and narrative structure. The genre and form of cultural productions shape their meanings. The formal expression of an idea complicates the impact of any work. It may undercut, contradict, and make ambiguous; or it may reinforce, extend, and amplify the theme. Existing methods of inquiry in the policy world are inadequate to the task of elucidating the impact of form on public attitudes. Surveys and focus groups miss the hidden meanings, the deeper resonances, of literature, film, and the other arts – they even miss important aspects of the language used in science writing.

By the time I began reading novels about genetics in the 1990s, I realized that I had developed informed opinions about genetic policy, opinions that were grounded on a relevant knowledge base, namely my lifelong study of literature, film, and popular culture. These opinions were informed, as well, by a disciplinary training in close reading, a theoretical model of the role genres and conventions play in shaping public attitudes, and a critical approach to the power of metaphor, analogy, and narrative. In short, I began to see why my training as a humanist gave me a perspective on the social implications of genomics that was not common

in policy circles. I saw how literary scholars could supplement the viewpoints of other actors in the policy world with new methods and new bodies of knowledge. Most important, I realized that the failure to include these perspectives was diminishing the quality of debate in the policy world.

Over the years, I approached the intersection of literature and genetics from many angles. At first, I thought of organizing my ideas around particular ethical dilemmas such as cloning, genetic engineering, and genetically modified organism (GMO) foods. Eventually, though, the problem of what approach to take solved itself, for I found that I was drawn irresistibly to questions that had ramifications for *both* literature and genetics. Chief among them was the problem of time.

Time is intrinsic both to narrative and genomics. Stories track the course of lives through time, explore the vagaries of memory, rearrange events, foreshadow futures, prolong suspense, and look for (but do not always find) closure at the end. Genetics, too, opens new vistas on time. Darwin shocked the nineteenth century by revealing the longue durée of our evolution as a species. In the twentieth century, the modern synthesis of evolution and genetics transformed the gradual movement of natural selection into mathematical algorithms, enabling us to model temporal change as information or data.

Today, genomics brings home an essential paradox of our existence in time, one shared with countless other aspects of life. That paradox is this: we experience time as linear, but we are also governed by temporal rhythms that are circular in nature. We live in accordance with cycles that are larger than ourselves – the familiar round of day and night, the seasons of the year. Yet we eat, work, love, grow old, and die in moments caught in an apparently irresistible flow toward the future. Religions have always acknowledged this paradox, celebrating the seasons of the year with their own ritual calendars. Contemporary science recognizes this paradox too. Stephen Jay Gould identifies cyclical time as science's response to phenomena that "cycle in simple repeating (or oscillating) series because they are direct products of nature's timeless laws, not the contingent moments of complex historical pathways" (*Time's Arrow* 196).

The paradox of genome time is the way it fuses the personal timescale of everyday life with the immense impersonal timescale of the species. On the one hand, your genetic code is unique, a personal inheritance from your parents that influences important aspects of your identity: height, weight, sex, skin coloring, facial features, facets of your personality, propensity for some diseases, and more. From this perspective, genetic inheritance occurs

in a linear, historical timeframe. Your personal genetic code is the species' *parole*, a speech act that can never be repeated. On the other hand, the genome has a synchronic dimension. It is a sign system, a language consisting of a four-letter alphabet with three-letter codons or "words." Astonishingly complex messages can be sent with this simple code, including the instructions for generating every organism that has ever lived on the planet. From this perspective, the genome is a *langue* that runs through and beyond the individual, reaching back to the first primordial cell and forward to whatever future humanity may encounter. As a self-contained sign system, the relationship between past, present, and future seems arbitrary, a game of chance and necessity worked out in successive generations. Although actual variations occur in linear time, the set of possible evolutionary variations are always already "there," in potentia. The past and future appear inscribed as theoretical possibilities within the virtual space of the code. Think of all one can discover in the DNA from a cheek swab – the origin of distant ancestors, the risk of future health problems – all written in the present moment. The effect is paradoxical. The present becomes everything, but the past and future are not effaced. In fact, they are made knowable in ways previously unimaginable – the true identity of an adopted child's parents, the existence of unknown relatives, the lurking presence of future diseases. All times are inscribed in the present, encoded in the moment. This is the key to genome time – the present is made to contain every possible permutation of time as a suddenly legible system of signs.[3]

Novelists have made much of the analogy between linguistic and genetic codes. One of the earliest literary works to explore genomics, Richard Powers's brilliant novel, *The Gold Bug Variations* (1991), develops the parallel between the four-letter alphabet of the genome and the language of literature. Powers plays with this analogy at every stage of his novel, invoking it in puns, poetry, metaphors, and theme. Most important, he uses the dual temporality of his plot to dramatize the double temporality of the gene. I have written about this foundational work elsewhere, but the innovative temporal structures found in other novels about evolution, genetics, and genomics from the nineteenth century to today indicate a deeper affinity between literature and the life sciences. The two fields, despite all their differences, developed their responses in tandem to changing conceptions of time.

* * *

This book charts the reciprocal exchange between literature and the life sciences across three exemplary "moments": the late-nineteenth-century response to Darwin; the 1930s and on through the Cold War when the modern synthesis of evolution and genetics was developed in dialogue with a distinctive conception of modernity; and the twenty-first century, the age of genome time. Each chapter tells part of the story of how the literary culture of England and (later) America engaged with evolution, genetics, and genomics. In the process, the chapters demonstrate the kind of insights that I believe literary studies can bring to science policy.

While this book is primarily addressed to readers in literary studies and the medical humanities, it may also prove of value to researchers in science policy and to students in humanities disciplines who would like to discover how they could use their training in literature, history, film studies, theatre, art history, or the arts themselves to embark on a career in science policy. Part I of this book, in particular, argues for the value of humanities perspectives in science policy, and it outlines concrete steps for humanists who would like to prepare themselves for careers in this area. My focus throughout is on genetics, but the methods I demonstrate through close readings of genetics novels would be equally useful in thinking about policy in a wide range of areas, including artificial intelligence, neuroscience, nanotechnology, network theory, media, technology studies, climate science, animal rights, urban studies, poverty, homelessness, race, sexuality, and more.

Some chapters engage policy questions more directly than others, but all are meant to model ways that literary scholars can establish themselves as experts in the field. This aspect of my argument is crucial: an aspiring policy analyst must first demonstrate expertise in a "home" discipline before he or she can hope to join the debate. A track record of relevant publications in one's own field is a necessary prerequisite. The readings here show one kind of work that would qualify. But there are many other canons and modes of humanistic inquiry that would serve to establish a relevant expertise – gender, sexuality, or race studies; global literatures; environmental humanities; digital humanities; as well as humanities disciplines outside of literary studies altogether. Close reading is perhaps the most recognizable mode of literary criticism to funding agencies and to the peer reviewers who evaluate grant proposals for those agencies. I will talk about three collaborative, multiyear grant proposals that my colleagues and I have submitted to the National Institutes of Health (NIH), all of which were successful in convincing funders that literary criticism should be considered a valid methodology for working on genetics policy. Our

argument was – and is – that close, historically sensitive attention to texts highlights the complexities with which public policy must grapple. The ability to read critically what people write, both what they explicitly mean and what may lie beneath the surface of their words, is valuable. Scientists do not have to be persuaded that language can be slippery, that buried metaphors can shape how messages are received, and that different communities often read texts in very different ways. The favorable response of reviewers to our NIH proposals and many conversations with audiences at medical schools and scientific conferences make that abundantly clear. Although this book features close readings, other methods in the humanities tool kit should work as well, as long as you are prepared to offer a clear account of your approach and are able to identify the distinctive benefits it will bring to the conversation.

By and large, the novels I explore in this book are impressive works of art. Consequently, novels and narrative theory play a prominent role in this discussion. Thinking about narrative can be of special value to policy work because of the power stories possess to immerse readers in richly imagined worlds, worlds in which the complexity of issues can be explored on multiple levels. A related focus is on questions of genre. Attending to the way in which genre molds expectations, often at the unconscious level, helps us understand why people respond in certain ways to stories, characters, and problems. Genre also encodes shared assumptions of particular historical periods or communities of readers. Tracing shifts in assumptions and expectations that are encoded in genres can be a powerful way of revealing how people are responding to a scientific discovery. The arc of narratives, the nuance of closely observed worlds, can speak to our society's greatest hopes and fears.

My emphasis on narrative, genre, form, and aesthetics is intended to underline the importance of doing what literary critics are trained to do – analyze literature. The only way the door to the policy arena will open for those of us in humanities disciplines is if we foreground our own distinctive methods and practices. Social science disciplines already assess the impact of culture from their perspective; we need to bring our methods to bear on the same problems. If we want to show that literature can lead to insights not easily revealed by philosophical reasoning or social surveys, then we should foreground the distinctive qualities of literature and literary culture.

In Part I, I explain how the policy process works today and discuss developments in related fields such as the medical humanities. I take Ian McEwan's *Saturday* (2005), a novel that foregrounds the relationship

between literature and science, as an exemplary first text. Since the growth of the policy world makes possible a new role for literature in a scientific age, it is important to understand how the relationship has changed over time. The literature of Darwin's age gave powerful expression to hereditary descent; with the rediscovery of Mendel's work in the twentieth century, modern genetics made the mechanism of descent clear. Genetics gave continuity with change a causal mechanism, and descent through time found an explanation at last. But when genomics arrived, linear descent suddenly seemed to be only part of the explanation. Then we had to allow for simultaneity as well as descent, for a system of the whole as well as individual variations. Later chapters will trace shifts in this relation through each of my three time periods: first, the science vs. literature debates of Thomas Huxley and Matthew Arnold in the nineteenth century; then the distinctively modern posture toward science and literature taken by Thomas Huxley's grandchildren, Aldous and Julian Huxley; and finally, the repositioning of literature vis-à-vis science occasioned by the growth of the policy world.

Part II turns back to the prehistory of genetics, examining the cultural response to Darwin. Darwin's theory of evolution was one of several scientific developments that led to a new understanding of time in the nineteenth century. The revelation that life had existed on earth for far longer than the Biblical 6,000 years contributed to a dizzying expansion of time, one that was difficult for the human mind to grasp. This disorienting new perspective has been called "Deep Time," and the concept is even more pertinent now as we struggle to come to terms with issues such as climate change that require a perspective that encompasses tens of thousands, if not millions, of years.

The flood of books in the wake of Darwin's *The Origin of Species* provides an illuminating counterpoint to cultural developments in our own day. One of the most significant methods that literary study can bring to policy discussions is the tool of comparative cultural analysis. But the lessons of the past rarely can be applied directly to the present. This section on the nineteenth century traces parallels and differences between three aspects of late-Victorian and twenty-first-century culture: sensationalistic debates about the ethical status of human-animal chimeras (Chapter 2), the seductive attractions of neo-Lamarckian thinking (Chapter 3), and the changing relationship of science and literature (Chapter 4).

Part III explores another turning point in the temporality of the life sciences. From the 1930s until almost the end of the twentieth century, the modern synthesis of evolution and genetics was the dominant

paradigm in biology. Chapter 5 explores a group of novelists, philosophers, and early geneticists who were prominent members of the Bloomsbury circle. It is not widely recognized that Aldous Huxley, author of one of the best-known novels about genetics, *Brave New World*, was the brother of Julien Huxley and friend of J. B. S. Haldane, two of the pioneers of the modern synthesis. The three of them, along with a few others in their extended Bloomsbury circle, shared a distinctive approach to modernity. The result was not only a revolutionary breakthrough in genetics but also an influential stance toward science and society.

The other chapter in this section examines science fiction (SF) written during the heyday of the modern synthesis from the early 1940s to the turn of the millennium, identifying two major phases in science fictional thinking about the posthuman – one relying on eugenics, the other on genetic engineering. This history of SF's engagement with genetics calls into question a widespread practice in policy discourse of narrating hypothetical futures that might result from current developments in genetics. By exposing the unacknowledged kinship between SF and the writing of some prominent bioethicists, this chapter models a double contribution that literary studies can make to policy: on the one hand, it can deconstruct the claims of scenario thinking to the status of nonfiction while on the other hand, it can help us see the policy value of some of the imaginary futures found in SF about genetics.

Part IV brings us up to the present. This section begins by defining the characteristic time signature of genomics, which can be traced in the public pronouncements of geneticists and policy experts alike. Genome time leads us to believe we can see the past and future already written in the present, encoded in our DNA. It is a millenarian attitude in which the present contains both past and future, legacy and prophecy all in one. Whether coded as damnation or salvation, or some mixture of both, the language of DNA is now seen as holding the secret of life itself.

The three chapters that bring the book to a close offer readings of novels that have a particularly strong bearing on contemporary ethical debates around genomics. Chapter 7 explores the implications of genome time in greater depth, paying special attention to how the temporal assumptions embedded in direct-to-consumer genetic testing shape the public's willingness to put their privacy at risk for uncertain health benefits. The chapter on biodystopias examines contemporary novels set in terrifying futures, futures that dramatize potential flaws in current US policies on genetic screening and GM foods. The final chapter considers the ethical implications of organ harvesting via an analysis of one of the most

poignant books of our time, *Never Let Me Go,* written by the Nobel Prize winning author Kazuo Ishiguro.

Powerful works of art, from *The Island of Doctor Moreau* to *Never Let Me Go*, enrich our understanding of the issues that matter most in our lives. They present questions that urgently need answering in all the complexity and ambiguity that policy makers need to grasp. By exploring the dense cultural networks that shape science and technology, these novels help us see multiple dimensions of policy issues that might be opaque to other forms of analysis. Ultimately, the novels discussed in the pages that follow provide a space for reflection, for deepening and expanding our awareness of the many forces that constrain and enable us – both as individuals and as communities – living in genome time.

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PART I

# *Literature and Science Policy*

CHAPTER 1

# *A New Project for the Humanities (Ian McEwan)*

> The misfortune lies with a single gene, in an excessive repeat of a single sequence – CAG. Here's biological determinism in its purest form. More than forty repeats of that one little codon, and you're doomed.
>
> Ian McEwan, *Saturday* (2005)

Huntington's disease. Perowne, the neurosurgeon in Ian McEwan's novel *Saturday*, readily diagnoses the genetic abnormality that afflicts Baxter, a petty criminal who is in the midst of assaulting him. It is like a tic with Perowne. He cannot stop himself from analyzing the biological causes of the poor emotional control, the violent temper, of the man who is beating him. Perowne regards himself as a "professional reductionist," a man of science who "can't help thinking it's down to invisible folds and kinks of character, written in code, at the level of molecules" (281). A lifetime of medical experience has led him to conclude that much of our behavior is dictated by biology. But Huntington's disease represents an extreme case. For someone with this condition, the "future is fixed and easily foretold" (94).

In the same year McEwan's novel was published, a committee established by the Institute of Medicine (IOM) was completing a study of how best to respond to emerging scientific discourses exploring interactions between genes and behavior. The committee developed fourteen recommendations for future research in this contentious area. The first was a call for transdisciplinary research into the "social, cultural, psychological, historical, political, genetic, and geographic/ancestral" factors that influence "fundamental aspects of human identity" such as "sex/gender and race/ethnicity" (Institute of Medicine, *Genes* 4). This appeal would seem to open a door to humanities professors to participate in an important collaborative endeavor. After all, these are topics that many humanists teach and write about every day. But most of us in the humanities are not even aware that such an opportunity exists.

*Saturday* tells the story of a doctor who makes some questionable ethical choices under extreme duress. To escape being beaten senseless, Perowne exposes the medical condition of his assailant in front of his companions. This act is not a violation of professional ethics since Baxter is not Perowne's patient, but it later turns out to be an error of judgment and makes Perowne worry that he was responsible for the events that follow. If there was an ethical lapse, it is personal, not professional, but the novel gives its readers considerable latitude in determining for themselves if this first choice was the right thing to do. Later, Perowne lies about the existence of a treatment for Huntington's disease to save his daughter from sexual assault by Baxter, who is still humiliated by the doctor's earlier revelation. Finally, Perowne consents to perform brain surgery on Baxter, despite the conflict of interest created by his personal involvement – even culpability – in Baxter's injury. The novel's complex portrayal of these ethical choices would make it an excellent text for a course in medical humanities or medical ethics. But its chief interest for genetics policy lies elsewhere. The novel's framing of the question of genetic determinism in terms of literary vs. scientific knowledge suggests that we reconsider this concept's central role in many policy debates.

Huntington's disease is one of the few adult-onset conditions for which one can say unequivocally that a mutation in a particular region of the genome is at fault, and it looms so large in writing about the field that one might be surprised to learn that the gene was identified only in 1993. Judging from the media, which breathlessly announces a new gene for some medical condition every few months, one would think that doctors and scientists believed that genes "cause" virtually every aspect of life, but that is far from the case. The belief that genes by themselves cause things to happen is called "genetic determinism"; it stems from a misunderstanding of the relationship between genetics and people's lives.

Huntington's disease results from an error in a single region on chromosome four where a three-letter DNA sequence (or codon) – CAG – may be repeated too many times. Everyone has multiple copies of this codon – anywhere between six and thirty is typical – but more than thirty-eight in a row and you will inevitably come down with Huntington's disease, if you do not die of something else first. In general, the more copies of CAG, the earlier the onset of symptoms. And there is no cure. The disease is always fatal. McEwan writes: "Anyone with significantly more than forty CAG repeats in the middle of an obscure gene on chromosome four is obliged to share this fate in their own particular way. *It is written*" (217, italics in original). The illness begins with telltale

tremors, which escalate to uncontrollable movements of the limbs, and later, the neck and torso. These physical signs are accompanied by behavioral changes. At the very moment his assailant is confronting him, Perowne observes symptoms that will lead him to diagnose Baxter's condition: "*a false sense of superiority*," "tiny movements with his head, little nods and shakes," "poor self-control, emotional lability, explosive temper, suggestive of reduced levels of GABA among the appropriate binding sites on striatal neurons" (92, italics in original).

The fact that Huntington's disease manifests in dramatic alterations of the personality – uncontrollable swings of mood and behavior – feeds into a symbolic opposition between science and literature that is a major feature of the novel. Perowne admits to being "a coarse, unredeemable materialist" (135), while other characters – notably his daughter, a young poet on the verge of publishing her first book, and his father-in-law, an elderly poet sometimes mentioned as a candidate for the Nobel Prize in literature – uphold the claims of the literary. A disease with both clear genetic origins and a brutal, inexorable course provides an apt foil to humanistic explanations of character. According to Perowne, Baxter's fate is "spelled out in fragile proteins, but it could be carved in stone, or tempered steel" (217). From Perowne's perspective, science can teach us more about the wellsprings of human behavior than the novels his daughter presses him to read. "There is much in human affairs," Perowne maintains, "that can be accounted for at the level of the complex molecule" (92).

The debate McEwan stages between Perowne's belief in genetic determinism and his daughter's commitment to the transformative power of literature is but a single instance of a larger social debate. Fate vs. free will. The biological animal vs. the autonomous self. Brute materialism vs. the soul or spirit. "This is his dim, fixed fate, to have one tiny slip, an error of repetition in the codes of his being, in his genotype, the modern variant of a soul, and he must unravel" (McEwan 289) . The novel brings to light the tangled implications of this debate for our society. And it does so in a way distinctive to literature – through the implicit and explicit arguments it embodies in its plot, dialogue, style, point of view, and form. The narrative reveals the unstated assumptions, the confused perceptions of right and wrong, the unintended consequences of decisions, and the subtle connections of individual lives with a larger world that enter into people's encounter with genetic disease. Its exploration of these issues is relevant to the problem posed by the IOM report on *Genes, Behavior, and the Social Environment* of assessing "fundamental aspects of human identity" (4). If transdisciplinary research into the "social, cultural, psychological,

historical, political, genetic, and geographic/ancestral" (4) factors that influence behavior is an important task for genetic policy, literary studies should stake its claim to be one of the disciplines addressing such questions.

## Science Policy Today

Humanists have an opportunity to make their voices heard in public policy circles today because a change has taken place in the way policy is formulated in the United States and most other developed nations. Over the last fifty years, the rules governing scientific research and much medical practice have been negotiated through a messy but now well-established process. The negotiations take place in a semiautonomous zone of activity informally known as the "policy arena." This arena is made up of ad hoc commissions, working groups, and standing committees convened by professional organizations, such as the American Academy of Pediatrics or the American Society of Human Genetics; by government and quasi-governmental agencies, including the three National Academies, the National Institutes of Health (NIH), and the President's Council on Bioethics; and by international bodies such as UNESCO, the Human Genome Organization (HUGO), and the World Health Organization (WHO). Designed to be inclusive, these bodies are made up of scientists, doctors, lawyers, social scientists, ethicists, and religious leaders. They solicit advice from other scholars, nonprofit foundations, patient advocacy groups, corporations, and more. The ethicists Wolpe and McGee have called this method "expert bioethics," a process "in which issues are framed and conceptualized at a high level of academic sophistication and political authority by groups of highly skilled professionals who are deputized to identify and resolve moral conflict" (182). The goal is to offer a broad-based, scholarly consideration of the factors that should inform political decisions.

The process typically begins with meetings of multidisciplinary committees. These committees pursue a variety of paths: they may hold hearings, take testimony from additional experts, sponsor colloquia, host town halls, submit their findings to peer review, and ultimately issue recommendations. The recommendations may be published in individual volumes, as reports of the National Academies generally are, or appear in peer-reviewed journals where they frequently are accompanied by editorials, commentary, or critical responses. It is not uncommon to have rival sets of recommendations on a given issue. For a pressing current issue,

such as human gene editing using CRISPR-Cas9, a wide cross-section of these organizations will commission reports; private foundations, religious dominations, and advocacy groups may do so as well.[1] While scientists and practitioners in affected areas may find this state of affairs confusing for a period, the effectiveness of a policy recommendation stands or falls, to a reasonable degree, on the quality of its insights and argumentation. Inevitably, the process is political. Lobbying by interest groups, public opinion, media coverage, corporate influence, institutional priorities, and political partisanship attempts to shape recommendations. But it is no messier than any other form of democratic contestation, and it has one distinguishing characteristic: at its core lies a substantive debate over ideas generated through research, scholarship, and intellectual exchange.

Eventually, policy recommendations may become the basis of state or national law. But here is a crucial point: whether written into law or not, policy recommendations have the potential to influence practice in their fields and become factors in decisions by funding agencies and the courts. Lawmaking is the exception in this arena, not the rule. Law defines the outer boundaries of what people can do. Within those boundaries, norms of practice and administrative structures shape the vast majority of behaviors. As Ellen Wright Clayton puts it, "Policy, in this view, is also the product of the unwritten practices of governmental entities and of the explicit and unspoken actions of numerous actors in society, including third-party payers, health care professionals and institutions, and employers" ("Policy Challenges" 23–24). By articulating norms and influencing behavior, policy recommendations make an impact, regardless of whether they become the law of the land.[2]

The new process of developing science policy arose first in biomedical fields. According to Albert Jonsen, the field of bioethics began in the United States in the mid-1960s and had established itself in university medical centers by the end of the next decade (Jonsen 115–16).[3] The growth of the field was stimulated by a series of high-profile biomedical events: the revelation of the Tuskegee experiments in 1972; the *Roe v. Wade* decision in 1973; the birth of the first "test tube" baby, Louise Brown, in 1978; and the controversy that erupted over removing Baby Doe from a ventilator in 1982 (108–13).

In the area of genetics, the field was given a special impetus by a bold move on the part of James Watson, the codiscoverer of the structure of DNA. When Watson became the first leader of the Human Genome Project in the United States, he announced that 3 percent of the annual budget would be set aside for research into the social, ethical, and legal

implications of genetics (Cook-Deegan 163, 237). Three percent of one of the largest expenditures on science in human history was an unprecedented investment in research on the social implications of science. As a result of Watson's commitment, a branch of the National Human Genetics Research Institute in the NIH was dedicated to research on the ethical, legal, and social implications of genetics – or ELSI, as it is still known today.

A third factor contributing to the rise of this new policy process was the creation of institutional review boards (IRBs) within hospitals and universities.[4] IRBs are charged with assessing risks to human subjects and other ethical or legal problems with research. First prominent within biomedical fields, the process has now penetrated throughout the university so that even people in the humanities have often heard about some projects needing IRB approval (although I suspect few humanists know in detail what that involves). The structure is designed to head off ethical and legal problems with research projects before they occur. Scientists often regard IRB requirements as a nuisance or a bureaucratic nightmare, but they cannot initiate even the simplest investigation involving human subjects without it. Much of the funding of science through public, private, or university agencies requires IRB approval in advance. As a result, the ethical impact of much science is weighed before – rather than after – research commences.

For much of the twentieth century, the reverse was the case. The idea that science would be subject to ethical review beforehand was rarely contemplated. The independence of science from social or political considerations was crucial to its growth in status and influence. The image of the neutral, and therefore unimpeachable, authority figure in a lab coat became an icon of the modern imagination, ubiquitous in print advertising and television commercials. The autonomy of science was the principal guarantor of its impartiality.[5] Researchers were not supposed to consider the social implications of their findings but to pursue truth wherever it lay. Leave the consequences of their discoveries for others to deal with – that was not their job. "Science cannot determine what is right and wrong, and should not try to," wrote the early twentieth century geneticist J. B. S. Haldane (*Science* 2).[6] Robert Oppenheimer famously said, "When you see something that is technically sweet, you go ahead and do it, and you argue about what to do about it only after you have had your technical success" (qtd. in Polenberg 46–47). Only after Hiroshima and Nagasaki did scientists such as Oppenheimer become outspoken about their doubts concerning the older norms of ethical neutrality. Oppenheimer's later call

for researchers to consider the consequences of a discovery ahead of time, along with similar public statements in the 1960s by Bertrand Russell, Hermann J. Muller, and other eminent figures, presaged the emergence of the new policy sphere.

Contemporary scientists encounter pressures from numerous directions to assess ethical questions before initiating research. Not only IRB requirements and the existence of the policy world but also new social movements focused on race, gender, and sexuality; animal rights; disability; and the environment have given impetus to this change. Moreover, the transdisciplinary character of contemporary science, with its shifting project-oriented teams, challenges researchers to think beyond old boundaries, and in the process, rethink assumptions that might be normative in their home disciplines.[7] Ethical standards demand that investigators respond to the very political, social, and cultural forces that once would have been seen as tainting science. If scientific *practice* lays as much stress as ever on neutrality and objectivity, scientific *policy* now frankly wrestles with the controversies of the day.

The new process of developing public policy alters the type of actors who are empowered to speak about scientific questions. The people who gain a voice in this arena are sometimes referred to as "policy experts," but the source of their expertise often lies in disciplines outside the policy arena. For example, one may get a master's degree or do a postdoc in health policy, but this credential generally complements rather than replaces the MD, JD, or PhD that constitutes the expert's primary qualification. At the higher levels of the policy world, the credential that matters is scholarly distinction in one's home discipline. The process depends on drawing experts from a representative assortment of disciplines who come together to forge positions on specific problems. In the twenty-first century, expertise plays its greatest role in public life through the intermediary of shifting, transdisciplinary gatherings of specialists who meet, deliberate, and speak in a defined set of venues.[8]

To date, few members of the literary, artistic, or historical branches of the humanities have become participants in this process. Consider the makeup of ethics committees: the professional schools send law, medical, business, and education experts; the social science division sends anthropologists, sociologists, political scientists, and economists; the natural sciences send every discipline relevant to a given problem. Testimony is taken from the corporate world, insurers, patient groups, special interest or advocacy groups, and any other organized body of citizens who are seen as stakeholders. The only professional sector of society not involved in

forging public policy is the humanities. There are two exceptions. Ethicists in philosophy and religious studies departments have gained access. But scholars of literature, foreign languages, history, art and art history, music, performance studies, film, media studies, and theater are missing. This imbalance represents both a problem and an opportunity for the humanities. The problem is that our absence from the room skews the resulting image of culture, and the large role that arts and entertainment play in shaping social norms makes this a serious issue. The opportunity is for literary and historical perspectives to begin to affect political and civic decisions more decisively than at any time since the Victorian era.

Three times now I have been part of humanities groups that have taken steps in this direction. In 2003, Priscilla Wald and I created a consortium between our universities (Duke and Vanderbilt, respectively) to promote the study of literature and genetics, and we established a working group of twelve literature professors at other universities to pursue collaborative research in the area. We received a large grant from the NIH, the first ever given to scholars in literature, to conduct meetings at our respective campuses and develop pedagogical and research methods for using literature and film to explore the ethical and social issues raised by genetics. From this beginning, genetics and literature has grown into a recognized specialization in literary studies well beyond our small group, opening doors for renewed collaborations. Accomplished scholars such as Jenny Bangham, Clare Barker, Michael Bess, Lara Choksey, Patricia E. Chu, Lennard Davis, Jerome De Groot, Regenia Gagnier, Josie Gill, Paul Hamann, Everett Hamner, Clare Hanson, Heather J. Hicks, Karla Holloway, Lisa Lynch, Susan McHugh, Frans Meulenberg, Robert Mitchell, Timothy Murray, Anna Neill, Judith Roof, Heather Schell, Philip Thurtle, Stephanie Turner, Sherryl Vint, Priscilla Wald, Alys Eve Weinbaum, Rebecca Wilbanks, and Hub Zwart have turned their attention to the field and are collaborating with one another and, in many cases, scientists and bioethicists, to address issues of genetics and culture.

Currently, I am one of the codirectors of a second transdisciplinary project on Genetic Privacy and Identity in Community Settings. Funded by an initial $4 million grant from the ELSI division of the NIH and renewed in 2020 for an additional $4 million, our group consists of nearly forty faculty, graduate students, and undergraduates at Vanderbilt University from a diverse array of fields including genetics, medicine, law, biomedical informatics, computer science, health policy, sociology, anthropology, economics, history, communication studies, English, and the foreign languages. I lead the Humanities team, which is tasked with

weighing the cultural factors that influence public attitudes toward genetic privacy. Our team meets regularly with the other two groups (the Law team and the Big Data team) with the aim of developing collaborative publications and synthesizing our collective efforts to formulate policy recommendations. During the renewal process, the peer reviewers singled out the humanities' contributions for particular praise, signaling that the ELSI community and the public policy world can see the merit in humanities approaches to science policy. The experience of working with colleagues from all parts of the university has been fascinating and has produced important results.

Here is a concrete example of the kind of insights that our humanities team has brought to the discussion of genetic privacy. One of the first publications our group produced was a coauthored article looking at Rebecca Skloot's 2010 bestseller *The Immortal Life of Henrietta Lacks* and the film adaptation directed by George C. Wolfe and starring Oprah Winfrey, which aired on HBO on April 22, 2017 (Clayton and King). Our reading highlighted the far-reaching collateral damages that can be caused by lost genetic privacy and the depth of psychic harms that can befall a family and community, especially for those living in poverty and subject to racial discrimination. Such intersectional harms have proven difficult to capture in existing survey-based studies, but the increased burden of this privacy violation on an African American family and community comes through with extraordinary power in Skloot's book and Wolfe's film. As a result of our reading, we reached several conclusions of interest to the public policy community. First, breeches of genetic privacy affect families and communities, not just individuals; communities, in turn, shape individual attitudes in multiple, interlocking ways. Policy recommendations should take into account harms touching relatives and other community members, not just affected individuals. This means not simply relying on metrics that assess how individuals want their genetic information to be treated but also attending to cultural markers that can signal how wider communities perceive genetic harms. Second, the affective dimension of a person's response to genetic information is not superfluous but fundamental to any research into public attitudes. Finally, researchers need to attend to the intersectional nature of the forces shaping the public's encounter with genetic information and threats to genetic privacy. Such intersections include not only overlapping oppressions or conditions of precarity, such as racism, sexism, class inequities, or disability but also the intersections among their personal, familial, religious, and communal lives.

Other humanities scholars are pursuing research that could have similar impacts on science policy and have led to grants and interdisciplinary collaborations. Michael Bess, a historian at Vanderbilt, received a grant from the NIH to look at the cultural history of genetics and robotics. Holly Tucker, in the French department, compared the reception of early modern blood transfusion to recent stem cell controversies in her widely acclaimed book, *Blood Work*. At Duke, Priscilla Wald's work on genetics and race, John Moore's spleen, and other topics in genomics have earned her important roles on interdisciplinary working groups, serving on the Governance Committee of Science and Society and the Steering Committee of Information Sciences and Information Studies. Wald's colleague Karla Holloway, a coinvestigator on our first NIH grant, spent a fellowship year at a bioethics think tank in Washington, D.C., and has published articles in the *American Journal of Bioethics* and a book on what she calls "cultural bioethics." Lennard Davis, another member of our first NIH working group, founded Project Biocultures at the University of Illinois – Chicago, and has published books that have been widely reviewed in science and medical journals such as *Nature, Lancet,* and the *British Medical Journal*. Kirsten Ostherr founded the Medical Futures Lab, a collaborative effort between Rice, Baylor College of Medicine, and University of Texas Health Science Center; her editorial on how the humanities can establish itself as an essential service in response to the corona virus pandemic recommends many of the same strategies for humanists that I discuss here (Ostherr). At Yale, Wai Chee Dimock has been disseminating information about collaborative programs and funding opportunities that bring together the sciences and literature to a wide network of scholars. Dimock regularly publicizes innovative programs such as UCLA's Laboratory for Environmental Narrative Strategies (LENS); the Health and Humanities Network at Columbia and five other universities; and the University of North Carolina's Health and Humanities Interdisciplinary Venue for Exploration (HHIVE). Internationally, Regenia Gagnier, Hub Zwart, and Frans Meulenberg have had success in gaining funding from the British Economic and Social Research Council (ESRC) and the European Union for literary approaches to genetics. Egenis (University of Exeter's Centre for Genomics in Society) includes literary scholars in its grant proposals and conferences.

These are examples of projects in the humanities that have received funding from sources not usually accessible to our disciplines and scholars. These efforts have begun to shift the boundaries of humanities research. But no one from the humanities has taken the next step. No one, so far as

I know, has begun to give testimony or serve on policy committees. But the time is ripe. Writing in the journal *Science,* Claire Craig and Sarah Dillon advocate embedding experts on narrative in science advisory systems "to tackle long-standing gaps in evidence for policy. What is needed now is for innovative practitioners to start asking for the narrative evidence that might be relevant to their specific and pressing questions, and for researchers to take on the challenge of creating it" (Craig and Dillon 136). The next time the National Academy of Medicine commissions a study on blood transfusions, for example, Holly Tucker should be considered for the panel. The same could be said for Lennard Davis and Michael Bérubé when next there is a committee looking into medical approaches to people with disabilities; or Priscilla Wald and Karla Holloway for investigations of racial disparities in science and medicine. But for that to happen, we must continue to demonstrate what literary studies have to offer to public policy.

## Literary Studies and Science Policy: Four Methods

Let me open the case for the humanities by proposing four ways that literary studies can contribute to science policy. My claim is that the study of literature provides insights into the public's understanding of genetics that are not available elsewhere and that cannot be uncovered by the research methods employed in other disciplines. Establishing this point will have an additional benefit for the humanities: it will help reposition our field within the institutional framework of the university and the professional economy of the nation.

(1) *New Archives*. The simplest contribution is to draw attention to a largely unexplored archive of art, literature, and films that provide a sophisticated reflection on the science of genetics. As I mentioned in the Preface, the last twenty-five years have seen an outpouring of literature with a bearing on genetics. This recent generation of novels has ancestors dating back to Victorian horror stories and eugenicist fantasies that began coming out soon after Darwin published *The Origin of Species* (1859) – these earlier works will be the focus of Part II of this book. A similar boom in genetic fiction greeted the modern synthesis, the focus of Part III. But the greatest interest has been displayed in the twenty-first century, to which I turn in Part IV.

This diverse archive of evolutionary, genetic, and genomic fiction is worthy of study for its own sake and because it can contribute to the field

of bioethics in multiple ways. First, literature prompts us to reflect on ethical questions. As countless readers have pointed out, great works of literature bring ethical issues alive. They make us confront questions emotionally as well as intellectually. They inspire and caution, lead us to speculate, and give us pause. Kwame Anthony Appiah puts this aspect of literature well: narrative "reinforces our common understanding, and the values we share." Stories "help us decide not only what we feel about the characters but how we should act in the world" (29–30).

Second, this archive offers humanities scholars the possibility of new institutional homes outside the Arts and Sciences division of universities in fields such as medical humanities, bioethics, and narrative medicine, many of which are located in medical schools, interdisciplinary centers, and foundations. These disciplines are among the fields that serve to legitimize researchers for participation in policy work. They provide a sanction or credential to a researcher in the eyes of policy experts. Such institutional considerations will be crucial to opening the policy world to humanities scholarship.

Finally, novels sometimes have a direct bearing on issues of genetics policy: the error of genetic determinism; the promise and perils of cloning; the dangers of bioterrorism; the ontological status of chimeras; the risk of environmental damage from genetically modified animals and crops; the issues surrounding genetic engineering of organs for transplants; the privacy of medical records; the genetic component of race and sexuality; the possibility that genetic screening programs could stigmatize people with undesirable characteristics; the genetics of behavior; the advent of a new eugenics; and the fear that the "geneticization" of society could desensitize people to data-driven stereotypes. Literature is capable of portraying the complexity of motives, the rich variety of meanings, the emotional impact, and the subtle resonance of such questions in individuals and communities in ways that survey questionnaires are unlikely to reach.

(2) *New Methods*. Literary study can add its distinctive methods of close textual analysis to the quantitative and qualitative investigations of attitudes toward genetics already underway in the social sciences. The impact of popular culture on perceptions of science has been studied successfully by communications scholars such as Celeste Condit or sociologists such as Dorothy Nelkin and Susan Lindee, who have done pioneering analyses of advertising, newspapers, television, and the Internet using surveys, focus groups, and methods of discourse analysis.[9] Work of this sort in the social

sciences has a recognized place in public debates about science and is regularly funded by the ELSI program and other agencies in the United States and abroad.

The role that the humanities can play in assessing this material differs from the approaches common in the social sciences. Discourse analysis, for example, a method often employed by researchers in sociology and communication studies, codes large corpura of texts – sometimes numbering in the thousands – for frequent images, themes, or topics. This qualitative methodology differs from literary criticism's emphasis on the study of individual texts. Discourse analysis also differs from distant reading and other emerging methods of the digital humanities. In discourse analysis, the coding of topics in a group of interviews or other body of texts is generally done by individual researchers whereas quantitative literary studies more often rely on machine reading of large collections of novels or other literary texts. Further, literary interpretation rarely involves empirical surveys or interview methodology. Rather, it analyzes imaginative works to bring out their nuances and conflicts, often revealing meanings that are not apparent on first reading. This procedure requires being sensitive to both the formal structures and the explicit themes of texts.

The dual focus on both formal structures and explicit meanings leverages important recent developments in literary studies, the aesthetic turn in literary criticism, on the one hand, and "surface reading," on the other.[10] Formal features such as genre, style, point of view, narrative technique, metaphor, irony, and much, much more shape the messages that audiences take away from literature and film. Attending to aesthetics and formal structures highlights what literary studies brings to the table in policy discussions – an approach to the ambivalent symbols and affects that circulate in our culture. The buried, sometimes contradictory feelings raised by genetic discoveries often find their most powerful expression in aesthetic modes, something humanities researchers are well equipped to explore. Surface reading, on the other hand, accounts for the explicit meanings of cultural texts, ideas that often connect with audiences in profoundly emotional ways and help shape people's opinions about biomedical research. Together, these methods grant access to both the buried, often unconscious impact of culture and to the explicit, even polemical, force of cultural narratives.

Literary criticism also differs from philosophic methods employed in the field of bioethics. Analytic philosophy is a common approach used to determine the ethical principles that should govern genetic research and practice. Additionally, philosophers often compose case studies of real-life

ethical dilemmas. Either mode of inquiry may use interpretive procedures like those found in literary criticism to assess the validity of practitioners' underlying assumptions, but the goals differ from those of literary studies. Whereas philosophers aim to determine governing principles, literary critics analyze the symbolic meanings and associations evoked by genetics. Literary study identifies the images and motifs that circulate in the larger culture and play a role in constituting us as individuals and groups – subjects who may engage with genetics as patients, doctors, scientists, or simply citizens.

(3) *New Focus on Scientific Language*. Another approach is to bring the techniques of literary analysis to bear on the language of science. The geneticist Richard Lewontin and the historian Evelyn Fox Keller, among others, have done valuable work on the role of metaphors in genetics.[11] Lewontin writes: "It is not possible to do the work of science without using a language that is filled with metaphors" (*Triple* 3). Keller emphasizes that much theoretical work in genetics depends on "the cognitive tensions generated by multiple meanings, by ambiguity, and, more generally, by the introduction of novel metaphors" (*Making Sense* 117). Lewontin and the historians of science who have looked at this question, however, are not literary critics, and they understandably pay less attention to other ways language affects science.

The mediation of language extends far beyond the use of metaphors; it encompasses every dimension of communication. The stories we tell and the words we choose structure our understanding of the world. From the smallest units of speech (grammar, syntax, idiom) to the largest conventions governing writing (form, genre, national language, cultural traditions), the way we communicate affects what is said. *Form shapes meaning*, even in the sciences. Researchers need a nuanced understanding of how the language they use affects their audience, whether other scientists or the general public. Health personnel need an awareness of the same issues to aid them in their communications with patients and fellow practitioners. Science policy needs to understand how the entire circuit of visual and verbal communications shapes the way people understand the ethical questions surrounding science. Language may register assumptions of which the author is unaware; all too frequently, it conveys connotations that are unintended. Literary criticism can yield important insight into those assumptions, and it can elucidate the linguistic sources of many biases and anxieties. Knowing how language conditions ideas about science will facilitate communication for everyone involved.[12]

(4) *New Pedagogy*. Literary studies can play an important pedagogical role in deepening ethical reflection not only in the policy community but also among students in high schools, colleges, and postgraduate programs, including medical schools. In the United States, every student in secondary schools and in most four-year colleges and universities takes literature courses. At a time when educators worry about the low level of scientific literacy in society, literature classes provide a valuable new platform for engaging students with the issues that surround science.[13] The benefit would extend not only to humanities majors but also to science majors. After all, educators in science, medicine, and engineering complain that their students often do not grasp the larger social context of their subjects. Teaching courses in literature and science – or, better yet, coteaching with a colleague in the sciences, as I do regularly – will introduce an untapped audience of students to the importance of understanding the role of science in society.

Universities around the globe are focusing renewed resources on STEM education (science, technology, engineering, and mathematics).[14] In a recent book, Richard Posner reproduces appalling statistics about the state of scientific knowledge among the public: "Only a third of American adults know what a molecule is, 39 percent believe that astrology is scientific, and 46 percent deny that human beings evolved from earlier animal species. . . . One study found that fewer than 20 percent of Americans can understand the *New York Times*'s Tuesday science section" (*Catastrophe* 93–94). Although Posner cautions readers not to overestimate results derived from surveys that may cause respondents to freeze up and forget what they know, he endorses Jon D. Miller's call for increasing "civic scientific literacy" in the public at large.[15] Posner notes that by Miller's metric, "only 17 percent of the adult U.S. population was scientifically literate in 1999" (*Catastrophe* 94). Miller's term captures the place at which literary pedagogy can intervene. If "civic scientific literacy" is defined as the ability to understand the *New York Times*'s science section, English department classes in literature and science can help create citizens who rise well above such minimal standards.

The classes I teach in this area attract a mixed clientele of students majoring in the biosciences, engineering, science communication, public policy, and English. The discussions that result are some of the most stimulating exchanges of my years in university teaching. Students quickly learn that the diverse skills they bring to the classroom enhance everyone's understanding of ethical dilemmas. Science students feel valued for their

ability to clarify unfamiliar genetic concepts or debunk misconceptions they detect in the fiction. Literature students are able to supply information about genre conventions, historical contexts, and literary techniques, which complicate the themes of the text in ways the science students do not always see for themselves. All learn to speak with respect about controversial matters with classmates whose rival perspectives are shaped by very different knowledge bases. The objective of such pedagogy is not to enhance competence in the sciences themselves but to create citizens educated enough to make informed decisions about scientific questions. That in itself is a recognized goal of the science policy world.

## *Saturday* and Time

Ian McEwan's *Saturday* is an apt text to illustrate the contributions that literary studies can make to genetics policy and pedagogy. The novel's most salient policy lesson lies in its critique of genetic determinism. Its greatest pedagogic value stems from the dialogue it stages between literature and science.[16]

The novel's handling of time is a good place to begin, for it nicely balances the claims of both science and literature. Set on a single day, the story moves forward through the hours from early morning until late at night, charting a course that is both chronologically straightforward and symbolically circular. The dual temporality is registered in both form and content. The hours of Perowne's day are linked to his past through memories, to the future through Baxter's inevitable death – and the prospective deaths of Perowne's mother and stepfather, mentioned on the final pages of the novel. "The time will come . . .," the novel concludes, when his son will leave home, his daughter will have a child, the house will empty out, and he and his wife will turn inward, cling to one another. "A time will come when they find they no longer have the strength for the square" and move out of the city. A time will come. "Their Saturday will become a Sunday" (285–86). Perowne's present cannot be disentangled from a past and future – no more for him than for anyone else.

Except that it can. The novel gives us glimpses of a different kind of time, a time in which the present expands to encompass everything and one forgets past and future. Such moments are granted to artist and scientist alike. In McEwan's book, they serve as common ground for the two cultures.

Obliviousness to time comes over Perowne both when absorbed in music and when performing surgery. "Perhaps only music has such purity"

(67), Perowne reflects, especially Bach's *Goldberg Variations* (a piece that has a special place in the canon of fiction about genetics).[17] Time also dilates for Perowne when listening to his son play one of his blues compositions: "There are these rare moments when musicians together touch something sweeter than they've ever found before . . . [giving] us a glimpse of what we might be, of our best selves, and of an impossible world in which you give everything you have to others, but lose nothing of yourself" (176). Perowne's thoughts about giving to others while losing nothing of himself prepare for an elaborate description of this phenomenon, which comes at the end of the novel when he operates on Baxter:

> For the past two hours he's been in a dream of absorption that has dissolved all sense of time, and all awareness of the other parts of his life. Even his awareness of his own existence has vanished. He's been delivered into a pure present, free of the weight of the past or any anxieties about the future. In retrospect, though never at the time, it feels like profound happiness. It's a little like sex, in that he feels himself in another medium, but it's less obviously pleasurable, and clearly not sensual. . . . He feels calm, and spacious, fully qualified to exist. It's a feeling of clarified emptiness, of deep, muted joy. (266)

The passing comparison to sex reminds us that a similar transport begins and ends the novel when Perowne and his wife make love. They are beautiful scenes of married love, rare in fiction, and they have the same power to suspend time. His love for his wife, like his absorption in music, suspends time as effectively as his immersion in surgery: "Now he is freed from thought, from memory, from the passing seconds and from the state of the world. Sex is a different medium, refracting time and sense, a biological hyperspace as remote from conscious existence as dreams, or as water is from air" (52). His daughter claims the same power for poetry and fiction. Athletes too, when they are "in the zone," experience the same absorption, and McEwan portrays that feeling during Perowne's long squash match in Chapter 2. The message is clear – this time out of time is available to all: poet, musician, scientist, lover, athlete, and the rest.

The two senses of time – everyday, personal time, in which the present is linked to a given past and an unknown future, and an impersonal time, or timelessness – appear in one contemporary novel after another when the topic of genetics arises. *Saturday* does not explain why – McEwan is more interested in finding a common ground between art and science than exploring the relation of this altered sense of time to genetics. But a close reading of the novel can perhaps disclose a reason for the association. The second chapter begins with a sustained passage about Darwin that includes the following meditation on time:

> What better creation myth? An unimaginable sweep of time, numberless generations spawning by infinitesimal steps complex living beauty out of inert matter, driven on by the blind furies of random mutation, natural selection and environmental change, with the tragedy of forms continually dying, and lately the wonder of minds emerging and with them morality, love, art, cities – and the unprecedented bonus of this story happening to be demonstrably true. (54)

The unimaginable sweep of time is what novelists cannot resist. They are intrigued by the paradox of a temporal span beyond the scope of personal perspective that nevertheless evokes the tragedy of forms continually dying and the wonder of individual minds emerging to experience history within time.

## Literary Studies and Genetic Determinism

The same paradox arises from the novel's treatment of genetic determinism, its chief contribution to a debate in the policy world. More than two decades ago, influential voices in the policy realm pointed to the tendency of literature, film, and other forms of popular culture to instill mistaken views about the power of genes to determine our identity and fate. Most prominent among these voices were two social scientists, Dorothy Nelkin and Susan Lindee, authors of *The DNA Mystique: The Gene as a Cultural Icon* (1995). In this influential book, Nelkin and Lindee argued that cultural representations of the gene portrayed it as the "master molecule," the origin of who we are and what we might become. Naming this belief "genetic essentialism," they criticized it as unduly deterministic and false to the actual science of genetics.[18] Since that day, it has been taken as a given in policy circles that we must work against this impulse. Critiques of genetic determinism are legion, many emanating from some of the most respected commentators on contemporary genetics: Richard Lewontin, Steven Rose, Ruth Hubbard, Evelyn Fox Keller, Lily Kay, Susan Oyama, John Dupré, and Donna Haraway.

One might conclude from this damning chorus that cultural representations of genetics irredeemably corrupt the public understanding of the science, but that is not the conclusion that Celeste Condit draws from her comprehensive survey of the effect of popular culture on people's belief in genetic determinism. Condit and her colleagues find that "general trends indicate that, contrary to the claims of the critics, there has not been a significant increase, over time, in the level of determinism in the public

discourse about heredity and genetics" (980) and conclude that "scientific research on human genetics can be accompanied by the development of public vocabularies that recognize the ways in which genetic factors exert influence on human outcomes without portraying those factors either simplistically or as all-powerful" (983).

Much of the literature discussed in this book facilitates "the development of public vocabularies" and shared understandings of genetics that do not portray it "simplistically or as all-powerful." I do the same in my teaching as my students and I explicate these same texts. As a result, I see a clear role for literary studies both in educating the public about such issues and in dispelling some of the misperceptions in the policy world about the effect of cultural representations of genetics. Although gross exaggerations of genetics abound, the impact of such representations is neither simple nor direct. Hence, it is hard to get a clear picture of how fiction or film affect the public's understanding of genetics by tabulating mistaken references to genetics in the media or asking people to respond to questionnaires, common methods of ELSI research. Literary studies and other humanities approaches present an alternative.

Literary scholars generally do not canvas individual readers to understand the impact of a particular text. Rather, we look at how texts position the reading subject within culture. [19] Individual works participate in larger networks of meaning. A single novel such as *Saturday* may have a negligible effect on public attitudes toward genetics – and that effect will differ from reader to reader and across varied demographics (gender, sexuality, race, class, abledness, age, etc.) – but interpreting McEwan's novel can tell us much about the cultural meanings encoded in its genre, conventions, metaphors, symbols, and narrative structure. By focusing closely on representative texts, we gain access to the kind of images that are circulating in the culture at large. This approach has affinities with what the anthropologist Clifford Geertz has called "thick description." Defending "an interpretive theory of culture," Geertz calls for a practice that is "much more like that of the literary critic" (9). We need this approach, Geertz says, because culture is not "something to which social events, behaviors, institutions, or processes can be causally attributed; it is a context, something within which they can be intelligibly – that is, thickly – described" (14). That is one of the things literary studies and other disciplines in the humanities can add to the existing policy discourse, a rich, nuanced description of the culture in which attitudes toward ideas like genetic determinism thrive.

## Genetic Determinism in *Saturday*

McEwan's novel identifies, yet avoids, the problem of genetic determinism by balancing the claims of both science and literature. *Saturday* reaches its climax in a harrowing confrontation in Perowne's living room. Baxter and one of his henchmen invade the Perowne household as the doctor and his family are gathering to celebrate the publication of the daughter's first book of poetry. The scene quickly turns violent. What transpires feels inevitable, both because it is triggered by Baxter's genetic condition and because the novel draws together causal clues from throughout the day. As Aristotle recommended over 2,000 years ago, the narrative culminates in a recognition scene (*anagnorisis*) that precipitates a reversal of fortunes (*peripeteia*) with the ensuing final chapter serving as denouement. In short, the novel is structured in accordance with classic principles of literary narrative, an elegant – if traditional – formal shape that reinforces the novel's own thematic emphasis on the claims of literature.

Perowne is unprepared for the events that unfold, despite not only his belief that Baxter's future was preordained by his disease but also numerous novelistic hints throughout the day that might have alerted him to the impending danger. Although no one believes that genetic determinism allows one to predict specific events in a person's life, Perowne's shock at the sudden turn of events needs to be interpreted in light of his faith in scientific certainty. It is a novelist's reminder of the uncertainty of human destiny. McEwan underlines the unexpected course of events by having Baxter undergo an abrupt change of heart. After learning that Perowne's daughter is a poet, Baxter makes her recite a poem for him while standing naked before him and her assembled family. Paralyzed, incapable of remembering a word of her own poetry, she is reminded by her grandfather of the lines she had learned as a girl from Matthew Arnold's "Dover Beach." Baxter's transformation is so abrupt that the novelist fears his readers will find it implausible, so McEwan adduces Huntington's disease as an excuse for what might be seen, from a strictly literary point of view, as a failure of realism: "Could it happen, is it within the bounds of the real, that a mere poem of Daisy's could precipitate a mood swing?" (229). Mood swings, we have been told more than once, are a common feature of Huntington's disease.

Let me pause over the novelist's careful staging of this scene of recognition and reversal. The narrative about-face leads to a more consequential reversal of fortune for Baxter when Perowne and his son manage to disarm their assailant and pitch him down the stairs, shattering his skull. The

climax is overdetermined by motives woven throughout the long day's events. Tangled causal relations extend everywhere: through the family's complex dynamics, their love as well as their quarrels, through Perowne's power and authority as a doctor, through Baxter's shaky standing among his criminal associates, and through factors beyond all these, far beyond in ways the novel adroitly registers, to aspects of life in the city, to inequities in wealth and education, and to England's complicity in the impending invasion of Iraq. Marshaling such a tangled web of motives and meaning is a traditional strength of fiction. But while the novelist arranges all these customary facets of realistic narrative to finesse the question of probability raised by Baxter's change of heart, McEwan holds a trump card in reserve. It is Huntington's disease itself. Neurological degeneration, a "wasting in his caudate nucleus and putamen, and in his frontal and temporal regions" (234), contributes to what happens next.

> [Baxter is] becoming manic, he's tripping over his words, and shifting weight rapidly from one foot to the other. . . . It's of the essence of a degenerating mind, periodically to lose all sense of a continuous self, and therefore any regard for what others think of your lack of continuity. Baxter has forgotten that he forced Daisy to undress, or threatened [her mother]. Powerful feelings have obliterated the memory. In the sudden emotional rush of his mood swing, he inhabits the confining bright spotlight of the present. (232)

This passage establishes a balance between the claims of biology and literature. A cursory (mis)reading of the scene up until these sentences might lead one to conclude that the power of poetry won Baxter over; that the magic of literature humanized him, convincing him not to continue his attack on Daisy; that the beast was tamed by beauty, Caliban by Miranda's art. After this neurological passage, a cursory (mis)reading might suggest that irrationality stemming from Huntington's disease caused Baxter to act in an unpredictable way. But neither is true by itself. Both genetics and literature play their part. This is one of the things that make *Saturday* compelling: its equitable assaying of the claims of art and science.

Look at how the novel complicates the opposition between genetic determinism, on the one hand, and a view of literature as revealing a world too complex for any genetic explanation, on the other. The book opens with Perowne awakening in the early hours of the morning, and then (in a foreshadowing of Arnold's poem to come) going to the window of his bedroom. He reflects on the mystery of the city outside, London "a brilliant invention, a biological masterpiece – millions teeming around the accumulated and layered achievements of the centuries, as though around

a coral reef" (3), and he wonders about his odd mood of euphoria, whimsically supplying both a *scientific* and a *novelistic* explanation: "Perhaps down at the molecular level there's been a chemical accident while he slept – something like a spilled tray of drinks, prompting dopamine-like receptors to initiate a kindly cascade of intracellular events; or it's the prospect of a Saturday, or the paradoxical consequence of extreme tiredness" (4).

Perowne is an egotist but reflective too, and the novel is narrated in a meditative, observant stream of indirect discourse that gives us everything from his perspective. Only a few sentences later, Perowne is reflecting on his own "astounding ignorance" of literature, including Darwin's *The Origin of Species*, which his "too literate daughter, Daisy" has given him, and which he has only recently dashed through (4). By the end of the chapter, in which we have followed his train of thoughts through a retrospect of his eight neurosurgeries on the previous day, his deep love for his wife, the awe he feels at the budding musical talent of his son, and his fears that a fiery airplane he has seen descending over darkened London might be a terrorist attack, we are ready to understand the words that begin Chapter 2, Darwin's famous words from the ending of *The Origin of Species*, not just as a comment on the science of evolution but on the entangled bank of human existence: "There is grandeur in this view of life" (53).

The method is novelistic to the core. Take an individual life and make it resonate with larger meanings – that is how novels work, or at least a certain kind of realistic novel. The unique particularities of Perowne's life are enlarged and given greater meaning by analogies, radiating out from his bedroom window to the city of London. The analogy is established by repeated passages about the city square on which his house fronts, the "perfect square laid out by Robert Adam" (16), the square celebrated by his son's blues lyrics: "So let me take you there / City square, city square" (176). From the city square, the analogy continues expanding outward to encompass world historical events. Setting the novel on Saturday, February 3, 2003, the date of London's mass protest against the impending Iraq invasion, establishes the largest context for Perowne's narrative, the analogy between his quarrel with Baxter, in its asymmetrical relationship of power and wealth, and the imbalance of power between Iraq and the West. It all comes together with a clarity of meaning and emotion characteristic of the best fiction. For this is how realistic novels work.

Over the years, critics have occasionally complained about McEwan's love of old-fashioned realist conventions. Here, the novel's emphasis on realism's traditional strengths becomes a way of signifying literariness *per*

*se*. The novel's structure thus plays a role in the book's central theme, the debate between literature and science, which is as much as to say, between the quotidian life of these characters and the power of a genetic condition like Huntington's disease to determine a person's fate. The conventional characteristics of the novel form become exhibit A for what literature can add to our understanding of the complexities of genetics.

What policy changes would I recommend based on my reading of Ian McEwan's *Saturday*? The most obvious proposal would be to reform how we try to dispel mistaken views about genetic determinism. Along these lines, Michael Dougherty, director of Education at the American Society of Human Genetics, has proposed that we alter how we teach genetics. Instead of beginning with single-gene traits (like Huntington's disease), which give students the impression that genes determine more areas of life than they do in reality, Dougherty proposes beginning the genetics curriculum with polygenic (or complex) traits, which make up the great majority of human behaviors. Understanding how gene-environment, gene-gene interactions, and epigenetic factors make it impossible to trace causal links for our actions back to a simple biological origin would help prevent numerous false beliefs about genetics. Perowne's mistake was focusing on a single-gene error on Baxter's fourth chromosome that would determine his death (at some unknown and still relatively remote time in the future) rather than on all the complex interactions of environment, character, circumstance, interpersonal dynamics, class relations, and yes, biology, which would lead to what happened on that day, that fateful Saturday. Inverting the genetics curriculum in medical schools, as Dougherty proposes, would be one step in the right direction. Another useful step would be to teach a single-gene disease like Huntington's through the lens of a novel like *Saturday*, a text that shows that even implacably deterministic conditions have indeterminate ends. This proposal would certainly work within high school and undergraduate curricula, and would even fit well within literature and medicine courses offered at some medical schools. In later chapters, my literary readings will lead to policy recommendations that are not tied to pedagogy, but it seems right to begin with education reforms when dealing with a novel that so dramatically poses the question of the two cultures.

## Training Humanists for Science Policy

The well-known literary critic Louis Menand writes: "The most important intellectual development in the academy in the twenty-first century has to

do with the relationship between the life sciences – particularly neurobiology, genetics, and psychology – to fields outside the natural sciences, such as philosophy, economics, and literary studies" (19). For some, this development suggests that humanists should try to become more like scientists, should attempt to join cognitive scientists in the laboratory, for example, designing experiments on theory of the mind or investigating what mirror neurons can tell us about the mimetic faculty. I am fascinated when I hear of successful collaborations of this sort. And some scholars in the humanities have made progress in this direction, enough to have coined a new name for their field, neuroaesthetics. Literary-scientific collaborations are emerging in environmental studies, too, prompted by the urgent problems presented by climate change. I sometimes hear of artists being embedded for a fellowship year in science labs. But I am skeptical of the long-range viability of literary scholars collaborating directly on scientific research because neither area has much in the way of structural supports for this kind of interdisciplinary work. There is limited grant funding, few promotion pathways, almost no tenure lines, and little graduate and postdoctoral training. Further, scientists have no *professional* incentives to collaborate with the humanities and many disincentives for trying. Why, for example, would scientists ever be tempted to browse the journals in which we publish when a literature search in their own fields might routinely yield 7,000 or more relevant hits in PubMed, as did a systematic literature review we performed for my current ELSI project on the topic of genetic privacy? Given the pervasive suspicion of big science among literary scholars (Guillory, Anderson), what would tempt a scientist to support a humanist on an NIH or NSF grant other than in exceptional circumstances? Scientists are understandably eager to use their hard-won resources on advancing the research they think is crucial to solving problems in their own areas. Individual scientists may look beyond the limits of their field and be sympathetic to the value of the humanities, but there are few structural supports and countless structural barriers to widespread collaboration between the two cultures.

There is one area, however, that welcomes the kind of interpretation and critique that humanists bring to the table – science policy. It is a field that has dedicated grant support for collaborative work and that welcomes participants from multiple disciplines. Because public perceptions of science play a large role in policy recommendations, policy committees recognize the importance of studying culture (Carver et al. 943). They readily admit the role that metaphor and language play in scientific discovery. They also acknowledge that deep-seated desires or fears are at

stake and that norms of identity, as well as ethical principles, hang in the balance. Unlike debates over whether culture shapes the findings of science, no one disputes that culture influences science policy. As a result, language, values, myth, and emotion already figure in policy analyses. Criticism and interpretation of culture is built into the policy process – just not by humanists.[20]

The President's Council on Bioethics underlined the importance of literary culture in its first meeting in 2002. Under the leadership of Leon Kass, a doctor and biochemist, the council devoted an entire session to discussing Nathaniel Hawthorne's "The Birth-Mark." In subsequent meetings, literature continued to receive attention, and the Council eventually released a fat anthology of stories, poems, and creative nonfiction ranging from Homer, Shakespeare, and the Bible to Isaac Bashevis Singer and Lorrie Moore.[21] It is impressive to read the musings about literature of this very smart group of doctors, lawyers, geneticists, neuroscientists, political scientists, philosophers, and religious leaders.[22] Any one of us might wish to be in such a seminar . . . and that is the point: we weren't. Of the scores of scholars who met with the President's Council and discussed the fundamental values of the nation's culture, invoking texts that we study and teach, not one was a scholar of literature, history, or the arts. It is ironic to hear poetry, myth, and fiction honored for how they prepare policy analysts for confronting the great biomedical issues of our time and to know that the people who have dedicated their lives to studying these cultural forms were never part of the discussion.

So how would one go about joining science policy discussions? Here are several initial steps that I would recommend.

- First, establish yourself in your own discipline. At the most basic level, this means completing an advanced degree in your field and publishing on relevant topics in your discipline's journals. You must have credibility in your own subject area before you can speak to the bearing of that area on policy issues.
- Second, use social media to follow organizations that focus on topics and issues with policy implications that match your own interests. In the area of bioethics, you might start with the Hastings Center, ELSIhub, American Society for Bioethics and Humanities, and International Health Humanities Consortium.
- Third, find a mentor at your own university or elsewhere who can guide you in your work, introduce you to colleagues, and include you

on projects as we have done on our grants with more than twenty humanities undergraduates and graduate students. Their participation has led to numerous publications, giving even undergraduate humanities students the rare opportunity to be co-authors of peer-reviewed papers.

- Fourth, meet others in the policy world by attending conferences, joining reading groups, and attending lectures at your home institution.
- Fifth, consider getting a second graduate degree. Acquiring a JD, MPP, MPH, MPA, or similar degree would be useful but perhaps not essential. A postdoctoral fellowship or affiliation with a university-based policy center might be an acceptable substitute. Short-term summer programs, which can enhance your credentials, are offered by a number of bioethics centers.
- Sixth, publish on relevant topics in academic venues both in and outside your home discipline. Additionally, op-ed pieces, blog posts, editorials, and commentaries in science or policy journals can help establish your presence in the field.
- Seventh, join collaborative grant proposals to funding sources outside the humanities. The NIH has shown itself to be hospitable to humanities scholarship. The Mellon Foundation and other private granting agencies are interested in connecting the arts and sciences too.
- Finally, be open to job opportunities beyond your own discipline, whether as faculty in medical centers or in staff positions with policy organizations in the state or national government, the nonprofit arena, or the corporate sector.

In the chapters to come, I will identify a number of topics on which literary scholars can shed light. Evolution, genetics, and genomics will be my principal focus. As the field in which ELSI research first arose, the structure and significance of the endeavor is most prominent there. Moreover, the problems and promise of genetics have inspired a body of literature and cinema that provides an important archive for study. But what I have to say applies to most areas of policy that rely on expert testimony by researchers, scholars, and professionals. The opportunity exists for humanists concerned about climate change, disability, artificial intelligence, immigration, economic inequality, racism, sexuality, and more.

There are signs that some scholars in the humanities are beginning to take advantage of this opportunity. When the pressure comes from above to be interdisciplinary and to quantify research's public impact, these

developments can be troubling. Such external pressures, which result from the disturbing trend of universities toward corporatization, should be resisted.[23] But the neoliberal economy that has created the corporate university is proving difficult to contest, and simply protesting the development is not going to be enough. The economic forces that threaten to marginalize the humanities require us to formulate new responses. The old strategy of staunchly maintaining the purity and integrity of a humanities sphere, set aside from the contaminating touch of commerce and society, manifestly has not worked. (I will say more about the origins and failures of this strategy in Chapter 2). Humanists insist on the importance of studying culture for its own sake – something I support as steadfastly as any of my peers and do my best to practice here – but we need to articulate a better rationale for the value of our enterprise than the one that has already failed to persuade our colleagues in the rest of the university and much of society.

As policy issues invade every aspect of the sciences, the humanities have a chance to speak with a renewed power about civic values. But we can do so only by embracing a new type of transdisciplinarity, one that thinks in terms of alliances among disciplinary investigators rather than of mastery of alien realms of thought.[24] The growth of research that depends on transdisciplinary teams has carved out a place for scholars whose areas of expertise concern meaning, symbolic forms, values, and interpretation. Social scientists and bioethicists have rushed in to occupy this space. Literary scholars should too. What they would find to work on in that space are novels, films, poetry, plays, and a vast array of popular culture about genetics.

Turning our attention to the policy sphere opens up new opportunities for a reconceived humanities that continues to read literature for its own sake but learns to speak about the experience of that reading to a new audience and in the language of public policy. This audience is not made up primarily of scientists. Scientists have other priorities to occupy their time, and even when they happen to enjoy literature, it plays no role in their research methods. *Humanists should address science policy analysts, not scientists themselve*s. Most scientists cannot engage with the kind of sensationalistic distortions of their work that often appear in film and popular culture on any level other than outrage. But science policy experts do take such representations seriously, since the impact of culture on science matters regardless of the distorted images it purveys. That is why I propose targeting an interdisciplinary audience that is already engaged with cultural issues – the policy world.

For the project to succeed, we do not need to prove that cultural representations of science have important consequences, something everyone admits. Rather we need to show that humanistic perspectives on those consequences can be of value to policy debates. As specialists deeply versed in literature, the arts, and cultural questions, humanities scholars can add something distinctive to collaborative policy groups and problem-oriented projects. The case will be made by offering humanistic methods and expertise to granting agencies outside the usual handful of humanities foundations; to our colleagues in the sciences who are often required to include a public impact or ethics component in their grant applications and almost always call on people in other fields to provide that component; to conferences in other areas; to journals of public policy; and, ultimately, to the commissions that formulate the rules that govern scientific research.

This book is my offering.

PART II

# *Deep Time*

A traveler stands on a desolate shore beneath a dying, red sun. His journey has taken him more than 30,000,000 years into the future when the only signs of life are lichen and a monstrous sea slug. Nothing remains of humans or their works. Extinction has taken all except for these last denizens at the edge of a dead sea. The planet itself has ceased to rotate and grown cold. His heart sickens at the death pangs of his world. To H. G. Wells's Time Traveler, as to many of his real-life compatriots in the nineteenth century, this end was implicit in the universe science had revealed. The incomprehensible sweep of time that brought humans onto the scene would one day take them off to extinction.

The crisis brought on by the recognition that the world was older than 6,000 years was certainly one of the defining issues of the Victorian era. Stephen Jay Gould has drawn attention to the discovery of what he calls "deep time" in the late-eighteenth and early-nineteenth centuries. Gould identifies James Hutton and Charles Lyell as two of the heroes of deep time in geology, and he nominates Darwin for the same honor in the life sciences. The concept of deep time opened an unsettling vista to the Victorians, a sense of time far beyond human comprehension, stretching back to the dim origins of the planet and forward to the cold embers of the sun. According to Gould, "Deep time is so alien that we can really only comprehend it as metaphor" (*Time's Arrow* 3) – hence, the usefulness of Wells's fiction. As a way to grasp the immensity of time, few visions have been more powerful than *The Time Machine* (1895).

Victorian unease about deep time is an early episode in our culture's ongoing struggle to come to terms with a disenchanted conception of eternity. Religious or ritual conceptions of time, which frame eternity in cyclical terms, seem to have always existed. Gould invokes Mircea Eliade's well-known discussion in *The Myth of the Eternal Return* to describe this perennial metaphor, but he does not acknowledge how wedded cyclical visions are to religious world views. Gould posits "time's cycle" as one pole

of a neutral dichotomy that takes historical, linear time – what he calls "time's arrow" – as its other extreme. This is a powerful formulation, but the attempt to describe the two poles as logical (and recurrent) alternatives leads Gould to underplay the Victorian religious context. For most of Darwin's contemporaries, what was disturbing about deep time was that it presented a materialist alternative to the dominant Christian narrative, which featured a circular but redemptive vision of humanity's fall from grace and salvation at the world's end.[1]

With few exceptions, it was not until the twentieth century that our culture found ways to describe time's cycle without religious overtones. In the third part of this book, I explore a genomic model of time that reframes cyclical temporality in openly secular terms, what I have called "genome time." But genetics is not the only current science transforming our temporal awareness. Although genomics was one of the early influences, today the sciences of climate change and the Anthropocene are reshaping our relation to temporality as well.[2] As I mentioned in the Preface, Gould takes cyclical time as science's natural posture toward phenomena that "cycle in simple repeating (or oscillating) series because they are direct products of nature's timeless laws, not the contingent moments of complex historical pathways" (*Time's Arrow* 196). Even after Darwin, most Victorians would not have been comfortable with such a disenchanted vision of time's cycle as a direct product of "nature's timeless laws."

The literary response to Darwin's *Origin of Species* (1859) was varied. Some authors, like George Eliot and Thomas Hardy, engaged with evolutionary ideas with sophistication. Gillian Beer has charted the reciprocal influence of Darwin and Victorian realism in the development of narrative works that produced an evolutionary understanding of life. George Levine has pointed to the shared emphasis on gradual almost imperceptible change over time, the continuum of life, the interconnectedness of all beings, and the role of chance in shaping our destinies. More recently, Anna Neill has argued that great Victorian novels by Dickens and George Eliot differed in their treatment of evolutionary themes from popular fiction. Neill draws on Bruno Latour's actor-network theory to maintain that major Victorian realists, with their expansive networks of relations, had the room to register the subtle interconnections of objects, people, and institutions, which allowed them to model the kind of gradual transformations over time that Darwin emphasized. The burden of this critical work has been to demonstrate that the realistic novel contained some of the most nuanced cultural responses to Darwin in the nineteenth century.

Another body of texts responded to evolution in sensational and often polemical ways. Frequently relying on genre conventions that violated realistic norms, a large group of novels brought notions like evolution and survival of the fittest to the public in exaggerated or distorted terms. In sensation novels, utopias, science fiction, imperialist adventure stories, and New Woman novels, the public came to terms with Darwin's dangerous idea through the mediation of fiction. As a group, these texts tamed Darwin's ideas and helped readers cope with a secular vision of deep time. Although they confronted the public with vivid depictions of the immensity of the evolutionary time scale, they tempered the brute materialism of natural selection with a more comforting vision, compounded out of hope for the progressive improvement of the species through the inheritance of acquired traits or by planned programs of eugenics. In effect, they made the endless eons tolerable by giving them a teleology and a method. Perfection of the human species was the teleology, and eugenics the method. Restoring a goal to evolution helped cushion its impact, even if the goal was secular rather than sacred, and identifying a supposedly "scientific" method for reaching that goal – eugenics – mitigated the sense of human insignificance in the face of a meaningless eternity.

By now it is well understood that both goal and method were tainted by racism, class prejudice, gender bias, and imperialist ideology. Much recent commentary has focused on these issues, which are unavoidable, but my main reason for concentrating on Victorian genre fiction is its bearing on the field that in the early-twentieth century would become genetics and still later genomics. The novels in this section revel in topical concerns such as the inheritance of acquired characteristics, eugenics, and the mutability of species. More than canonical works of realism by George Eliot, Trollope, Gaskell, or Hardy, Victorian genre fiction dramatizes issues that would bedevil the public response to genetics throughout the twentieth century and on into the twenty-first.

Neo-Victorian fiction in our day has responded to this legacy in fascinating ways. As participants in a culture shaped by both late-twentieth-century biology and Victorian literature, neo-Victorian novelists capitalize on aspects of both intellectual moments. Further, the authors of neo-Victorian novels such as A. S. Byatt, Andrea Barrett, and David Mitchell feel free to exploit the resources of realistic narrative *and* nineteenth-century genre fiction. When combined with an implicitly self-reflexive posture, this body of literary reflections on the past constitutes an equally important response to the temporal complexities of our moment.

CHAPTER 2

# *Victorian Chimeras*
## *(H. G. Wells, Thomas H. Huxley)*

> You begin to see that it is a possible thing to transplant tissue from one part of an animal to another, or from one animal to another, to alter its chemical reactions and methods of growth, to modify the articulations of its limbs, and indeed to change it in its most intimate structure.
>
> H. G. Wells, *The Island of Doctor Moreau* (1896)

The scientific breakthrough Wells imagined at the end of the nineteenth century has become a reality in the twenty-first. In the past few decades, the questions raised by the creation of interspecies hybrids, xenotransplants, and chimeras have become pressing enough to prompt the Institute of Medicine (IOM) to issue guidelines covering the ethical constraints on such research. The guidelines were new when they were published in 2005, but the problem was not: as far back as the mid-1980s, scientists had successfully created pigs with human DNA, transgenic mice, the "geep" (a goat-sheep hybrid), and human-monkey hybrids made by grafting stem cells from one organism into another. Dr. Moreau's Monkey Man had seemed a monstrous fantasy at the time, but the questions Wells raised about the ethics of creating chimeras have a new relevance today.

H. G. Wells's novel *The Island of Doctor Moreau* tells the story of Edward Prendick's shipwreck and ten-month stay on an uncharted island in the Pacific where Dr. Moreau and his assistant Montgomery have established a biological station to conduct illicit experiments in xenotransplantation. A decade earlier, the discovery of Moreau's gruesome activities had led to his banishment from the London scientific community. Now the doctor has refined his technique and operates on animals to transform them into "grotesque travesties of men" (110). He has devoted his life to the study of the "plasticity of living forms"; he has learned to change "not simply the outward form of an animal" but the "physiology, the chemical rhythm of the creature"; the entire being can be "made to undergo an enduring modification" (97). By the time Prendick arrives, the island is

populated by some sixty of Moreau's creations. These "Beast People" include three Swine Men and a Swine Woman, a chattering Monkey Man, a loyal Saint Bernard Dog Man, a Satyr, the dangerous Leopard Man, and other "half-humanized brutes" (169). Even though Moreau's creations are formed by surgical rather than genetic modifications, they qualify as what scientists today call chimeras – mixtures of biological material from two or more species.[1]

The IOM report that discusses chimeras is a 166-page document titled *Guidelines for Human Embryonic Stem Cell Research*. It reviews the scientific potential of stem cell research, the ethical concerns attendant on it, the current regulatory environment, and the appropriate protections for embryo donors, and then recommends guidelines in this contentious area.[2] The report endorses human stem cell research but proposes limits and increased oversight to address the concerns of opponents.

Regarding chimeras, the committee recommends that any research combining human with nonhuman tissue should be permitted only after review by special oversight committees and that the creation of chimeras involving humans and nonhuman primates should be prohibited at this time. This recommendation is prompted by two concerns, both of which Wells anticipated in *The Island of Doctor Moreau* – the possibility that chimeras might breed and the risk of enhancing nonhuman intelligence. Primates receive special attention for fairly obvious reasons. The degree of genetic similarity to humans affects the likelihood of a chimera's developing human traits, and the size of an animal's brain influences whether its neural development can approach that of humans.

The media greeted this report with a parade of mythological and literary references and quoted scientists and medical ethicists who did the same. Maureen Dowd accused the committee of having "a fit of *Island of Doctor Moreau* queasiness" and quoted Henry Greely, a leading scholar of law and bioethics who spoke at the committee's two-day workshop, as remarking: "The centaur has left the barn" (Dowd A27). Nicholas Wade regaled readers with Lon Chaney in *The Wolf Man*, sphinxes, the Minotaur, mermaids, Caliban, and Medusa (D1). Scholarly articles about chimeras, before and after the report, mentioned the same imaginary monsters. For example, Karpowicz and his collaborators cite *Doctor Moreau* as evidence that the "sinister connotations" of chimeras in myth and literature "have probably had an impact on current negative perceptions of interspecies combinations" ("Ethical" 331). A 2011 report in the United Kingdom by the Academy of Medical Sciences on *Animals Containing Human Material*

notes that the term "humanized animals," now commonly "used in scientific literature to describe transgenic animals or chimaeras" (71), first appeared in Wells's novel. The report situates *Doctor Moreau* with other fictions such as Shelley's *Frankenstein* and Kafka's "Metamorphosis," which it sees as generating concerns that "we need to take seriously" (72).[3] More than a century after the publication of Wells's fable, it is still exerting an influence both on the public's view of the life sciences and on the discourse of science policy.

## Misreading *Moreau*

Unfortunately, prominent policy experts have drawn the wrong conclusions from novels like *Doctor Moreau* and then used them to recommend positions that Wells would have rejected. Citing mythological creatures such as the Greek chimera itself or monsters from literature as evidence of our instinctive abhorrence to mixing species is common among conservative and religious bioethicists, particularly those Steven Pinker has labeled "theocons." What would dismay Wells, a passionate advocate of the biological sciences, is the attempt to use a feeling of repugnance as a principled argument for halting research on stem cells or other potential biomedical advances.

In opposition to this view, I want to emphasize two points. First, that *Doctor Moreau* actually weakens the case against creating chimeras by modeling an ethical stance toward this kind of research in the figure of the narrator. Prendick initially feels sympathy, not repugnance, toward the Beast Men, and his response contains a thoughtful assessment of the issues that surround the laboratory creation of chimeras. Although Prendick identifies both dangers that the IOM *Guidelines* saw as especially worrisome, the book as a whole cannot fairly be described as antiscience. Instead, it implicitly suggests standards for the ethical conduct of research on chimeras. Since bioethicists who endorse continued research on human-nonhuman chimeras have proposed some of the same standards, perhaps *Doctor Moreau* would have little to teach them. But it certainly holds a message for those who oppose such research – a very different message from the one they think it teaches.

Potentially more valuable to policy discussions is the historical juxtaposition of Wells's situation in the 1890s with that of our own time. The disciplinary status of the sciences was in flux in the late-nineteenth century. Its reputation was on the rise, and its role in the larger culture was growing. One of the most telling indicators of how science was on the

march was the threat it appeared to pose to the prestige of literature, a threat that Mathew Arnold made manifest in his debate with Wells's mentor, Thomas H. Huxley. This debate over the comparative value of science and literature had a large impact on nineteenth-century society, as did Huxley's related work to raise the prominence of science education in the universities. Hence, when Wells twice introduces Huxley's name into *Doctor Moreau*, we should understand the references to be more than autobiographical allusions to Wells's former mentor. They are indications of Wells's lifelong commitment to renegotiating the relationship between science and literature. In different ways, the careers of both Huxley and Wells turn out to be exemplary of the disciplinary changes that were shaping their times.

With the rise of the policy realm today, science is having to renegotiate its relationship with the larger culture as well. Increasingly since the 1960s, science has had to account for its impact on society as part of normal operating procedures – most overtly, in dealing with institutional review boards (IRBs); most consequentially, in adapting to policy recommendations; most confrontationally, in responding to social movements, which intermittently but insistently have protested a wide range of environmental and ethical impacts. The changes in the two periods are very different from one another. I do not mean to draw a parallel between the forces reshaping nineteenth-century science and those at work today. Rather I want to show how we can learn from the differences between these two historical moments. Comparative historical study can illuminate as much by juxtaposing the contrast between historical formations as by identifying their similarities. In this case, I want to draw attention to mistaken strategies proposed by Wells later in his career for bridging the gap between science and literature and argue that we not go down that road again.

Understanding the history of literature's relationship to science over the last 150 years will be a recurrent topic in this book. It is an important subject if humanists today are to capitalize on opportunities to participate in science policy discussions. Historical perspective can help us recognize the shape of the new configuration between the two disciplines, not misunderstand our moment, as did the cultural purists of the late-nineteenth century, like Matthew Arnold, who defended literature by emphasizing its aloofness and superiority to science, and those twentieth-century thinkers – characterized by Wells's later books and by C. P. Snow – who hoped that being a generalist could bridge the two cultures. Neither strategy worked in its day, and neither is appropriate for our own time.

## Moreau and Prendick: Two Visions of Science

Prendick's adventures on a South Sea island make for a thrilling tale, one that combines elements of the shipwreck narrative, horror story, and Swiftian satire. His encounter with Dr. Moreau also contributes to a stereotypical critique of science comparable to that which has been derived from *Frankenstein*, *Dr. Jekyll and Mr. Hyde*, and *Brave New World*. Like each of these fictions, *Doctor Moreau* is deeply embedded in the intellectual currents of its day – in Wells's case, the debates over evolution, degeneration, and vivisection, as well as with the biology he learned as a student of Thomas Huxley. Yet the "lessons" of these novels have been consistently simplified and divorced from their historical moment and then adapted for films that further twist their meaning. Wells's portrait of an irresponsible scientist, driven to pursue his investigations at any cost, contributes to a prominent cultural stereotype: the mad scientist.[4] This vision of an egomaniacal scientist playing God is usually all that newspapers have in mind when they invoke the novel. Worse still, their memory of the mad scientist figure is usually derived from one of the wildly distorted movies.

The contrast between Moreau and Prendick, however, results in a more nuanced response to science. Prendick initially thinks that the Beast People have been created by altering humans to make them more animalistic. He fears that Moreau is using surgical means to accelerate what E. Ray Lankester called – in more biologically correct terms than Social Darwinists of the time – degeneration.[5] Although relieved to discover that Moreau's experiments were performed on animals, not humans, Prendick continues to be bothered by the cruelty of this research. Wells was aware of the antivivisectionist crusade of the previous two decades, and his descriptions of Moreau's cruelty to research animals are as harrowing as any in Wilkie Collins's attack on the practice in *Heart and Science* (1883). But Wells did not oppose experimentation on animals. In fact, his position resembles the normative stance of the scientific establishment (from the nineteenth century to the present), which objects to needless cruelty in research and medical education but finds animal experimentation justified in pursuit of legitimate scientific and therapeutic goals.[6] Prendick reflects: "Had Moreau had any intelligible object I could have sympathized at least a little with him" (133).

Prendick's next question involves the possibility of these new mixtures breeding. Just as the IOM committee is troubled by the idea of allowing chimeras to reproduce, Prendick is disturbed by the prospect of Moreau's Beast People bearing offspring. Moreau's assistant Montgomery admits

that they do, but he justifies the practice by noting that the offspring generally die and that besides "there was no evidence of the inheritance of the acquired human characteristics" (112). This latter comment is an echo of the anti-Lamarckian findings of August Weismann, whom Wells had been reading in the 1890s,[7] but the position remains relevant today. The IOM committee finds it "highly unlikely" that human cells "could contribute to the germline" of an animal already beyond the early stages of fetal development (*Guidelines* 33). Some members of the President's Council on Bioethics take consolation from the same point:

> The mixing that is being done so far . . . has not resulted in the emergence of altered human-like features or functions in the non-human. And interestingly, the reason why the new material has not produced a new compound creature seems to be that species are to a certain extent at least fairly impervious to tampering. Monsters aren't so easy to create. (Transcript, 4 March 2005)

To be on the safe side, however, the IOM committee recommends a ban against "breeding of any interspecies chimera" (*Guidelines* 5).

The concern with possible changes in nonhuman brains receives more extended consideration in Wells. Dr. Moreau expresses frustration at not being able to alter the brains of his chimeras enough to achieve something like full human cognition: "It is in the subtle grafting and reshaping one must needs do to the brain that my trouble lies. The intelligence is often oddly low, with unaccountable blank ends, unexpected gaps" (106). Prendick is aghast at Moreau's arrogance. It torments him to think that by raising the Beast People's intelligence, Moreau has produced creatures with a wholly new capacity for suffering. The Beast People have a new claim on Prendick's sympathy. They live in agony, both physical and mental, beset by internal struggles between the old animal instincts and a new humanlike consciousness.

To juxtapose the views of Wells and contemporary bioethicists is to induce a slight shock – both of incongruity and of recognition – when one sees the reactions of Prendick rephrased in the language of policy analysis. Because many people today think that the ethical status of a being is related to its "mental capacities such as the ability to feel pleasure and pain, language, rationality, and richness of relationships," ethicists are concerned that "neural grafting might change capacities in a way that changes moral status" (Greene et al. 385). They worry that "more humanlike capacities might also confer greater capacity for suffering" (Greene et al. 386). More blandly, the IOM committee remarks: "The idea that human neuronal

cells might participate in 'higher-order' brain functions in a nonhuman animal, however unlikely that may be, raises concerns that need to be considered" (*Guidelines* 33).

The urgency of this issue was brought home by the success in 2000 and 2001 of experiments in grafting human neural stem cells into the brains of mice (Uchida et al.) and fetal monkeys (Ourednik et al.). Most scientists agree that there are good reasons for undertaking research in this area, including testing potential therapies for spinal cord injuries and neurodegenerative diseases such as Parkinson's and Alzheimer's; learning whether neural stem cells can repair or regenerate damaged areas of the brain; and discovering whether functioning human tissue or organs could be grown in a host animal for later transplantation into humans. Scientists also believe it to be unlikely that transplanting human neuronal cells into postnatal animals would enhance intelligence to human levels, especially if three conditions are met: (1) the cells are dissociated rather than transplanted as a large mass or entire organ, (2) the cells are not implanted in the very early stages of fetal development before the native brain architecture has been established, and (3) the brain size of the host animal is significantly smaller than that of the human. It is these last two caveats that lead the IOM committee to recommend banning any introduction of human stem cells into nonhuman primate blastocysts (*Guidelines* 7), even though other commentators see less danger in such research.[8] Additionally, the IOM recommends that oversight committees be created to attend to how human cells affect the higher functions of the nonhuman brain (*Guidelines* 6).

## The Emergence of Disciplinarity in Science and Literature

Drawing attention to the serious as opposed to the sensationalistic features of Wells's treatment of science could help deepen the public's response to an important area of biomedical research. Although literary criticism is unlikely to reach a wider public, introducing such ideas into the classroom would have a salutary effect. I know from experience that *The Island of Doctor Moreau* has a similar appeal to secondary school and college-age students as widely taught novels like *Animal Farm* and *Lord of the Flies*. When I draw out science policy issues from *Doctor Moreau* in the classroom, thoughtful and lively discussions of contemporary ethical questions invariably emerge.

A second approach to policy questions in the novel involves comparative historical studies. Because of Wells's deep interest in the place of science in

his time, his work illuminates the changing relationship between science and literature in the 1890s. According to Amanda Anderson and Joseph Valente, "disciplines are always constituted in relation to, and in a kind of dialogue with, other disciplines" (5). This is especially true of Wells and Huxley, who both wrote in and about academic disciplines on either side of the two cultures.

In the early nineteenth century, there was nothing like today's disciplinary structures. The sciences only began to assume their modern forms in the 1860s, and the humanities and social sciences developed still later in the 1880s and 1890s.[9] For most of the nineteenth century, discipline-based expertise was not the primary way a savant gained influence in the public sphere, much to the frustration of early advocates of disciplinarity such as Charles Babbage. By the dawn of the twentieth century, however, the existence of a professional elite, trained and credentialed in their respective disciplines, could be counted on as a resource by both government and industry. The story of this transformation has been frequently told, as has the tale of the divergent trajectories taken by the humanities and the sciences during the remainder of the twentieth century.[10] But these developments form an essential backdrop to understanding the new potential for the humanities to participate in public policy debates. The developments I refer to are most frequently identified by the phrase C. P. Snow coined in 1959: the split between the "two cultures." As is well known, Snow described the gulf between literature and science, using literature as shorthand for the humanities generally. Invoking his own career-long attempt to bridge the gap (and there is a strong affinity between the efforts of Snow and Wells), Snow lamented what he saw as the progressive worsening of the division, and he attributed it to the growth of specialization. Wells, too, struggled against this split, but his attempt (like all others in the twentieth century) must be judged a failure. Although Wells wrote best-selling books of popular science and successfully promulgated his positions on political and scientific questions, neither his fiction nor his nonfiction did much to reverse the widening gulf. Wells's choice to reject literary modernism did not bridge the gap, nor did his plea to scientists to write more accessibly for a general public. Disciplinary specialization was becoming increasingly necessary to modern science, and no amount of clarity or intellectual breadth could heal a breach that was a consequence of some of the largest social and economic trends in Europe and the United States.

There is an even greater irony in Wells's struggle. From his mentor Thomas Huxley, Wells inherited an abiding desire to reform higher

education by elevating the prestige of science and engineering in schools and universities. In the 1890s, this project took the form of insisting that science teaching needed to be laboratory based (one of Huxley's innovations at the Normal School of Science that Wells attended) and of advocating that scientists simplify their style and use a less technical vocabulary.[11] His goal was to spread science literacy throughout the general public and hence reduce the two-cultures gap. But he combined this mission with another, contradictory agenda, without recognizing how the two impulses worked at cross-purposes. This second agenda was an attack on the prominence of classical studies in the university, a cause also championed by Wells's mentor, Thomas Huxley. Writing of the "conflict of studies," Wells advocated replacing classics with more practical courses in science and engineering, thus driving another wedge between partisans for the humanities and the sciences ("Science Teaching" 23).

The parallel with those proponents of STEM education (science, technology, engineering and mathematics) today who call for the replacement of humanities classes in the curriculum with practical classes in science, engineering, and computer science is hard to miss. But such calls have become rallying points for some state legislators and business leaders, as well as by a few education reformists. Richard Posner typifies this vein of advocacy when he writes:

> Bright students have little to lose by substituting math and science for courses in postmodern literary criticism and cultural studies, sociology, women's studies, black studies, journalism, the Holocaust, film .... Society would not be worse off even if by concentrating on technical fields the bright students failed to become cultured persons in the sense in which "culture" denotes familiarity with the classics of the Western philosophical, literary, and artistic traditions. (*Catastrophe* 95)

Posner's rhetoric is more inflated than Wells's, but the position is largely the same.

Wells's campaign for science education exacerbated the two-culture split. As early as *Anticipations* (1901), Wells claimed that people with a scientific background were becoming "naturally segregated" (4: 255). Amid the "world-wide process of social and moral deliquescence" of the day, "a really functional social body of engineering, managing men, scientifically trained, and having common ideals and interests, is likely to segregate and disentangle itself from our present confusion" (4: 127). Wells's account of why this division was probable reads like a formula for manufacturing the two cultures:

> The practical people, the engineering and medical and scientific people, will become more and more homogeneous in their fundamental culture, more and more distinctly aware of a common 'general reason' in things, and of a common difference from the less functional masses . . .. They will be linked in professions through the agency of great and sober papers – in England the *Lancet*, the *British Medical Journal*, and the already great periodicals of the engineering trades. (4: 125)

Just as important to Wells, scientists will be trained in a new type of institution, the research university: "The old-fashioned university, secure in its omniscience, merely taught; the university of the coming time will, as its larger function, criticize and learn. It will be organized for research" (4: 234). There is a place in this new university for literature, but it will be, in the words of an earlier essay, a "clear and sensible" literature that spurns classics and "hates allusions and quotations" (Wells, "Literature of the Future," qtd. in David Smith, 85). As Wells continued in *Anticipations*, "To mumble over the past, to live on the classics, however splendid, is senility" (4: 234).

Rather than regretting this growing division, as might have been expected of a writer with a foot in both camps, Wells celebrated the emergence of a technocratic elite because he hoped it would produce the governing class of a new World State. In years to come, "the power that will finally supersede democracy and monarchy altogether, the power of the scientifically educated, disciplined specialist . . . will triumph" (*Anticipations* 4: 185). Wells felt comfortable trumpeting the demise of democracy and its replacement by the rule of technocrats because of science's reputation for detachment and impartiality. More disturbing still, Wells's unflinching displays of scientific reason justified him, in his own mind, in making heartless calculations, such as working out the competitive advantage that would accrue to a country that "sterilizes, exports, or poisons" its unfit people (*Anticipations* 4: 184).

Wells's example should give us pause when considering Posner's willingness to emphasize the technical fields even to the entire exclusion of "the classics of the Western philosophical, literary, and artistic traditions" (*Catastrophe* 95). Wells's solution to the conflict of disciplines, like Posner's, aligns him with the people whom Huxley, a great scientist, called "Goths and Vandals" who want "to sweep away all other forms of culture and instruction, except those in physical science" (Huxley 3:55). The answer, however, is not the integration of the humanities with the sciences – a vain hope – but collaboration among the disciplines, particularly on projects that raise pressing social, ethical, legal, and cultural questions. In pursuit of solutions to large, shared problems, the humanities, arts,

social sciences, engineering, and natural sciences may each contribute valuably from its own perspective without sacrificing the methodologies that give each specialty its ability to produce new knowledge and insight.

## Prendick's Mentor, Thomas H. Huxley

*The Island of Doctor Moreau* is an indictment of irresponsible science, not all science, and of the kind of heartless experimenter that was even then a cliché of popular culture. It is critical, that is, of the very kind of unswerving rationalist Wells was to celebrate a few years later in *Anticipations*. Moreau freely admits: "I have never troubled about the ethics of the matter. The study of Nature makes a man at last as remorseless as Nature" (*Doctor Moreau* 102). Moreau's cruelty to the animals he operates on without anesthesia, his blind neglect of all ethical questions, and his disdain for the critics who drove him from London are judged harshly in the novel. Prendick's final verdict on this man is unsparing: "He was so irresponsible, so utterly careless. His curiosity, his mad, aimless investigations, drove him on" (*Doctor Moreau* 133).

Wells's novel establishes Moreau as only one pole of a spectrum of scientifically trained men whose other pole is the narrator. Prendick, it turns out, has been educated as a biologist at the Royal College of Science under Thomas Huxley himself. Moreau's assistant Montgomery represents a third variant of the scientifically trained person. He is a disillusioned young man who has washed out of medical school because of too much carousing and now spends his hours complaining about his lot. This range of attitudes and destinies contrasts with the "homogenous" class of "practical people" that Wells was to hail five years later.

Despite Wells's sympathy with Prendick, he understands that the cultured scientist that Prendick represents is not readily available to the specialist of his own time. The narrator harks back to a type of amateur experimenter and literary man who already had a marginal or residual role in the 1890s because of professionalization in both fields. At the end of the novel, Prendick has escaped from the island of horrors and has retired into the country, where he writes the narrative we are reading and spends his "days surrounded by wise books, bright windows, in this life of ours lit by the shining souls of men. . . . My days I devote to reading and to experiments in chemistry, and I spend many of the clear nights in the study of astronomy" (*Doctor Moreau* 185). Prendick's mixed predilections perfectly illustrate the unevenly professionalized culture of the late-nineteenth century, a position surprisingly epitomized by Thomas Huxley too.

From the very beginning of his career, Huxley was an eager participant in the push to professionalize science, working ceaselessly to reform university curricula, to infiltrate himself and his friends into leadership positions in professional societies, and to secure governmental posts, journal editorships, and prestigious university chairs. He was no leisured gentleman of science like *his* revered predecessor Darwin, who leveraged an 1830s scientific education and mode of practice into success in a mounting disciplinary regime. Rather Huxley was a self-made man, keenly aware of how a lack of disciplinary structures could be used to keep people such as himself out of power. (In this respect, too, he was a pattern for Wells, who rose from the working class to a position of influence.) For Huxley, organizing science into distinct disciplines was a way of democratizing intellectual labor and safeguarding the pursuit of truth from the interference of religious orthodoxy.

At the same time, Huxley also managed to emulate another cultural type, the scientist as literary figure or Victorian sage. Like Darwin and the other gentlemen scientists of the 1830s, Huxley was keenly interested in a host of topics that fell outside of his professional competence: art, literature, education, religion, and philosophy. His struggle to combine the role of public sage, reminiscent of an earlier generation of savants, with that of a dedicated professional scientist marks him as a transitional figure. A tireless advocate of disciplinary specialization, he was also an eloquent and versatile writer who addressed religious, ethical, and philosophical topics as widely as his sometime antagonist, Matthew Arnold. Indeed, Stephen Jay Gould nominates Huxley for the title of "greatest prose stylist in the history of British science" ("Introduction: Thomas H. Huxley" x).

One example of Huxley's writing will have to suffice. It is a small piece, Huxley's Romanes Lecture of 1893, "Evolution and Ethics," but it happens to be an address that influenced Wells as profoundly as anything he ever read. One of Wells's critics rightly remarks, "[t]here is almost nothing in Huxley's lecture which did not issue in a literary equivalent somewhere in Wells's work" (Haynes, *H.G. Wells* 26). Huxley's address is a tour de force, written near the end of his life under constraints both professional and personal that brought out his best energies. He had been asked to deliver the second in a new series of lectures at Oxford, following up the inaugural address by Prime Minister William Gladstone, whose uninformed pronouncements on evolution and religion Huxley had devoted the prior year to demolishing. Both speakers had agreed to avoid politics and religion, and both found ways to circumvent their pledge.

"Evolution and Ethics" treats fairy tales, the Book of Job, Buddhism, Heracleitus, and the Stoics before drawing a series of concluding parallels with the "modern doctrine of evolution" (9: 69). It is structured as an allegorical Progress of the Ages, but unlike much Victorian writing that saw civilization as steadily advancing, Huxley offers a cyclical vision in which each age finds a way to say something similar about humanity's place in the cosmos. Huxley is a rare example of a Victorian who confronted a disenchanted conception of deep time, rejecting popular views of evolution leading toward human perfection. "From very low forms up to the highest – in the animal no less than in the vegetable kingdom – the process of life presents the same appearance of cyclical evolution. Nay, we have but to cast our eyes over the rest of the world and cyclical change presents itself on all sides" (9: 49).

Huxley's survey of philosophical and religious precursors to evolution presents us with the repeated spectacle of intellectual pioneers who embraced a disenchanted view of life only to have their vision diluted by renewed mystification. Heracleitus is the clearest exemplar of this pattern. His understanding of the universe as nothing but "restless, fiery energy" was doomed to be watered down by the Stoics, who "metamorphosed" his ideas into "transcendental theism," "decked out with all the attributes of ideal Divinity" (9: 70–71). Buddhism, too, had at its core a rigorous, demystified vision. Huxley admires this "system which knows no God in the western sense; which denies a soul to man; which counts the belief in immortality a blunder and the hope of it a sin. . ." (9: 68–69). But the turn to the doctrine of Karma represented an error for Huxley, a renewed mystification aimed at mitigating the severity of Buddhism's ethical ideal. The notion that the transmigration of character from life to life gave each generation a chance to improve on its inheritance falls prey to the same wishful thinking, according to Huxley, as the contemporary belief in the idea of the "hereditary transmission of acquired characters" (9: 62).[12] Both are forms of grasping at straws.

The enduring contribution of "Evolution and Ethics" is its defense of human aspiration in the face of evolution's message that the universe has no higher purpose. Huxley argues against the "fallacy" of social Darwinists who think that because "animals and plants have advanced in perfection of organization by means of the struggle for existence and the consequent 'survival of the fittest;' therefore men . . . must look to the same process to help them towards perfection" (9: 80). The struggle for existence may be the law of nature, but "social progress" has given humans the power to resist this cruel law of nature and substitute "that which is ethically best"

(9: 81). Hence, Huxley scorns advocates of social Darwinism or the so-called "'ethics of evolution'" (9: 80). True ethics

> is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect but shall help his fellows; its influence is directed, not so much to the survival of the fittest, as to the fitting of as many as possible to survive. (9: 82)

The error of social Darwinism arises because people mistake "fitness" in the evolutionary sense with "best" when the term only means most adapted to existing conditions. In a passage that directly inspired the ending of Wells's *The Time Machine*, Huxley comments that if the planet were to cool again, the fittest organisms would be nothing more than lichens and microscopic creatures. Thus, social Darwinism is premised on a misunderstanding of evolution. It confuses adaptation to the conditions of existence with perfection of the species. "Let us understand, once for all, that the ethical progress of society depends, not on imitating" nature's struggle for existence "but in combating it" (9: 83)

Huxley's method for rising above the struggle for existence provides the key to understanding Wells's perspective on science in *The Island of Doctor Moreau.* Huxley likens the action of human intelligence on the process of evolution to the operation of a governor on a steam engine, which controls the mechanism of which it is a part through feedback.[13] The notion that the mind is part of nature, even as it potentially acts to modulate its environment, is a leap that few of his contemporaries were equipped to take. They saw the human ability to reason as evidence of what separated us from nature and as an argument against godless materialism. But this leap is exactly what Prendick advocates in the closing sentences of the novel. This vision of ethics as a feedback mechanism that checks natural processes is what gave Huxley – and later Wells – the certainty that a part of nature could rise above evolution. It gave both writers a rationale for a materialism that was not divorced from ethics.

## The Use and Misuse of *Moreau* in Public Policy

Wells's perspective at the end of *Doctor Moreau* reflects Huxley's certainty that the truth of evolution did not vitiate humanistic ideals and spiritual strivings. Prendick, who represents the opposite pole of scientifically trained men from Moreau, refuses all the false consolations proffered by

social Darwinists and neo-Lamarckians in the 1890s and embraces, instead, a disenchanted view of "man's place in nature," to echo the title of one of Huxley's most famous books. After his rescue from the island, Prendick finds that his view of humanity has been undermined by strange doubts. He can no longer take solace in the thought that the people around him are different from the Beast People on the island. He feels a nameless sense of dread, an uncertainty, born of his realization that humans are part of the animal kingdom, that there is an unbroken continuity leading from the beasts in the forests on through to modern humanity. As he walks the streets of London, he fears that the men and women he meets are only "animals half wrought into the outward image of human souls and that they would presently begin to revert" (182). The prospect of reversion, rather than of upward progress, brings home Huxley's understanding of evolution as non-directional, potentially "cyclical," change.

This disenchanted view of human nature brings Prendick close to a breakdown. He feels a horror at his fellow men akin to what Kurtz experiences in Conrad's *Heart of Darkness*, published only a few years later, and Wells's depiction of the London streets is as bleak as anything in Eliot's *The Waste Land*.

> When I lived in London the horror was well-nigh insupportable. I could not get away from men: their voices came through windows; locked doors were flimsy safeguards. I would go out into the streets to fight with my delusion, and prowling women would mew after me, furtive craving men glance jealously at me, weary pale workers go coughing by me, with tired eyes and eager paces like wounded deer dripping blood, old people, bent and dull, pass murmuring to themselves, and all unheeding a ragged tail of gibing children. (183–84)

The traditional comforts of religion are unavailing: "Then I would turn aside into some chapel, and even there, such was my disturbance, it seemed that the preacher gibbered Big Thinks even as the Ape Man had done" (184). Instead, Prendick turns to "a mental specialist" (182) for help, seeking a modern remedy for a modern ailment. But nothing works, and Prendick eventually retreats to the relative solitude of the countryside.

In retirement, Prendick takes consolation from his reading and his chemistry experiments, but most of all, he finds comfort in his contemplation of the infinite spaces of the stars: "There it must be, I think, in the vast and eternal laws of matter, and not in the daily cares and sins and troubles of men, that whatever is more than animal within us must find its solace and its hope" (184–85). Victorian readers were prepared to hear

either materialism or humanism in these words, depending on whether they laid stress on the "*laws of matter*" or on the "*more than animal*," but it was hard to hear both unless they had taken to heart Huxley's message. Like his teacher, Wells is attempting to account for the purely material basis of life *and* for what – to use a twenty-first-century vocabulary – we might call the unplanned "emergence" of a consciousness that is more than material. Without pretending to explain the mechanism, both men were clear that the emergence of the human mind did not require a superior intelligence organizing life from above.[14]

The last paragraphs of "Evolution and Ethics" sound the same Pascalian note while emphasizing that anything in humanity that may be more than animal – literature, art, civilization, ethical behavior – is so only because it is part of, not above, the vast and eternal laws of matter: "Fragile reed as he may be, man, as Pascal says, is a thinking reed," Huxley writes; "there lies within him a fund of energy operating intelligently and so far *akin to that which pervades the universe*, that it is competent to influence and modify the cosmic process" (9: 83–84, my italics). For both Huxley and his disciple Wells, what makes human intelligence not only competent to, but worthy of, influencing its environment is a recognition that humans will forever remain part of that environment. Their future is tied up with the material universe to which they are akin.

The complexity of Huxley's and Wells's positions on "man's place in nature" makes it clear why invoking *Doctor Moreau* as evidence of our "natural" repugnance to chimeras, as has occurred frequently in debates about genetic engineering, is mistaken. It is crucial to situate literary perspectives in their own historical contexts rather than simply apply them to today's policy questions. It is not enough to invoke lessons from literature without also registering how they resonated in their day and how they intersect with the altered circumstances of the present.

An analysis of the current pair of writers, for example, would need to specify at least six relationships to science in the nineteenth century. (1) Darwin capitalized on the relatively incomplete disciplinary structures in place when he began writing in the 1830s and that remained viable throughout his productive years, enabling him to exert influence in scientific circles and in the culture at large; (2) Huxley was a transitional figure, able to retain some of the power of a Victorian sage like Darwin while also promoting and exploiting the emerging disciplinary environment of science; (3) at the same time, a figure such as Prendick had only a "residual" relationship to the new paradigm of professionalized science; while Wells himself shifted from (4) the posture he adopted in imitation of Huxley in

the 1890s to (5) advocacy of the "emergent" paradigm of modern disciplinary science in *Anticipations* (1901) and later texts; a change that (6) paradoxically estranged him from literary modernists in the early twentieth century, many of whom were embracing autotelic conceptions of art in part as a reaction formation to literature's increasing isolation from popularity and cultural power (see Chapter 5).

Prendick's residual relationship to professionalized science makes him less well equipped to deal with a demystified universe than figures like Huxley or Wells. Unlike Huxley, the great advocate of modern disciplinary structures, or Wells, who later in the twentieth century advocates for the research university, Prendick clings to amateurism. He is trapped between two worlds – he has the skeptical posture of a modern scientist without the disciplinary training or professional status of a specialist. He is a generalist in an age when that position is already becoming less tenable. Thus, his ethical perspective on animal research is ineffectual because it is ungrounded in any of the modern institutions that would give it force. It remains merely one man's opinion – sensible, well informed, but with little purchase on the emerging world of science.

Still, Prendick's difference from the position of the President's Council on Bioethics is stark and revelatory. "Would it not be degrading to our humanity and an affront to human dignity," one Council report asks, "to produce animal-human chimeras with some human features and some features of lower animals?" (Schulman 17). It was not an affront to *human* dignity that concerned Wells, and his novel should not be adduced as supposed evidence of our culture's repugnance to creating human-non-human chimeras. It was the realization that there was no difference between humans and animals that at first disturbed Prendick, and it was the realization of their shared place in nature that eventually brought him peace.

The reason *Doctor Moreau* seems to speak directly to contemporary ethical concerns about chimeras is that the place of ethics in research has changed in recent decades, a topic I broached in Chapter 1. For most of the twentieth century, the novel's message resonated only with stereotypes of the heartless scientist, a critical perspective that made literature's stance largely oppositional to science. Hostility to the excesses of science is certainly the lesson audiences derived from both the 1932 movie version of *Island of Lost Souls* (1932) with Charles Laughton and the grotesque 1996 film of *The Island of Dr. Moreau* starring Marlon Brando. Today, however, the same text carries more finely tuned resonances, which complement the efforts of people working within science to promote ethical

standards of research. To put it another way, the cultural location of bioethics and health policy is, at least in part, internal to science, which means that the stance of the oppositional (but ultimately powerless) outsider is no longer the only posture available to literature and the other humanities. Oppositional critics of science, who speak from philosophical or theoretical perspectives circumscribed by their own disciplines, are certainly not amateurs like Prendick, but their insights have slight impact because of their isolation from a disciplinary structure like the policy world that would give them force. As long as humanists speak only to fellow humanists, they will have as little effect on scientists as Prendick in his retirement.

What should a humanist say to a future President's Council on Bioethics if asked about *Doctor Moreau*'s lesson concerning chimeras? First, our hypothetical humanist would need to underline the obvious warning about scientific hubris. But then he or she would need to locate the novel in its time. Attending to the context of Wells's novel in the disciplinary conflicts of the day enables one to show that *Doctor Moreau* cannot be invoked as an indictment of all scientific research on chimeras. The qualified affirmations of the ending of the novel indicate something more interesting. They suggest that the novel's prophetic insights into the dangers of creating chimeras should be balanced against an equally profound respect for the importance of science, and for the value of pursuing research that acknowledges humanity's kinship to the universe.

Much more remains to be said about Wells and Huxley. It would be instructive to show how Huxley's comment about evolution reaching a summit and then taking the downward route to extinction (9: 86) provides the model for the far future depicted in *The Time Machine* (1895). Similarly, Huxley's remark about the possible supersession of humanity by other species forms the germ of *The War of the Worlds* (1898). Huxley's suggestion that both Karma and belief in the hereditary transmission of acquired characteristics were similar responses to the problem of undeserved suffering clarifies not only what Wells was attacking in *Doctor Moreau* but also what Collins was attempting to say in some rather muddleheaded passages in *The Legacy of Cain* (1888). Finally, Huxley's talk of future modifications of the human species gives scientific precision to themes in the air in the years before and after his lecture in a group of novels that feature divergent paths of human evolution: Edward Bulwer-Lytton's *The Coming Race* (1871), W. H. Hudson's *The Crystal Age* (1887), and, of course, the Eloi and Morlocks of *The Time Machine*.

These are some of the novels that I turn to next. In the following chapter, we encounter popular novelists who took a different path from Wells and instead of facing a materialist universe, cast about for reassuring answers to the doubts Huxley raised about "man's place in nature."

CHAPTER 3

# *Cain's Legacy*
## *The Mark of Lamarck in Late-Victorian Fiction (Edward Bulwer-Lytton, Samuel Butler, H. Rider Haggard, Wilkie Collins)*

> For twenty years past, my friend, I have been studying the question of hereditary transmission of qualities . . .
>
> Wilkie Collins, *The Legacy of Cain* (1888)

The Victorians knew nothing about genetics, but they had a vigorous discourse about the hereditary transmission of behavior. Scientists and novelists alike wrestled with the problem of whether "character" was heritable. Today, for reasons that at first seem entirely unrelated, we are witnessing a resurgence of interest in the biological foundations of character. After some fifty years of ethical doubts about the wisdom of pursuing such avenues of research, the heritability of behavior is once again a hot topic.

In the biological sciences, this renewed interest comes from three main directions: genetics, which garners the lion's share of public attention for its success in identifying genes that are associated with increased probability for a given trait (a success that has accelerated dramatically with the advent of genomewide association studies); neuroscience, a diverse field that draws variously on cognitive psychology, linguistics, brain imaging, and evolutionary biology; and epigenetics, which is the concern of this chapter. Because of its focus on nongenetic sources of inherited traits, epigenetics should be of interest to scholars of the nineteenth century, a period that did not yet understand the genetic mechanism of inheritance. Surprisingly, the reverse is true as well – some epigeneticists look back longingly to the moment in the late-nineteenth century when it seemed to many that Lamarck, not Darwin, held the key to evolutionary theory.

"Epigenetics" can be defined as the study of heritable characteristics that have a molecular basis independent of DNA. According to the journal *Nature*, which ran a special section on the field in May 2007, "epigenetics is riding a wave of popularity" (Bird v). Noting that more than 2,500 articles had been published on the subject within the year, the editors of

*Nature* observed that the media portrayed epigenetics as "a revolutionary new science" (Eccleston et al. 395). Epigenetic changes are crucial for normal cell growth and have long been a topic in developmental biology, but the recent discoveries have to do with how cells can transmit acquired traits to daughter cells through nongenetic modes of inheritance and with evidence that some variations in species may be directed toward a goal rather than being random. Eva Jablonka and Marion J. Lamb summarized the four main contentions of epigenetics on the first page of their book, *Evolution in Four Dimensions*: "there is more to heredity than genes; some hereditary variations are nonrandom in origin; some acquired information is inherited; and evolutionary change can result from instruction as well as selection" (1).

These are disorienting claims, which seem to violate some of the central tenets of genetics and contradict much of what we have learned about Darwinian evolution. They suggest that biological traits can be inherited from sources other than DNA, that natural selection does not arise solely from chance mutations, that Larmarckism may have more validity than most of us dreamed, and that evolution at times may be channeled in a particular direction rather than being random. I will explain more of the fundamentals of this new research as I proceed, but first I want to characterize the related debates that raged around inherited behavior in the late-nineteenth century.

During the last three decades of the century, the question of whether acquired characteristics could be inherited increasingly preoccupied popular novelists from Edward Bulwer-Lytton and Samuel Butler in the 1870s to Grant Allen and Sarah Grand at the end of the century. Many scientists also returned to Lamarck to explain what they saw as the inability of natural selection to explain the dramatic changes required by Darwinian evolution. The evidence appeared to be mounting from all sides that the gradual accumulation of small changes could not account for the diversity of life, especially after Lord Kelvin's (incorrect) calculations of the age of the earth seemed to demonstrate that there had been insufficient time for natural selection alone to have produced such abundant varieties of life.[1] Lamarck's model of inheritance offered an alternative explanation to scientists who were convinced of the truth of evolution but had come to believe that natural selection played only a secondary role in shaping descent. Rival conceptions of biological inheritance were fought out *between* circles of true believers in evolution: neo-Lamarckian novelists, periodical writers, and many scientists on the one hand, and Darwinians, on the other. By 1885, the year the term "neo-Lamarckism" was coined,

the anti-Darwinian party had become so strong that the historian Peter J. Bowler describes this period as "the eclipse of Darwinism."[2]

"Neo-Lamarckism" was the name of a loose assortment of evolutionists who argued for the central role of the inheritance of acquired traits in shaping the descent of plants, animals, and humans. Little known today, it constituted a serious challenge to Darwin from within the ranks of naturalists, morphologists, and physiologists, as well as philosophers, novelists, and journalists. One of its guiding principles was the notion that characteristics that one learned during one's lifetime could be passed on to one's descendants. This idea applied equally to physical features and learned behaviors. Discredited during the 1930s, the period of the modern synthesis of genetics with evolution (discussed in Part II), neo-Lamarckism was long viewed with amusement or scorn by geneticists, who took it as a given that no acquired abilities can flow backward into the DNA of an individual. Even with the advent of epigenetics, which suggests nongenetic mechanisms for some acquired adaptations to be conserved for future generations, most geneticists still regard neo-Lamarckian ideas as preposterous. To be clear, so do I. But some epigeneticists, who perhaps do not understand all the implications of neo-Lamarckism, have aligned their research with this earlier movement.

The late-nineteenth-century revival of Lamarck incorporated other aspects of his thinking as well, including the directed nature of evolution, its progressive movement toward perfection of the species, use or disuse of an organ as a cause of species change, the importance of maternal inheritance, and the conscious, willed nature of some evolutionary changes. Darwin's theory of natural selection made room for some Lamarckian ideas (a fact that Samuel Butler never tired of pointing out). In *The Origin of Species* (1859), Darwin acknowledged that use or disuse of an organ could lead to morphological changes in the species, and more grudgingly, that habits could eventually be internalized as instincts. In *The Descent of Man* (1871) and *The Expression of the Emotions in Man and Animals* (1872), Darwin increasingly emphasized the role of both Lamarckian concepts. But Darwin always objected to conceiving of evolution as progressive or directed toward the perfection of the species. Moreover, Lamarck's more valuable ideas were often subsumed by neo-Lamarckians in popular culture under the banner of the heritability of acquired characters (Bowler, *Eclipse* 7n3; Otis 6). Samuel Butler established a powerful analogy for this process by arguing that acquired characteristics constituted an "unconscious memory" of the species, which directed evolution toward a purposeful goal.[3] Every individual, Butler asserted in a series of polemical

books published over nearly a decade (1878–87), contained the collected wisdom of the race as its birthright, an inherited record of successful adaptive strategies.

Neo-Lamarckians did not have the field to themselves. Ranged against them were Alfred Russel Wallace, Thomas Huxley, and most important, August Weismann, whose publications of 1883 and 1885 developed the concept of the "continuity of the germ plasm" (104).[4] Weismann argued persuasively against the "transmission of acquired characters" and disputed that "changes of the organism which result from external stimuli can be transmitted to the germ-cells and will re-develop in the next generation" (104). Instead, he maintained that the germ cell "transfers its hereditary tendencies from generation to generation, at first unchanged, and always uninfluenced in any corresponding manner, by that which happens during the life of the individual" (69), or as we would phrase it today, one's genotype is inherited from one's parents and cannot be affected by changes in the parents' phenotype caused by experience or the environment. Historians of science have identified Weismann's concept as a precursor to what would later become the "central dogma" of genetics, the principle that information can flow only in one direction, from genes to the proteins that they express.

Some exponents of epigenetics view Weismann's work as a harbinger of a "wrong turn" that biology took in the twentieth century toward "genetic centrism" and away from inquiries into developmental biology that might have revealed the possibility that acquired characteristics were heritable (Webster and Goodwin 111–17). Richard Lewontin, Evelyn Fox Keller, Susan Oyama, and others maintain that the emphasis on the "causal primacy of the gene" (Keller, *Making Sense of Life* 125) led biologists for much of the twentieth century to underestimate the importance of developmental systems and epigenetic interactions for the resulting organism. It also obscured the possibility of extra-genetic mechanisms of inheritance of the sort that neo-Lamarckism emphasized. Jablonka and Lamb are unabashed neo-Lamarckians. But a too-easy equation of epigenetics with neo-Lamarckism carries the risk of duplicating some of the mistakes of nineteenth-century literature and social theory, including the kind of beliefs that led to racial science or that a supreme being was directing evolution toward perfection of the human race.

This chapter will consider several areas in which an overly hasty assimilation of epigenetics to neo-Lamarckism presents policy risks. The first involves the religious impulse that frequently accompanies talk about "directed evolution." In the nineteenth century, the idea that evolution

might have a purpose quickly led to arguments for a divine Director as well as calls for eugenic interventions that would steer evolution toward goals that were assumed to be part of God's plan for the species. Today we see similar religious arguments put forward by creationists under the banner of "intelligent design."

A different risk stems from one of Lamarck's more valuable points, the importance of the maternal-fetal environment. Evelyn Fox Keller discusses "the long disregard of 'maternal effects' on development" (*Refiguring* 34n10), which she believes contributed to genetic centrism and impeded developmental biology as a discipline. Lamarck's salutary emphasis on the effects of maternal inheritance, when exaggerated and confused with gendered notions of women's roles (as was the case in much neo-Lamarckian thinking), could lead to unfortunate assumptions about women's proper place in society. A similar concern today is that epigenetics' valuable insights into the importance of the maternal-fetal environment will lead to "blaming the mother" (Smeele; Metzl) for anything that goes wrong. The danger is that well-meaning efforts to increase attention to embryonic development and early maternal care will result in restrictions on rather than empowerment for women, especially among mothers of low socioeconomic status. This is what occurred when neo-Lamarckians highlighted the deleterious effects on children of alcoholism and bad diet among indigent mothers. Instead of striving to improve the conditions of working-class mothers, many reformers advocated eugenic solutions such as sterilization campaigns to reduce the birth rate of the poor.

Finally, the belief in the inheritance of acquired characteristics in the nineteenth century eventuated in widespread assumptions that social behaviors – such as criminality or promiscuity – could be passed down to later generations. This dangerous assumption led to a deterministic conception of inheritance – your destiny lies in your genes, we might say today. The sins of the father, they said then, would be visited on the children unto the fourth generation. It was the curse of Cain.

## Neo-Lamarckism in Late-Nineteenth-Century Popular Culture

Much popular fiction, especially in subgenres such as the imperial romance, detective novel, sensation fiction, utopian fiction, and the New Woman novel, drew on neo-Lamarckian themes. Why, then, were the major Victorian realists more attracted to Darwin? It would be easy to assume that canonical authors like George Eliot, Trollope, Gaskell, Meredith, and Hardy were simply more thoughtful than authors of

Victorian genre fiction, but in many cases, formal aspects of the kind of fiction they wrote played a role too. Realist conventions accorded well with Darwin's emphasis on the gradual accumulation of small changes; his insistence that species development was not unidirectional or predetermined; and his reluctance to think that a legacy from the past determined behavior in the present.[5] All the same, I do not mean to suggest a causal relation between genre and evolutionary theories or vice versa. It is a mistake to think that formal structures entail a particular set of beliefs. What we find instead is a distinctive historical moment when a group of formal conventions interacted synergistically with a cluster of linked but not always consistent ideas about the nature and consequences of evolution. Not all popular texts took an interest in debates about evolution, and not all that did were neo-Lamarckian, but a significant number of the most popular and representative examples of Victorian genre fiction did.

I take my title for this chapter from a striking anomaly. Neo-Lamarckism was interpreted in popular culture through the notion that human evolution was guided by a collective destiny that was driving our species toward perfection. Each of our inherited talents is supposedly leading us inevitably toward a more perfect human race. Yet in the works I examine, the mark of Lamarckism is almost always Cain's. Why should this Biblical tale of jealousy, murder, and a curse that descends through the ages be a prominent metaphor in novels that embrace neo-Lamarckian theories that maintain evolution will lead our species to perfection? The reason tells us much about why some genres tended to treat evolution differently from the canonical novels of realism. The answer lies in the demands of a thrilling plot.[6] The mark of a criminal inheritance in *Dr. Jekyll and Mr. Hyde* (1886), *She* (1887), *The Legacy of Cain* (1888), *The Fourth Generation* (1899), and many other genre stories responds to the needs of what H. Rider Haggard promises in the very first sentence of *She:* "one of the most wonderful and mysterious experiences ever undergone by mortal men" (11). Inconsistency means nothing. Coherence of idea or theme falls by the way in the face of what a good story requires. In his autobiography, Haggard spells the requirement out: "action, action, action from the first page to the last. For the rest, little matters" (*Days of My Life,* vol. II 94–95).

There is one exception. The genre of utopian fiction in the period puts little emphasis on thrilling action. In Bulwer-Lytton's utopia, *The Coming Race*, where perfectibility of the species governs the slow-moving plot as well as the neo-Lamarckian theme, Cain's legacy nowhere appears. This absence is hardly surprising, however, for the mark of Cain highlights an originary violence and its descent in man, which is clearly at odds with a utopian outlook.

## Bulwer-Lytton's *The Coming Race*

The cultural influence of neo-Lamarckism predated the coining of the term in 1885. More than a decade before, three British publications gave a powerful boost to the ideas that would become pervasive in the mid-eighties: St. George Jackson Mivart's theistic account of evolution, *On the Genesis of Species* (1871), Edward Bulwer-Lytton's utopian novel *The Coming Race* (1871), and Samuel Butler's better-known utopia *Erewhon* (1872). Mivart's work was one of the leading sources for arguments against natural selection (Bowler, *Eclipse* 49); his vivid depiction of evolution as taking place by large, discontinuous leaps helped associate skepticism about Darwin's gradualism with the theistic argument by design. Bulwer-Lytton's and Butler's novels, though, set the mold for later neo-Lamarckian utopias, from W. H. Hudson's *A Crystal Age* (1887), with its "later race," which had developed the "passionless, everlasting calm of beings who had for ever outlived, and left [emotion] as immeasurably far behind as the instincts of the wolf and ape" (174–75) to William Morris's *News from Nowhere* (1891), with its socialist population that had evolved beyond the "hereditarily" weak, ugly, and idle people descended from slaveholders and capitalist employers (34) and to Grant Allen's *The British Barbarians* (1895) with its traveler from the future who tells of a human race that has evolved beyond "war, bloodshed, superstition, fetich-worship, religious rites, castes, class distinctions, sex taboos, [and] restrictions on freedom" (58).[7]

Neither Bulwer-Lytton nor Butler was an opponent of Darwin when they published their utopias. Bulwer-Lytton saw his fable as a strong plea for evolution by natural selection, just as Butler did the following year, when *Erewhon* came out. Both novelists believed that the struggle for existence was a motive force for evolutionary change. Here is how Bulwer-Lytton puts it: "since in the competition a vast number must perish, nature selects for preservation only the strongest specimens" (52). But they believed that the progressive direction of natural selection would be shaped by the inheritance of acquired characteristics: "We are all formed by custom – even the difference of our race from the savage is but the transmitted continuance of custom, which becomes, through hereditary descent, part and parcel of our nature" (Bulwer-Lytton 94).

*The Coming Race* was enormously popular in its day, which is hard to comprehend. Many readers today find it dull, although the satire on war, religion, capitalism, and democracy amuses some and the vision of a future in which women are more powerful than men contradicts stereotypes of

the Victorian age.[8] Still, like many utopias, its static discursive chapters on linguistics and social customs can be heavy going. Whether one finds the work entertaining or not, this bizarre Darwin-haunted fable illuminates much about how evolution was assimilated by late-nineteenth-century popular culture.

Bulwer-Lytton's novel tells the story of a mining engineer who stumbles across an underground civilization vastly more advanced than his own nineteenth-century world. The subterranean people have abandoned industrial and technological progress and rely entirely upon an all-pervasive energy in the universe that they call "Vril" – something like the Force that Jedi knights channel in the *Star Wars* movies. The people have developed the ability to harness this power over thousands of years of directed evolution. Their greatly elongated thumbs, the outward sign of this adaptation, have been cultivated by "continuous exercise, of the Vril power" by people who "devote[d] themselves to that paramount science," and it could be "slowly developed in the course of generations" by the "higher beings of the [human] race" (58). The notion that the willed use of a trait could strengthen its powers and result in heritable characteristics became a pillar of neo-Lamarckism in the next decade. Vril is the source of the strange race's many abilities: telepathy, winged flight, control over matter, and the power to blast entire cities into atoms with a single ray. The evolution of such powers has led them to abandon war and all forms of aggression as useless since any individual could destroy all others with a wave of her Vril-stick – a Victorian version of the doctrine of mutual assured destruction.

The relation of these themes to utopia lies in the apparent rationality of making hard choices to guide the species. In the wake of Darwin, selective breeding and willed species change fit easily into the utopian genre's commitment to rational social planning. In Butler's *Erewhon,* citizens who fall ill are imprisoned, and the ugly or weak forbidden to reproduce. Bulwer-Lytton's Vril are eugenicists *avant lettre*,[9] who strengthen their stock by exogamous marriages with distant communities and exterminate all weaker races. As a result of this rigorous program of social hygiene, an entirely new species of posthumans has evolved, the "coming race" of the title. Here is how the narrator describes them:

> I arrived at the conviction that this people – though originally not only of our human race, but, as seems to me clear by the roots of their language, descended from the same ancestors as the great Aryan family, from which in varied streams has flowed the dominant civilization of the world . . . had yet now developed into a distinct species with which it was impossible that any community in the upper world could amalgamate. (119)

The Aryan reference is telling. As with later invocations of an Aryan destiny, the Vril are persuaded of "their ultimate destiny to destroy and replace our existent varieties of man" (119). Humanity's only hope of survival would be miscegenation: "we might be saved from extermination by intermixture of race," but the narrator is not optimistic: "instances of such *mésalliance* would be as rare as those of intermarriage between the Anglo-Saxon emigrants and the Red Indians" (119).

This ugly example of racial science looks forward to its pervasive role in the "imperial gothic" of Stevenson, Haggard, Conan Doyle, Kipling, and others (Brantlinger 227–53). The utopias that looked forward in time had a counterpart among adventure stories that portrayed lost civilizations from the distant past: H. Rider Haggard's *She* (1887), to which I turn in the next section, or Rudyard Kipling's *The Man Who Would Be King* (1888) and Arthur Conan Doyle's *The Lost World* (1912). But there is a profound difference between the two forms, one that is simultaneously structural and ideological. Fredric Jameson has proposed that utopia incorporates a critical impulse by imagining an alternative to the existing social order (*Archaeologies* 12) – the feminism of *The Coming Race* is a clear example of this phenomenon. Lost world fiction, by contrast, tended to reinforce dominant ideology by flattering the existing social order's vision of itself. In *The Coming Race*, the critique of society lies in the tension between an evolutionary destiny and present-day England, for the Aryan destiny belongs not to humanity but to another, posthuman species. The novel thus has it both ways. The white, Anglo-Saxon race may be the highest our planet has produced, according to the narrator, but England is not destined to be the home of the surviving Aryan line. A biological destiny that ends in the destruction of humanity manages to indict the existing social order and preserve the end-directed plot structure of utopia too.

Jablonka and Lamb are wary of any hint of goal-oriented evolution being read into epigenetics. Consequently, they are careful to assert that nothing in the evidence for directed variation entails believing in a purpose or destiny to evolution, and they explicitly reject an intelligent-design interpretation of their results. Scientists, however, rarely have control over how their findings are interpreted. Having a special destiny is a seductive concept – not only in religious belief systems but in popular literature as well, where formal closure is highly valued. The fact that nineteenth-century popular culture almost always invested directed evolution with spiritual meanings augers poorly for Jablonka and Lamb's hopes.

## H. Rider Haggard's *She*

> Like Cain, I was branded – branded by Nature with the stamp of abnormal ugliness . . ..
>
> H. Rider Haggard, *She* (1887)

Holly, the principal narrator of Haggard's monumentally popular adventure, *She*, is introduced in the novel's first chapter as an abnormal specimen of humanity with "long sinewy arms," a "low brow," and "thick black hair," a throwback that makes one woman whisper that his appearance had "converted her to the monkey theory" (18). With this shuddering reference to evolution, Haggard announces the post-Darwinian provenance of his romance. Elsewhere compared to a "gorilla" and "baboon" (12, 112), Holly stands in sharp contrast to his ward, Leo, whose golden curls, tall stature, and broad shoulders make him an idealized representative of English masculinity. The dichotomy aligns neo-Lamarckian fears of degeneration and fantasies of racial superiority with basic romance conventions that tend to assign characters to positions in a symbolic system – light vs. dark, good vs. evil, etc.

The literary critic Richard Chase's influential account of romance fiction describes romance characters as "two-dimensional types," "abstract and ideal" figures (13), which lend themselves easily to allegorization – exemplified in *She* by Leo and Holly's nicknames, "Beauty and the Beast" (30). In contrast to the novel, "romance will more freely veer toward mythic, allegorical, and symbolistic forms," which often results in plots that have a "symbolic or ideological, rather than a realistic plausibility" (Chase 13). This symbolic or ideological dimension is what makes romance such an effective vehicle for articulating neo-Lamarckian social theories. Wendy Katz, in her book on Haggard and empire, extends Chase's point, arguing that romance's "ideological plasticity" gives the genre "an infinite capacity for political propagandizing." Romance's allegorical characters and symbolic landscapes can be "controlled and manipulated so easily that [they] can be made to do the romancer's ideological bidding" (Katz 44–45).

Haggard's novel is a veritable treasure trove of romance motifs. An orphan, a casket, occult wisdom, a shipwreck, prophetic dreams, a magical basin of water, a quest through symbolic landscapes to find eternal life, labyrinthine underground passages, trials that have doomed countless forbearers, a sorceress of mesmerizing beauty living in a city of the dead, a loyal servant named Job and a wise mentor, Holly – these are only some of the details that shape the story of Leo Vincey's legacy into a symbolic

rather than realistic form. Leo's legacy is the Sherd of Amenartas, a broken piece of pottery that has descended through sixty-six generations of Vincey ancestors. Inscribed on this Sherd is the story of an ancient quarrel between two women, one fair and the other dark, over Kallikrates, a man of uncommon beauty and the founder of the Vincey line. Ayesha, the imperious white Queen of an African tribe, kills her beloved Kallikrates in a fit of jealousy when she realizes that she cannot possess him and swears an awful oath to await his coming again, an oath whose fulfillment is made possible by her discovery of the Fountain of Life. Leo, we guess from the very beginning, is the destined heir, returned at last to the two rival women, but the consummation of this destiny destroys Ayesha and brands Leo, turning his beautiful head of hair completely white, a mark of Cain as visible as Holly's simian features.

*She* is equally a treasure trove of social Darwinian and neo-Lamarckian themes, which can be demonstrated by a comparison of Haggard's romance with the ideas of Samuel Butler, perhaps the most prominent voice in this period advocating Lamarckism. When Butler published *Life and Habit* in 1878, he saw himself as providing an interpretation for facts that Darwin himself could not explain, and Butler fully expected that Darwin would receive the work with respect. Instead, Darwin ignored *Life and Habit*, regarding it as mere speculation with little basis in anything but analogy and introspection. Darwin's neglect infuriated Butler, and in three subsequent monographs, he attacked Darwin for not acknowledging his numerous predecessors, particularly Lamarck and Darwin's own grandfather, Erasmus Darwin. The vitriol had some impact on Darwin's reputation, but Butler's arguments for the power of will to shape evolution toward an ideal destiny had an ideological influence of far more consequence.

Butler's books on evolution are obsessively repetitive, but even a small sampling of his arguments will show how they promote a reassuring destiny for the human species. Here is Butler arguing that something more than chance must be guiding species change: "I cannot think that 'natural selection,' working upon small, fortuitous, indefinite, unintelligent variations, would produce the results we see around us. One wants something that will give a more definite aim to variations, and hence, at times, cause bolder leaps in advance" (*Life and Habit* 261). And again: "Will the reader bid me wake with him to a world of chance and blindness? Or can I persuade him to dream with me of a more living faith than either he or I had as yet conceived as possible?" (307). Butler openly affirms "the whole theory of Lamarck, that the development of organs has been due to

the wants or desires of the animal in which the organ appears" (244–45). Hence, Butler often asserts that willed behavior is the source of evolutionary change: "a pigeon might in the course of ages grow to be a peacock if there was a persistent desire on the part of the pigeon through all these ages to do so" (202).

Butler's boldest idea was his explanation of heredity as unconscious memory. Since Darwin admitted that he did not know the mechanism by which hereditary information was transmitted from parents to children, Butler felt empowered to argue that something in the child must *remember* features of its parents' lives – remember both morphological processes and acquired habits of behavior. Memory, Butler asserted with increasing certainty, must be the hidden principle of hereditary descent, an idea encapsulated in one of the chapter titles from *Life and Habit,* "Instinct as Inherited Memory" (161). If an embryo can remember how to grow two arms and two legs, he reasoned, it must be capable of remembering other aspects of its ancestors' lives, even if not consciously: "each of the germs to which the memory of the new germ reverts, is itself imbued with the memories of its own parent germs, and these again with the memories of preceding generations, and so on *ad infinitum*" (122). For an author whose first book was a memoir and last an autobiographical novel, *The Way of All Flesh*, the recourse to memory as the principle of continuity should not be surprising. In the next chapter, I shall return to the link between memory and literature as a way of identifying part of literature's contribution to public discourse. For now, let me simply say that Butler's substitution of "unconscious memory" for a biological link between the generations is a literary or aesthetic act, dependent on analogy and metaphor rather than scientific evidence.

Unlike Stevenson, Haggard does not seem to have had a detailed knowledge of the science behind evolution, but he had clearly absorbed much of the popular debate about the subject.[10] Throughout *She*, references to the more sensational aspects of evolutionary theory abound. We hear Herbert Spencer's notion of the "survival of the fittest" in lines like "Those who are weak must perish; the earth is to the strong" (*She* 204). Ayesha openly boasts of her eugenic breeding program, which she used to produce deaf and dumb servants: "it hath taken many centuries and much trouble; but at last I have triumphed" (157). Later, Ayesha invokes the idea of racial degeneration when she blames miscegenation for creating "a bastard brood" among the nearby tribes (184). She draws on ideological notions of progress when she describes the evolution of civilization from its primitive origins in Africa through Greece and Rome to its apex in present-day England (151).[11]

Ayesha's death scene, in which she shrivels back through evolutionary stages until she resembles a "baboon" or "monkey" (292), invokes while reversing Haeckel's idea that ontogeny recapitulates phylogeny. Finally, Haggard anticipates Wells's vision of the extinction not only of humanity but also of the planet itself: "on and on, through periods, spaces, and times, from æon unto æon, till the world is dead, and the worlds beyond the world are dead" (189).

The most distinctive trace of neo-Lamarckism is the novel's view of reincarnation. Butler's notion that each embryo contains the memories of all its ancestors seemed to give a scientific foundation to the beliefs of many spiritualists in the late-nineteenth century. It was only a small leap from Butler's assertion that a person's "past selves are living in him at this moment with the accumulated life of centuries" (52) to the idea of reincarnation. Late-nineteenth century spiritualists from Madame Blavatsky to Annie Besant, although they do not mention Butler by name, were quick to make the connection between neo-Lamarckian conceptions of evolution and reincarnation.[12] Carolyn Burdett, who has written well on Haggard's interest in reincarnation, connects him with Annie Besant, noting wryly that the lifelong Tory imperialist and the radical socialist made "unlikely bedfellows" (Burdett 218). Jeffrey Franklin attributes the spread of the idea of reincarnation in the popular consciousness to the novels of Haggard and Marie Corelli (89) and suggests that Haggard's knowledge of Tibetan Buddhism came from Madame Blavatsky and several widely read Western scholars of the subject (94–96).

Reincarnation plays a crucial role in both *She* and its sequel *Ayesha*. In the earlier novel, Ayesha tells Holly that she has been waiting for more than 2,000 years "for one I loved to be born again" (153). She refuses to leave her hidden underground kingdom because "when he, my love, shall be born again . . . he shall find me *here* where once he knew me" (154). Her faith in this destiny is founded on a doctrine of descent through change. "There is no such thing as Death, though there be a thing called Change" (153), she declares, and Leo's father says much the same thing the night before he dies (23). Each of us may die to the world, but something is passed down, to be "born again and again" in different forms (153). The whole course of the plot seems to validate Ayesha's beliefs. Not only does Leo bear an uncanny resemblance to the mummified corpse of Kallikrates, but Ayesha's rival for Leo's love in the present age looks exactly like Kallikrates's first wife. Despite her belief in descent through change, Ayesha overlooks the consequences of her own failure to change. She

remains static, failing to develop or evolve over the course of sixty-six generations, and her timelessness proves to be her undoing.[13]

Ayesha's prolonged life comes to a horrific end when she steps back into the path of the burning pillar of Life. She is hoping to demonstrate to Leo and Holly that the fire that brought her supernatural longevity was harmless, but instead it wrought another transformation, causing her to age catastrophically before their eyes. This scene has had an indelible impact, visible from *The Picture of Dorian Gray* (1890) to *The Raiders of the Lost Ark* (1981):

> she *was* shriveling up; . . . smaller and smaller she grew; her skin changed colour, and in place of the perfect whiteness of its lustre it turned dirty brown and yellow, like an old piece of withered parchment. She felt at her head: the delicate hand was nothing but a claw now, a human talon like that of a badly-preserved Egyptian mummy . . .. Smaller she grew, and smaller yet, till she was no larger than a baboon. Now the skin was puckered into a million wrinkles, and on the shapeless face was the stamp of unutterable age. I never saw anything like it; nobody ever saw anything like the frightful age that was graven on that fearful countenance, no bigger now than that of a two-months' child, though the skull remained the same size, or nearly so. (292)

The moment has impressed critics too, provoking readings that link the episode to evolution, degeneration, gender (a beautiful woman is punished for her presumption), and imperialism (Western materialism triumphs over primitive magic) (Etherington xviii; Arata 101–3; Gilbert and Gubar 18–21; P. Murphy, 764–65; Stott 121–25). But I want to emphasize two additional points. First, in Ayesha's death agony, descent through modification triumphs over an unnatural existence that has endured through the ages without change. Of the two options for continuity over time – hereditary transmission of traits or near-eternal youth – the former prevails. Second, historical memory proves more powerful than timelessness. The memory preserved in the writing on the Sherd – a memory reinscribed by dozens of Leo's ancestors on its reverse side – sets Leo's quest in motion and leads to Ayesha's end.

Memory is intimately entwined with our sense of a human timescale rather than the incomprehensible durée of deep time. The poignancy of our memories of youth, of distant friends and lost loved ones, underlines the finitude of human existence as do few other emotions. A potent source of affect, memory has a privileged place in literary discourse, aligned with autobiography, lyricism, elegiac poetry, and closure in narrative. It is internal, subjective, personal. Its all-too-human qualities make it the very opposite of deep time.

Ayesha is immured from historical memory. In fact, she suffers from a memory disorder, traumatic fixation. She is "tormented by the memory of a crime ... without companionship, without comfort, without death" (201). She is rooted to the scene of her crime, unable to forget her transgression or to move on to a new life. Nicholas Dames calls trauma the "conceptual opposite" of memory in the nineteenth century and quotes Cathy Caruth who argues that trauma is "'a break in the mind's experience of time'" (165). In this context, we might think of trauma, with its failure to heal over time, as the psychological equivalent of Ayesha's physical timelessness. Her identity is as static as her body is ageless.

The novel leaves it uncertain whether Leo is the literal reincarnation of Kallikrates or merely a descendant with an uncanny resemblance to his ancestor. But Butler's conflation of memory with both reincarnation and the mechanism of heredity makes this a moot point. Either way, two mortal men survive at the end of this romance, giving one the ability to continue his biological line if he chooses, the other to preserve his legacy through writing, which he does by composing the manuscript we have just finished reading.

By linking reincarnation to spiritualism, on the one hand, and neo-Lamarckian ideas, on the other, Haggard gave late-Victorian readers an attractive new way to assimilate evolution. Readers who were troubled by materialism but understood the power of science to transform the world could toy with the notion that something persisted after death, whether as spirit or as heritable personality traits, or both. Survival of the fittest, inheritance of acquired traits, willed species change, and directed evolution pass as background knowledge, the common sense shared by narrator and reader alike, in contrast to the outlandish events of the romance. In the process, this common sense served as an alibi for other ideological goals, such as justifying imperial expansion and eugenic measures to strengthen the position of white, middle-class Englishmen. This is one of the major ways in which repellent ideas become normalized by popular culture. And it is another reason why we should be cautious about linking the science of epigenetics with neo-Lamarckism.

## Nineteenth-Century Literature and Science Policy Today

At this point, it is worth pausing to ask how one would go about making research on nineteenth-century novels useful for a policy discussion. Noting that fiction dramatizes the issues at stake and enables the public to identify with the consequences of ethical choices is an important first

step. A more problematic approach is that advocated by Leon Kass, chair of the President's Council on Bioethics: to insist that literature reveals enduring truths about the human condition. Literature presents a multitude of perspectives on human nature, even questioning whether there is such a thing. But even were one to embrace Kass's viewpoint, one would not want it to apply to all aspects of fiction, particularly not to the racist and eugenicist themes in works like *The Coming Race* and *She*. Yet these popular works had enormous impact on the reception of evolution in their time and for years to come.

In opposition to Kass's approach, many humanists would argue that readers learn to think critically about the human condition by situating a work of fiction in its own historical moment and by attending to the differences as well as the continuities between that time and one's own. Others might suggest that examining the formal complexities of a work of art could potentially undercut the very lessons Kass seeks to derive from it. In short, most humanists would advocate an approach that was more critical because it was more alert to historical or formal complications.

My approach is to treat these late-nineteenth-century popular novels as part of a case study of how scientific developments are mediated by the larger culture. They demonstrate the power of popular culture to assimilate science to its own preoccupations. This assimilation occurs not only on the thematic level – through explicit passages and polemical messages – but on the formal level too, as in Haggard's deployment of romance conventions for ideological ends. An adequate understanding of the impact of culture on the reception of science requires insight into the complex interactions of form and content, a perspective that can be aided by comparative literary-historical study.

A case in point: some epigeneticists have argued that knowing that the genome is not the only source of developmental traits might undermine genetic essentialism, the widespread belief that one's character is written in one's genes. As the editors of the special supplement of *Nature* put it: the field may be "an antidote to the idea that we are hard-wired by our genes" (Eccleston et al. 396). Jablonka and Lamb hold out a similar hope. They argue that molecular studies will help discredit the idea that "there is a gene *for* adventurousness, heart disease, obesity, religiosity, homosexuality, shyness, stupidity, or any other aspect of mind or body" (6, italics in original). They may be right: widespread awareness of the science of epigenetics might reduce the temptation to think there is a *gene* for adventurousness, intelligence, and so on, but it does not follow that belief in biological determinism will be undermined. Neo-Lamarckian common sense led to a

very different result. Faith in the inheritance of acquired characteristics spawned a whole host of deterministic theories about human behavior. Take, for example, the belief in a hereditary propensity toward crime, the subject of my next discussion.

## Wilkie Collins's *The Legacy of Cain*

> Children may inherit the disease of crime just as they may inherit the disease of consumption or gout.
>
> Walter Besant, *The Fourth Generation* (1899)

*The Legacy of Cain* (1888), a sensation novel by Wilkie Collins and the final novel he published before his death, is structured as a case study of the respective influences of nature and nurture. The novel tells the story of two sisters raised in the same household, one the adopted daughter of a woman who was executed for murder, the other the biological child of the Reverend Abel Gracedieu and his cold, overly intellectual wife. The central question of the book is whether the daughter of the murderess will reveal a "hereditary taint" from her mother (237) or whether an orderly, religious environment will prove the stronger influence on the child's character. To complicate the mystery, the Minister, after his wife's early death, conceals that one of the two children was adopted. For much of the novel, the reader is kept guessing about which young lady is the daughter of a murderer. We find ourselves weighing each mental and physical characteristic of the sisters against our memory of the two mothers, the murderess, who dearly loved her daughter, and the Minister's cold, clever, and deceitful wife.

Let me relieve your suspense. If I don't reveal the sisters' names, I can safely disclose the outcome of this convoluted plot without ruining the novel for anyone who has not read it. The daughter of the murderess does indeed inherit the propensity for murder from her mother, but the biological daughter of the Minister and his intellectual wife is the one who ends up trying to commit murder. The unexpected twist of having the murderer's daughter resist the temptation to kill and the Minister's daughter give in to the same temptation stems from another neo-Lamarckian tenet: that maternal inheritance outweighs paternal influences. In the contest of nature vs. nurture, maternal inheritance beats out paternal environment. The outcome still seems paradoxical, though, until one realizes that the murderess's daughter inherits both her mother's propensity for violence and her great capacity for Love, and it is the latter that wins out in the end.

Collins reveals that the murderess's daughter is struggling against an inherited tendency toward murder by a simple novelistic expedient, ready at hand from gothic conventions. When betrayed in love, she finds herself literally possessed by her mother's murderous spirit. The ghost of her mother, in a perverse echo of Dickens's *A Christmas Carol*, comes to the daughter in her sleep and shows her three different ways to dispatch her rival. To make the overpowering force of heredity a bit more plausible, Collins borrows a device from his earlier novel *The Moonstone* by having her drink a dose of laudanum before she falls into her somnambulant trance. Nonetheless, when under the influence of what the narrator calls "the lurking hereditary taint" (237), the daughter feels overcome by a "new evil self" (153), a "hateful second self" (223). To dramatize behavioral impulses inherited from another rather than a product of one's own will, Collins lets the daughter be possessed by a spiritual revenant of her mother.

The eventual criminal, the Minister's biological daughter, ends up trying to poison her fiancé, for reasons I need not go into other than to say that they stem from her maternal inheritance. When crossed in love, the Minister's daughter does not resist the temptation to kill because she has inherited her mother's cold, rational disposition. Just as the impulse to Love in the adopted child is a finer quality that she has inherited from her mother, so an unfeeling nature is a legacy from the Minister's intellectual wife. In both cases, the mother is to blame. The criminal sister is last heard of in America, where she leads a utopian community dedicated to the "Worship of Pure Reason" and to the "superiority of woman over man" (346), a last authorial sneer at intellectual women.

The problem of inherited traits is not allowed to rest there, however. Collins confuses matters by postulating that there exists an inherent quality in womanhood that is independent of both nature and nurture. Although "inherent," it is somehow not derived from the nature side of the nature vs. nurture debate. Critics have attributed the novel's incoherence to Collins's supposed misunderstanding of Darwin (Ashley 120–21; Marshall 106, 114). This view is wrong on two counts. First, it is not Darwin whose ideas are being explored here but the neo-Lamarckian views circulating in the 1880s. Second, the confusion in the book does not stem from a faulty grasp of current thinking about heredity but from conventional assumptions about women's roles, assumptions that contradict what the novelist appears to have learned about the inheritance of acquired characteristics.

In several places, the narrator affirms his faith that "[t]here are inherent emotional forces in humanity to which the inherited influences must

submit" (217). These emotional forces do not come from the environment – the Minister's careful nurture of his two daughters was of inestimable value to their development, but the narrator insists that these emotional forces are "inherent" rather than acquired. In particular, they seem to be intrinsic to womanhood. The narrator explains why he believes in this inherent force in a long passage dedicated to assessing the possible influences on the good sister's character. While admitting the dominant power of heredity and marking a lesser role for environment, the narrator postulates a third, independent "power for Good," whose origin remains unexplained by either nature or nurture. The narrator proposes (comically enough) that the advent of this power comes with the onset of puberty. When a girl becomes a woman, her feminine capacity for Love protects her. In hindsight, we can identify this mysterious "power for Good" as a pure emanation of Collins's own ideological presuppositions about gender:

> While, therefore, I resigned myself to recognize the existence of the hereditary maternal taint, I firmly believed in the counterbalancing influences for good which had been part of the girl's birthright. They had been derived, perhaps, from the better qualities in her father's nature; they had been certainly developed by the tender care, the religious vigilance, which had guarded the adopted child so lovingly in the Minister's household; and they had served their purpose until time brought with it the change, for which the tranquil domestic influences were not prepared. With the great, the vital transformation, which marks the ripening of the girl into the woman's maturity of thought and passion, a new power for Good, strong enough to resist the latent power for Evil, sprang into being, and sheltered [her] under the supremacy of Love. (216–17)

Woman's inherent power to Love exists independently of nature or nurture. Postulating this intrinsic quality in womanhood renders all the foregoing analysis of heredity incoherent. Gender assumptions trump everything Collins knows about nineteenth-century scientific theories of inheritance. If the change brought by time, the great and vital transformation that marks the ripening of the girl into womanhood, is nothing other than puberty, then why did the other sister not find strength in a similar transformation? The answer is simple but ludicrous: the other sister is just too bright. Collins emphasizes again and again how much smarter the evil sister is than the good one, and her cleverness, inherited from the Minister's intellectual wife, seems to prevent the ripening of a feminine power for Good.

In this context, we might recall Leon Kass's celebration of literature's ability to reveal enduring truths about humanity. Collins presents woman's

capacity for Love as one of the "inherent emotional forces in humanity" (217) that can counterbalance the effects of heredity. But who among us would be tempted to accept as enduring truths the gender assumptions that structure Collins's belief? Who among us would endorse the principle that the possession of a strong intellect in a woman is liable to render her vulnerable to murderous impulses and that a woman's inherent affinity for Love may be the only thing preventing her from giving into a biologically hardwired propensity for homicide?

In its very incoherence, Collins's novel has something to teach us about the popular understanding of heredity in late-nineteenth-century England. It used to be commonplace to assert that Collins made "very little reference to the intellectual currents of his own time" (Marshall 114), but this view has been countered in recent years by the research of Jenny Bourne Taylor, Lyn Pykett, Christopher Kent, and others, who have demonstrated the ways in which Collins's novels respond to the social and scientific debates of his day. Taylor stresses the novelist's engagement with discourses of degeneration and points to an echo in *The Legacy of Cain* of Henry Maudsley's work of the 1870s on "inherited taints" (J. Taylor 237–38). She also notes Collins's familiarity with "Lamarck's model of willed transformation" (138). Christopher Kent connects a minor character in the novel, Miss Chance, with Collins's interest in the role of chance in evolutionary theory, and links the narrator, who begins the novel as the governor of a prison with notions of hereditary criminality prominent in late-nineteenth-century social science (61, 64). Given what we now know about the extensive preparation Collins made for writing his antivivisection novel, *Heart and Science* (1883), it is abundantly clear that the older view of the novelist as out of touch with intellectual debates is wrong.

In fact, Collins's confused account of nature, nurture, and the inherent capacity of women for Love is typical of the unsettled state of evolutionary theory not only in the popular consciousness but among scientists themselves. As Morton puts it, "during the few decades which elapsed between the publication of the *Origin* and the foundation of Mendelian genetics around the turn of the century evolutionary biology was in a state of extraordinary confusion and ambiguity, and a wide range of writers were able to exploit the science for their own aesthetic or polemic ends" (6).

## Epigenetics and Neo-Lamarckism

Let me end this chapter by turning again to the question of my argument's bearing on science policy. Advocates of epigenetics think that attending to

the nongenetic sources of human inheritance might have desirable social consequences. For example, more than one have argued that this new science will challenge the reductive conclusions of evolutionary psychology in which human behavior is referred back to adaptive evolution in the prehistoric past, what John Dupré amusingly calls "the appeal to the stoneage" (80–98). Since "epigenetic variations are generated at a higher rate than genetic ones, especially in changed environmental conditions," Jablonka and Lamb believe that people can adapt to altered life circumstances on a far more rapid scale than traditional, gene-centered evolutionary psychology would allow (114). They think that this insight might dampen appeals to the "Paleolithic brain" by enthusiasts of evolutionary psychology, such as members of the school of literary Darwinists.[14] I agree – it might, and it should. But this insight also undercuts one of the most powerful scientific arguments used against eugenics in the early decades of the twentieth century, which is that genetic change moves too slowly to be directed toward the kinds of racial, social, and behavioral results dreamed of by neo-Lamarckians. Which social consequence of epigenetics will prove to be the most powerful remains to be seen. The example of the nineteenth century suggests that eugenicist conclusions might prove to have more popular appeal. Hence, policy advocates might want to resist the association of epigenetics with neo-Lamarckism.

Other commentators on epigenetics have suggested that a continuation of the neo-Lamarckian emphasis on maternal influences would have had a salutary effect on twentieth-century biology and helped curb some of the social ills arising from genetic centrism. Epigeneticists emphasize that the mother's cytoplasm makes an important contribution to the developing faculties of the embryo (Non et al.). They point to research on DNA methylation and RNA interference that suggests mechanisms by which heritable information other than DNA can be transmitted not only from cell to cell but from mother to child. These mechanisms can be activated by environmental stress, and if the stressful conditions continue for long enough, these cellular states can become subject to natural selection. This is, in effect, an explanation of how environmental conditions affecting the parent, especially the mother, can be passed on to the child (Barnes and Dupré 90–92).

Acknowledging the importance of maternal transmission of qualities, Jablonka and Lamb argue, would have encouraged research in developmental biology and have positive effects on maternal care. The example of Collins, among others, suggests something different. Although the popular understanding of heredity in the late-nineteenth century made ample

allowance for the kind of maternal influences on biological development that epigenetics stresses, in the hands of Collins and other commentators on the dangers of educating women, this point led to unfortunate polemics about the threat of intellectual women. Collins's assumptions about gender overruled his take on the science of the day, wreaking havoc with his novel's theme. In 2014, Sarah S. Richardson commented on a similar tendency in the popular reaction to epigenetics to "blame today's mothers" for the long-term health outcomes of their children (131).

The lesson is clear: The social consequences of science depend not only on how the population at large understands the research but also, just as much, on cultural concerns that may have little or nothing to do with the science. Literature and other symbolic forms are among the most powerful indicators of the concerns that are intertwined in people's minds with research results that may be relatively distant from those concerns. The association of popular literary conventions with neo-Lamarckian themes is a case in point. The example of Collins shows that the public could well view results that proved the heritability of acquired characteristics as powerful new arguments for biological determinism and that cultural presumptions about gender (and other issues) often outweigh what people know about science. While Collins was not tempted to see the hand of an intelligent designer in adaptive evolution, many other people in the 1880s were eager to draw exactly that conclusion – as they are today.

The mark of Lamarckism was inscribed in nineteenth-century culture through novels that took readers to the heart of Africa, deep below the surface of the earth, and into sensational murder plots. We are only beginning to glimpse where the mark of epigenetics will take us today.

CHAPTER 4

# *Evolution in the Tropics*
## *Neo-Victorian Fictions (A. S. Byatt, Andrea Barrett, David Mitchell)*

Alfred Russel Wallace lies sleeping uneasily in his cabin aboard the sailing ship *Helen* 700 miles off the Bermuda Islands, bound for England and home. He has been burning with fever for the last few days and is still feeling weak when the captain enters the cabin and says, "I'm afraid the ship's on fire. Come and see what you think of it." At first the smoke, thick though it is, does not seem threatening. But soon the *Helen* is engulfed by flames, and the crew and passengers clamber into the boats where they watch helplessly as the fire consumes their ship. Wallace writes: the flames

> rushed up the shrouds and sails in a most magnificent conflagration. Soon afterward, by the rolling of the ship, the masts broke off and fell overboard, the decks soon burnt away, the ironwork at the sides became red-hot . . .. It now presented a magnificent and awful sight as it rolled over, looking like a whole caldron of fire, the whole cargo of rubber forming a liquid burning mass at the bottom. (Wallace 87, 90)

Wallace has lost almost everything and is fortunate to escape with his life. The fruits of four years labor on his first expedition – most of his journals, his drawings, his splendid collections of insects and birds, and worst of all, the live animals he was conveying, monkeys and parrots and other tropical birds – all lost. Only one parrot falls into the water and is picked up. Wallace struggles to preserve its life in the overcrowded boat, but it too dies. This terrible event haunts Wallace for the remainder of his days. The loss of his collections, which would have meant financial independence for a young naturalist, the loss of the animals and birds, the loss especially of the parrot – they return in his autobiography as ghosts of what might have been.

Wallace's fire at sea reappears in two remarkable works of neo-Victorian fiction, A. S. Byatt's novella "Morpho Eugenia," which forms the first half of her 1992 book *Angels and Insects*, and Andrea Barrett's "Birds with No Feet," a story from her National Book Award–winning collection *Ship*

*Fever* (1996). Both center on fictional naturalists who meet and correspond with Wallace in the South Seas; both mention that Wallace's bad luck seemed to guarantee their safe passage home; and yet both lose their collections, nearly their lives too, in shipwrecks at sea. Barrett's description echoes Wallace's experience in striking detail, writing of the live animals trapped below deck, the birds wheeling in circles and then diving into the flames, even of a pet sloth, plucked out of the water, only to die later in the lifeboat.

These two stories about Wallace are only a fraction of the neo-Victorian fiction that deals with nineteenth-century voyages to the tropics. Anglophone authors whose cultural heritage circles the globe – England, America, Australia, New Zealand, and South Asia – have illuminated globalization today by juxtaposing it with Queen Victoria's empire. Merely to list the most notable of these works is to register a surprising conjunction: Peter Carey's *Oscar and Lucinda* (1988) and *Jack Maggs* (1998), A. S. Byatt's *Angels and Insects* (1992), Andrea Barrett's *Ship Fever* (1996), Roger McDonald's *Mr. Darwin's Shooter* (1998), Matthew Kneale's *English Passengers* (2000), Daniel Mason's *The Piano Tuner* (2002), David Mitchell's *Cloud Atlas* (2004), Sebastian Faulk's *Human Traces* (2005), Harry Thompson's *This Thing of Darkness* (2006), Lloyd Jones's *Mister Pip* (2006), and Amitav Ghosh's *Ibis* trilogy (2008–2015).[1] Darwin and Wallace are prominent in many of these fictions, although H. G. Wells's *Island of Doctor Moreau* appears often as well, and even Dickens demonstrates the power of his legacy in *Jack Maggs* and *Mister Pip*.

Although many neo-Victorian novels are set in England, most of the books that feature Darwin or Wallace take place in the tropics, no doubt because of the naturalists' formative voyages to the region. Cannon Schmitt argues that for many in the nineteenth century, "the tropics *are* nature . . . not simply because they offer the spectacle of intense struggle and diversity but also because" they represent "a remnant of the past that has survived into the present" (19, italics in original). To this, I would add that the tropical setting of these neo-Victorian novels draws attention to the global reach of Western imperialism and poses vivid examples of the risk explorers, missionaries, and merchants posed to sensitive ecologies – issues that came up in the writings of the naturalists at the time and remain pressing concerns in our own day (see Grove).

This chapter addresses a concern that inevitably arises when one makes the case for literary study's relevance to public policy. As fiction, what kind of knowledge claim can literature make? Even if one asserts that literature has a cognitive component, as many do, it is clear that the insights of

fiction differ in kind from knowledge provided by quantitative study, from "facts and figures," in Dickens's memorable phrase (*Hard Times*). There is nothing to be gained, in my view, from attempting to minimize the difference between literature and other forms of knowledge. Rather I want to emphasize that difference as part of my argument for why the policy world needs to add literary study to its armamentarium. Literary reading gives access to meanings, meanings that often circulate below the threshold of consciousness, meanings that may be difficult to capture in facts and figures. We are faced with a simple but enduring question, one that frames the differences between science, literature, and history in bold terms. The question is this: How do we weigh the respective claims of meaning vs. knowledge?

It is a new version of a very old debate: Poetry or Science? Fiction or Fact? The question of poetry's place in the hierarchy of knowledge can be traced back to Plato and Aristotle, and it was prominent in Philip Sidney's *Defense of Poesy* (1578). But from the Enlightenment onward and with increasing urgency in the nineteenth century, the debate about the value of poetry was framed in relation to science. Wordsworth maintained that the opposite of poetry was not prose but science, a sentiment Coleridge echoed in almost the same words a decade later. "Art is not science," Hazlitt declared, "because science is mechanical and art is not" (482). Dickens famously parodied his century's obsession with facts rather than imagination in *Hard Times.* But John Stuart Mill came closest to formulating the question I am posing in his two essays comparing Bentham and Coleridge. Bentham, Mill said, challenges us to inquire of any opinion "Is it true?" whereas Coleridge leads us to ask ourselves "What is the meaning of it?"[2]

## Poetry and Knowledge

Once poetry was not so clearly divorced from knowledge. Although pleasure has always been central to determining poetry's value, the Roman poet Horace emphasized poetry's dual function, to "please and instruct." For Sidney, poetry still united pleasure with instruction. But, for Wordsworth, the *type* of delight poetry gives readers was one of the things that separated it from the austere pleasure scientists can experience during their long and arduous pursuit of truth. According to Wordsworth, the Poet taps into universal sources of enjoyment, pleasures that are accessible to all, whether old or young, learned or unlettered. The Man of Science, by contrast, "seeks truth as a remote and unknown benefactor" pleasing himself, despite the difficulty of the path, with the conviction that the

goal is lofty and the sacrifice justified (Wordsworth 738). Whereas for Horace, poetry pleased *and* instructed, poetry now is seen as bringing a richer, deeper pleasure than the sciences, especially when poetry eschews instruction. It already is "the breath and finer spirit of all knowledge" (738) so does not need to stoop to didacticism. It infuses and enlivens all intellectual life, even what science has murdered to dissect. Thus, Wordsworth envisions a day in which the facts of science may themselves become the stuff of poetry. "The remotest discoveries of the Chemist, the Botanist, or Mineralogist, will be as proper objects of the Poet's art as any upon which it can be employed," but only when "these things shall [become] familiar to us . . . as enjoying and suffering beings" (738).

The realignment of poetry and science in the nineteenth century creates a compelling rationale for neo-Victorian fiction to take up the question of their respective merits. Focusing on this question in metahistorical fiction further complicates matters by simultaneously raising the issue of history's status as a discourse. Is history fact or artifice, a construct of the historian that makes it an unacknowledged variety of fiction? During the 1980s, a strain of postmodern theorizing about science and history argued that both discourses exaggerated their status as knowledge by ignoring the fictiveness of all discourse. The claim of either discipline to objectivity, one line of reasoning went, was undermined by the situated character of all knowledge. This postmodern critique, however, is not particularly relevant to neo-Victorian novels about science. Barrett and Byatt are representative of a number of contemporary novelists who are less invested in deconstructing science or history than in identifying the distinctive value and ethical use of each. They skirt the pitfalls of epistemology – as well as the scorched terrain of the science wars – by focusing on the affordances of each mode, not just the limitations of scientific and historical truth claims.

The different stances of postmodern theory and neo-Victorian literature are shaped by their divergent genres and audiences. As a realist form of metahistorical fiction, neo-Victorian novels emphasize sympathetic attention to the human dimension of science and the desire to know what we can about the past. This difference in orientation toward science is what makes neo-Victorian novels particularly useful for the researcher interested in thinking about science *policy* rather than in challenging the foundations of science. The genre explores the personal, social, and political meanings that flow from scientific discoveries, a task of importance to policy makers.

Neo-Victorian fiction probes not only the transgressions but also the plight of nineteenth-century scientists in the tropics. They attend to the sufferings and failures of their characters more often than to their

triumphs. The dilemma of Victorian scientists in the tropics has been well described by Jonathan Lamb, who noted that European explorers and natural historians in the South Seas, "rather redoubled their ignorance than increased their knowledge" when "confronted with the vastness of the ocean, and the unclassifiable diversity of its people and its plants" (4). But the goal of understanding science and history on their own terms does not blind neo-Victorian novelists to the complicity of their scientific protagonists with what Robert Aquirre has characterized as "informal imperialism." Aquirre argues that practices of mapping, categorizing, displaying, and narrating shaped "an audience receptive to the influx of British power in the region" (xvi), despite the prevailing opposition of British scientists to colonial conquest and slavery. Similarly, the scientists in Barrett and Byatt's stories are progressive men of science who are horrified by the devastation of native populations and natural environments brought on by colonization, yet they are themselves still guilty of all manner of sins: scientific racism, eugenics, cultural appropriation, bio-prospecting, economic exploitation, and more.

In *Dying to Know: Scientific Epistemology and Narrative in Victorian England*, George Levine details the costs of a scientific stance that required the sacrifice of human entanglements to produce knowledge. Nineteenth-century science, Levine shows, increasingly demanded "denial of self" as "the means to a greater good" (114). A dispassionate attitude and disinterested frame of mind were the price Victorian scientists thought they had to pay to obtain objective results. In related terms, Lorraine Daston and Peter Galison explore this mindset as a requirement of nineteenth-century scientists who aspired to achieve objectivity.

Neo-Victorian novels about science dramatize the opposite loss: the sacrifice – of factual accuracy, of scientific knowledge, in some cases, of life itself – demanded in the pursuit of meaning rather than knowledge. Such fiction amounts to a rationale for literature, a contemporary defense of poesy, which counterposes the effort to find meaning in a character's life to scientific lives spent in the pursuit of knowledge. They bridge the gulf Wordsworth postulated between science's remoteness from the wellsprings of shared human suffering and poetry's close contact with those waters. That the scientific lives in question are Victorian – whether actual Victorian scientists like Wallace and Darwin or fictional versions like the characters in these stories – implicates history in the problem, challenging us to ask if history is a form of knowledge or of meaning.

The stories I turn to next capitalize on the prominence of the dichotomy between literature and science in the nineteenth century to write

metahistorical fiction about the distinctive character of all three modes: literature, science, and history. The fact that the nineteenth century also saw the origin of the two-cultures split makes this period of special concern to the increasing number of novelists who are fascinated by science today.

## Andrea Barrett's "Birds with No Feet"

Wallace devoted much of his career to studying birds. Both of Wallace's major voyages – to the Amazon and to Borneo, Sumatra, and the Aru Islands – were dedicated in part to the pursuit of rare species of birds. Wallace traveled hundreds of miles up the Amazon, battling fever, loneliness, and privation in a successful quest to find the white umbrella bird. Later, he devoted months to the search for the fabled bird of paradise, a quest that took him to one island after another in the South Pacific. His persistence was rewarded with triumphant success, as he collected examples of numerous varieties, including one that bears his name.

Andrea Barrett's "Birds with No Feet" concerns an unsuccessful nineteenth-century explorer and would-be naturalist whose expeditions bring him into contact with Wallace, first in the Amazon and then in Borneo. Significantly, his experiences of bird hunting, feverish dreams, the capture of a live bird of paradise, and the loss of all his collections in a fire at sea mirror those of Wallace. Barrett uses her fictional collector, who fails to become the scientist he longs to be, as a way of responding to Wallace's voyages, even as she includes Wallace and his achievements as independent elements in the story.

"Birds with No Feet" is only one of several stories in *Ship Fever* that juxtapose the lives of Victorian naturalists – Darwin, Wallace, and Mendel – with those of scientists today.[3] The volume as a whole employs a dual time scheme – both within some of the individual stories and across the collection as a whole – characteristic of many neo-Victorian fictions. The first story of *Ship Fever,* "The Behavior of the Hawkweeds," encapsulates Barrett's method in miniature. The story moves fluently back and forth in time between a lonely woman in the present married to a genetics professor at a New England college, her immigrant grandfather who once knew Gregor Mendel, and Mendel himself who worked in isolation on a discovery that no one would notice until the next century. What unites the three is a letter that Mendel gave to the woman's grandfather and that she in turn shared with her husband. Mendel's letter is like a genetic trait passed down through time, but the letter itself is less important than the stories the characters tell one another about its transmission. These stories,

more than the inheritance itself, bind the present to the past in ways that both damage and redeem. Stories prove as tenacious as DNA in connecting us across time.

In "Birds with No Feet," Barrett imagines a young American collector named Alec, the wayward son of an improvident tavern keeper, who aspires to become a naturalist and gain the fame and position that Wallace eventually achieved. After the shipwreck that destroyed all the specimens he had hoped to sell in Philadelphia and the journals that he had hoped to turn into a narrative that would bring him both scientific and popular renown, he finds himself forced to abandon his scientific ambitions for more commercial goals. On his second voyage he becomes so consumed with killing and preparing specimens for the market that he has no time for science. By the end of his expedition to Borneo, he finds himself reduced to a shadow of his former self, wasted physically by repeated bouts of malaria and spiritually by his failure to live up to his dreams. When he returns to America in 1862, he finds his country consumed by civil war, a national trauma that extends and magnifies his sense that his pursuit of knowledge has been in vain. As he enlists for "another murderous journey" (122) with the army of the North, he sees his pretense to science – perhaps science itself – as merely an illusion. How do his dreams of contributing to knowledge matter in the face of an entire civilization tearing itself to pieces?

The story ends with a boy on Aru asking what would become of all the birds Alec has shot and preserved for his collections. Alec remembers a line from one of Wallace's letters: "*Each bird we shot and butterfly we netted was in the service of science*" (122, italics in original), but this disappointed character knows the words do not apply to him. Instead of knowledge, all that has come out of his voyages is memory and a persistent desire for something more, something unattainable. In that, the collector mirrors – and comments on – Barrett's own relation to the past. For her, historical knowledge plays a secondary role to meaning. Memory and desire for the unattainable – these are not what history *or* science would classify as knowledge, but they are the remainder of a life – its meaning, if you will.

What would become of all the birds? What becomes of Alec's life? The Aru boy answers: "We believe that all the animals you kill and keep will come to life again. . . . They will rise . . . when the forest is empty and needs new animals" (121–22). To Alec, this answer seems as probable as Wallace's theory of natural selection. Both are efforts to make sense of change over time, of generation and extinction, of loss. But one is a source of meaning and solace, the other a contribution to knowledge. If "meaning

can never quite penetrate reality," as Lukács tells us, "without meaning, reality would disintegrate into the nothingness of inessentiality" (88). That is what has happened to Alec, who has returned from the failure of his scientific dreams to a reality engulfed by war. Hence, his attraction to a myth about the resurrection of forest animals. But Alec sees the value of both the Aru myth and Wallace's insight, a dual perspective that produces what Lukács calls "the melancholy of the adult state" (86). The pathos of Barrett's story, the beautiful solace it offers, can help us distinguish Alec's melancholy recognition from the convenient fictions that some people today prefer to scientific facts. It is fear or anger that motivates many in our world to deny reality and embrace myths about vaccines, say, or climate change, or to deny, as Alec never will, the theory of natural selection. The meaning Alec finds in Aru myth is as valuable as the scientific knowledge it will never displace.

## Literature, Memory, and Meaning

Andreas Huyssen has observed a penchant in contemporary culture for approaching the past via memory rather than history. Memoirs, journals, memory gardens, memory quilts, testimonials, eyewitness accounts, oral histories, video recordings, autobiographies, and historical fiction – these forms of remembrance take pride of place today, Huyssen argues, replacing in the popular imagination forms of historical investigation that rely on documentary evidence or records that can be verified by others. This "memory fever," as Huyssen calls it, is particularly intense in "border-crossing memory discourses" (12) – for which the Holocaust serves as Huyssen's archetype – memory discourses that are simultaneously generalizable yet particularized with each new atrocity from Rwanda to Bosnia to Xinjang.

Given its popularity, neo-Victorian fiction would seem to be a prime symptom of "memory fever" supplanting history, especially when considering border-crossing stories of European scientists in distant lands. Huyssen foregrounds the intimate connection between art, memory, and meaning in these kinds of texts, and contrasts this affective collage, hyperbolically in my estimation, with the decay of history's prestige in today's media-saturated culture. Yet to view this genre merely as symptomatic of a deplorable, recent trend is to overlook the divergent aims and values of literature and history. Rather than seeing one as a pallid substitute for the other, providing the weak pleasures of nostalgia rather than authentic history, as Fredric Jameson once argued postmodernism did,

one should look closely and care deeply about the particular cultural work performed by these forms. Literature has been a vehicle of both personal and cultural meaning since writing began to replace oral traditions as a source of knowledge about the past. A historical text can be such a vehicle too, but the burden of history is that it must strive for Truth before it can have meaning for others. Literature must have meaning for others before it can be True.

If one had to identify a period in which the affective collage of literature, memory, and meaning began to intensify, one would have to turn again to the nineteenth century. From Wordsworth's day, and increasingly throughout the century, literature seemed called upon to supply the meaning once provided by religious belief. T. E. Hulme derisively called Romanticism "spilt religion" (118). Raymond Williams and M. H. Abrams both chronicled what the latter called "natural supernaturalism," the investment in literature and the arts that led figures like Mill and Arnold to seek the consolation that they could no longer find in received doctrine through poetry – Wordsworth's verse in particular. In the twentieth century, the emphasis on literature as a source of meaning was one of the factors behind the interpretive turn in literary studies, inaugurated by Eliot, Empson, and Leavis in England and Vanderbilt's New Critics in America.

Of course, there have always been forms of literature that emphasized knowledge as much as meaning – wisdom literature, Menippean satires, Georgics and other didactic poetry, Hazlitt's "Literature of Knowledge," the group of texts Northrop Frye called "anatomies" (*Anatomy* 308–14), encyclopedic fictions like *Finnegan's Wake* or *Gravity's Rainbow*, the novel of ideas, *roman a theses*, or documentary fictions, such as Upton Sinclair's *The Jungle* or James Agee's *Let Us Now Praise Famous Men*. These are eccentric genres, however, oddities or sports that survive today but rarely flourish in furrows cultivated by uncommon energy or genius. They propagate few offspring.

Equally, science can be a source of meaning for both scientist and layperson alike. Einstein maintained that the "strongest and noblest motive for scientific research" was the "cosmic religious feeling" (238). In *The Meaning of Human Existence*, E. O. Wilson contended that science, not philosophy, would explain the meaning of humanity (38). Darwin himself always searched for the larger meaning of his theories, in part to forestall the very different constructions that would be put on his ideas by others: "There is grandeur in this view of life," he wrote at the end of his greatest work (396). But Stephen Jay Gould spoke for the majority when he said

that science had little to say about "questions of ultimate meaning and moral value" (*Rocks of Ages* 6). The notion that science can provide answers to existential questions has been called the "naturalistic fallacy" (Coyne 111), and belief in a guiding scientific idea has often led to pernicious ideologies, as was the case with eugenics in the early twentieth century or among some advocates of Wilson's sociobiology today. On the other hand, disbelief in science has become a widespread problem in our society – witness creationists who reject evolution and climate change deniers. The mistaken notion that science is something that one should believe in (or disbelieve) represents an inappropriate response to the kind of knowledge it provides. One does not *believe* in scientific knowledge; one tests it, extends it, and employs it to improve the world and make new discoveries.

## A. S. Byatt's "Morpho Eugenia"

On one level, A. S. Byatt's novella, "Morpho Eugenia," is a takeoff on Victorian sensation fiction, filled with lurid sexuality, and connected to the extensive arguments about Darwin, Wallace, and evolution only by the dangers of inbreeding that an incestuous brother and sister run. The naturalist, William Adamson, finds himself marooned in England by shipwreck and poverty, dependent on an elderly, religious patron, Sir Harald Alabaster. Troubled at first by this enforced idleness, Adamson soon finds himself seduced by the charms of the family's eldest daughter, Eugenia. The course of this plot is swift and predictable. Although far above him in social standing, Eugenia marries Adamson as cover for her ongoing affair with her older brother and promptly begins to bear children that run true to the Alabaster family morphology. But if this plot is as obvious to the reader as it is opaque to Adamson, a second, more complicated plot emerges from the naturalist's friendship with Matty Crompton, a companion for the children who shares his fascination with birds, butterflies, bees, and ants. During their field trips with the children to nearby woods, Matty reawakens his passion for science and together they write a successful children's book of natural history about an anthill on the estate. Matty turns out to be a secret author herself. Through an engaging faux-Victorian fairy tale, she conveys an allegory to Adamson with the moral: "Things are not what they seem." The irony, of course – or rather, one of several ironies – is that this message is a commentary not only on Adamson's marital charade but on Byatt's metahistorical fiction.

"Morpho Eugenia" turns out to be a compendium of narrative structures for conveying double meanings. On the first page we learn of the

split nature of experience for our protagonist. After ten years in the tropics, the loss of all his notes and collections at sea, and fifteen days of near starvation in a lifeboat, everything at the Alabaster estate seems unreal. His hostess is urging him to dance, and he admires the "shimmering girls," pale and blond in their "shell-pink and sky-blue" gauze and tulle (3). But he cannot shake the image of "communal dancing" in the Amazon with dark, nearly naked Indian women. Throughout his time on the Alabaster estate, Adamson is haunted by what Byatt repeatedly calls "double consciousness" (28). The world seems filled with "strange analogies" (35) – analogies between English manners and Amazonian customs, and between instinctual ant behavior and human practices. Everywhere he looks on the estate – dances, marriage rites, religious beliefs, male dominance displays, a slave-making ant species – Adamson is tormented by a "double vision, of things seen and done otherwise in another world" (7), whether a distant human society or an equally alien insect world.

Doubleness is not merely a matter of Adamson's experiences in two worlds. It is a structural feature of the story itself. Byatt underlines this point by making copious references to literary forms that highlight double meaning. The novella is chock-a-block with parables, fables, analogies, anagrams, dream interpretations, extended metaphors, didactic children stories, fairy tales, puzzles, and riddles.

Personally, Adamson distrusts analogy. In his arguments about evolution with Sir Alabaster, who reasons in the vein of Paley's *Natural Theology* by basing his proofs of God's hand on analogies, Adamson objects: "You may argue anything at all by analogy, Sir, and so consequently nothing" (104). Adamson speaks of "irrelevant analogies" (74) and reproves his own habit of seeing his life in terms of a "diminishing analogy" with the ant world. "Analogy is a slippery tool," he comments. "Men are not ants" (116). Here we find in succinct form one objection to using analogy to prove a point. By contrast, Devin Griffiths has argued that romantic poets and nineteenth-century scientists alike employed analogy more creatively, turning it into an exploratory tool, an instrument for intellectual inquiry. For some writers, Griffiths maintains, analogy changed from being the kind of formal structure to which Adamson objects, the sort that simply maps information from a source domain to a target domain, while suppressing the semantic dimension of the former; instead, it became a reciprocal structure, where both domains in a comparison offered perspectives on a new relationship. In such cases, analogy would become a stimulus to further experimental investigation,

turning literature, like science, into a vehicle for investigating reality. While this probing, exploratory use of analogy may inspire scientists as much as poets, analogy produces meaningful ways of looking at the world, not facts. The use of analogy that Adamson reproves is the kind that presents an analogical relation as a form of proof, as self-evident knowledge, not a tool of inquiry.

Adamson's objections to "irrelevant analogies" prepare the way for the sustained case Byatt makes for the value of literary ways of thinking. The story endorses literary modes of saying one thing and meaning something else (reciprocal analogies, parables, riddles, allegories, fairy tales, etc.), one of the basic ways in which fiction makes meaning out of stories. The parade of literature's formal resources for introducing ambiguity and doubt into the act of representation reaches a climax in the metaphor that gives the story its title. Eugenia, like the butterfly that shares her name, transforms from one morphological form to another, the Alabaster *nympha* he thought he was marrying to the *imago* who is her brother's compliant mistress.

Griffiths argues that the probing, comparative form of analogy that emerged as a central feature of the nineteenth-century historical novel became a model for adventurous scientists of the period – Charles Darwin in particular. What Darwin (but not Paley) shared with historical fiction was a "commitment to analogy . . . as a tool that brings the relation between previous ages and present into focus, seeking the origin of contemporary social and natural order within the patterns of past events" (Griffiths 2–3). This same comparative historicism is what Byatt seeks to emphasize by parading such a wealth of analogical literary modes in front of the reader. She is making a claim about the value of literary modes of thinking for uncovering meaningful relationships between past and present. In the process, she dramatizes Adamson's learning from Matty to trust analogy's insights and to discover a more adventurous way of doing science, one more like his hero Darwin and less like that of an old-fashioned natural historian.

In the fairy tale Matty writes to warn Adamson about his deceitful wife, she uses a bit of nonsense language to capture the role that names and tropes play in making meaning out of relations between things. "Names, you know, are a way of weaving the world together, by relating the creatures to other creatures and a kind of *metamorphosis,* you might say, out of a *metaphor*, which is a figure of speech for carrying one idea into another" (150–51, italics in original). For this Son of Adam, who once thought that by naming the insects, natural history could pin down the

world, the lesson comes painfully late, yet in time to enable him to escape on another voyage of discovery.

Byatt and Barrett both have a gift for ending their stories with resonant images, which condense meaning into emotion. It is a skill of special value to the short story as a genre, for stories rely on compression to make a life come to a head in a revelatory moment. Years ago, in *The Sense of an Ending*, Frank Kermode described the power of this kind of narrative closure in words that moved me as much as any critical writing I have read before or since. Kermode wrote that the end of stories cast the "benefaction of meaning" over all the turmoil and strife that had gone before (178). In our own lives, we are born into the middle of things, and we die before the world's end, but in literature we can experience a completion that is impossible elsewhere – that is fiction in every sense of the word. Kermode's insight enables us to recognize affect as a critical component of literary meaning and experience aesthetic pleasure as understanding, if not knowledge.

The end of "Morpho Eugenia" takes place on the deck of the sailing ship *Calypso*, bound once again for the tropics. Far out to sea, Adamson and Matty are surprised by a Monarch butterfly, which has fluttered exhausted onto the rigging. They are filled with emotion, although uncertain whether this feeling is fear or hope. The butterfly is "so fragile, and so easily crushed, and nowhere in reach of where it was going," Matty murmurs. "And yet it is still alive, and bright, and so surprising, rightly seen" (183). We understand this butterfly as yet another metaphor for the two vulnerable characters, still nowhere in reach of their goal. "As long as you are alive," the captain responds, "everything is surprising, rightly seen" (183). Not a conclusion that contributes to the store of human knowledge. But an end that makes sense of a life.

## David Mitchell's *Cloud Atlas*

Unlike Barrett and Byatt's stories, David Mitchell's novel *Cloud Atlas* (2004) is not primarily a neo-Victorian fiction. Its innovative structure ranges across six different time periods, each nested within the others like a set of Russian matryoshka dolls, an image the novel invokes more than once. But the opening and closing chapters are neo-Victorian. They consist of the nineteenth-century journal of Adam Ewing, a shipwrecked traveler searching for passage home from a South Sea island while being slowly poisoned by Dr. Henry Goose who is posing as his friend. The journal breaks off in mid-sentence, and the next chapter picks up the story

of a different character, a young composer living in 1931. Each subsequent chapter shifts to the story of a new character decades in the future until the novel reaches its pinnacle in a distant, postapocalyptic world, only to reverse course back down time's ladder, completing the stories in reverse order.

The neo-Victorian sections introduce one of the novel's central themes: Will human history be ruled by survival of the fittest? In each of the six linked stories, characters who believe that "humanity may transcend tooth & claw" (508), as Adam does, contend with the will to power of characters such as his supposed friend who believes "the weak are meat the strong do eat" (489). This Darwinian theme is everywhere evident: in the extermination of a peaceful island tribe by conquering Maori, in the extinction of seals by overhunting, in the devastation of native populations by Western diseases, in the looming environmental damage from an unscrupulous nuclear power corporation, in the cloning of human slaves in the near future, and in the radioactive dead lands that cover most of the planet in the far future. "Our will to power, our science, and those v[ery] faculties that elevated us from apes, to savages, to modern man," one character declares, "are the same faculties that'll snuff out *Homo sapiens* – before this century is out!" (444–45).

The opening sentence of *Cloud Atlas* literalizes Dr. Goose's cannibalistic metaphor via a reference to the cannibals in Defoe's *Robinson Crusoe*. Adam stumbles upon a trail of fresh footprints on a forlorn strand, which leads him to the predator who will nearly kill him. Although supposedly a surgeon to the London elite, Dr. Goose is first seen collecting human teeth from the sand, the remains of a "cannibals' banqueting hall," where "the strong engorged themselves on the weak" (3). This is the first of many references to the later nineteenth-century belief in social Darwinism, the supposedly scientific justification for all manner of horrors, from unbridled *laissez-faire* competition to plundering of natural resources to human slavery and genocide. Dr. Goose has taken to heart a particularly uncompromising version of this "scientific" social law. In a conversation late in the novel, Dr. Goose listens to a preacher named Horrox who sermonizes on God's wisdom in establishing Anglo-Saxons as the "highest of all the races" on "Civilization's Ladder" (487). Horrox takes the standard line: "Nature's Law & Progress" will lead to extinction of lesser races; "Unpleasant scenes may ensue, but men of intellectual courage must not flinch" (488). Dr. Goose agrees but goes him one better. It is not God who has made the white races dominant, he responds, and then explains later to Adam:

> Why tinker with the plain truth that we hurry the darker races to their graves in order to take their land & its riches? Wolves don't sit in their caves, concocting crapulous theories of race to justify devouring a flock of sheep! . . . True "intellectual courage" is to dispense with these fig leaves & admit all peoples are predatory, but White predators, with our deadly duet of disease dust & firearms, are examplars [*sic*] of predacity par excellence, & what of it? (490)

In case we have missed the analogy between cannibalism and social Darwinism, Dr. Goose adds that he sees humans not as "sacred beings" but as "joints of meat," "ready for the skewer & the spit" (503).

Extinction and slavery were incidental themes in Barrett and Byatt, but they are major refrains in *Cloud Atlas.* Mitchell's novel treats the urge for domination as one of humanity's original sins and confronts not only the extinction of individual species but also the possible end of all life on the planet.[4] We have come full circle. Wells's *Time Machine* foresaw the strong Morlocks consuming the weak Eloi in our distant future and understood extinction of life on earth as part of an inevitable, planetary process, eons in the making.[5] Writing in the twenty-first century when global warming poses a present danger and new forms of slavery thrive in global sweatshops and the sex trade, Mitchell sees each age hurrying on to the end through its own heedless will to power.

The unusual temporal structure of the novel allows Mitchell to end his story twice – once at the exact center of the book, when the story begun hundreds of years earlier in Adam's journal reaches the chronological end of humanity in a distant, postapocalyptic future. Then, again, on the last pages of the book, when Adam is delivered from the murderous designs of Dr. Goose by his ship's long-delayed arrival in safe harbor.[6] Each of these endings – the chronological ending at the center of the book and the closing pages of the book's final chapter – takes place in the tropics, in Hawaii to be exact. The shared tropical setting binds Adam's Pacific Journal to the story of Zachry, the protagonist of the central chapter. A to Z, alpha to omega, the beginning and end of the six discrete narratives to the beginning and end of all humanity.[7] Here, as elsewhere, the temporal structure of the novel expresses the conflicting imperatives of deep time and personal history. Each of the six time periods immerses us in the story of an individual. The Adam and Zachry chapters reinforce this personal dimension by employing what Huyssen identifies as "memory discourses" par excellence (12) – a journal and an oral life history.[8] In the latter case, Zachry narrates his life story at the request of two young lovers, interrupting himself to explain, in his distinctive dialect, that "these are the

mem'ries what are minnowin' out" (243). A garrulous old man at fifty, Zachry is haunted by guilty memories, like Coleridge's Ancient Mariner, and his autobiography is as much expiation as personal history.

Huyssen laments the "memory fever" that has infected our times. An earlier theorist of history, Walter Benjamin, sees memory playing a more valuable role in our grasp of the past. In "Theses on the Philosophy of History," Benjamin writes that the kind of history that matters "seize[s] hold of a memory as it flashes up at a moment of danger" (255). And that is eminently true of Mitchell's novel. All the historical periods respond to a "moment of danger," for the protagonist, for society, and ultimately, for the species. The danger is particularly salient in the Darwinian passages that pepper Mitchell's text, most of all in the passage I quoted earlier on the dangers that lie within the West's "civilizing" mission. "Our will to power, our science . . . are the same faculties that'll snuff out *Homo sapiens* before this century is out!" (444–45). I hear echoes in this dark critique of another of Benjamin's famous theses: "There is no document of civilization which is not at the same time a document of barbarism" (256).

The progress of civilization, inaugurated in the neo-Victorian chapters of the novel, moves inexorably toward barbarism and extinction. Yet there is a countermovement in Mitchell's novel. Each time period also stresses the commonalities, recurrences, and shared traits that bind the characters together and transform them into instances of a cyclical or recurrent pattern. Reincarnation, Nietzsche's Eternal Return, variations on a musical theme, nested matryoshka dolls – countless motifs in the novel evoke time's cycle. Events repeat one another; characters share the same birthmark and remember things that happened centuries in the past or future; genres and media recapitulate the history of forms – journal, epistolary narrative, pulp fiction, film, hologram – then back to the earliest form of all, oral narrative. The paradoxical combination of linear and cyclical perspectives on time reflects both the genre's commitment to the narrative of individual lives and our more contemporary concern with the fate of the planet. In doing so, it captures the way in which our culture's understanding of time has developed since the nineteenth century.

The neo-Victorian embrace of such a paradoxical conception of time was not a recourse available to most Victorian authors. Cyclical time was still too resonant of its sacred roots for post-Darwinian materialists, while a starkly secular view of linear time, with no guiding destiny or redemptive end, was intolerable for most religious readers. Mitchell, by contrast, openly embraces time's duality, an attitude characteristic of genome time. With our limited lifespans, individuals experience deep time primarily

through art, ritual, and religion. But for Mitchell, these three modes are interrelated – literature and art, he asserts, construct belief. The novel repeatedly dramatizes how fictions give purpose and meaning to his characters' struggles and to civilization's best instincts – or its worst. "Pretendin' can bend bein,'" Zachry declares (283). And Adam in his journal: "If we *believe* humanity is a ladder of tribes, a colosseum of confrontation, exploitation & bestiality . . . [then this] predatory world *shall* consume itself" (508). On the other hand, "If we *believe* that humanity may transcend tooth & claw, if we *believe* divers races & creeds can share this world . . . [then] such a world will come to pass" (508, italics in original). Like Barrett's failed naturalist finding meaning in a belief he knows to be a fiction, Adam finds purpose in believing in a cause, abolitionism, because "belief is both prize & battlefield, within the mind & and in the mind's mirror, the world" (508).

Adam's adventures in the Pacific prompt him to picture deep time as a "stream grinding boulders into pebbles through an unhurried eternity" (507). The earth's unhurried ages have provided Adam with more examples of violence and rapacity than he cares to contemplate, and he has heard too many men justify their hunger for power as part of Nature's plan. But Adam rejects this interpretation of deep time, averring instead that "for the human species, selfishness is extinction" (508).

## Conclusion: Meaning or Knowledge?

In an essay on Darwin's *Voyage of the Beagle*, George Levine argues that Darwin increasingly came to prefer factual knowledge to the "entanglements and sublimities to which he was emotionally drawn" (365). Levine's essay, "By Knowledge Possessed," charts Darwin's movement from "an essentially poetic response . . . to a scientific one" (379). As he grew older, Darwin "increasingly reject[s] the unmodified attempt to describe" nature in favor of capturing the "phenomenon in secular and systematic terms – 'general laws' produced from large collections of facts" (379–80). Levine's account of Darwin's journey away from pleasure and meaning to general laws and facts makes the opposite, yet complementary point to my own – that nineteenth-century science had to give up certain kinds of personal fulfillments to achieve knowledge.

It is an old debate: Poetry or Science? Fiction or Fact? to which I would like to add Meaning or Knowledge? Levine's work laid bare the costs of a scientific epistemology that required the sacrifice of human entanglements to produce truth. "The West, in order to know, had to die to desire, had to

die to its human interests" (*Dying* 268). In Barrett, Byatt, and Mitchell's fictions those are the only things that remain, desire and its human interests. They are the beautiful remnants of lives that persist in memory – and in literature – after the fruitless voyages have come to an end. The scientist who has produced no knowledge produces for us, readers of literature, an alternative that seems to suffice: recognition of what it means for a person to have lived.

PART III

# *The Modern Synthesis*

The final paragraph of James D. Watson's autobiography, *The Double Helix* (1968), sounds a plangent note. It reverberates with the melancholy tones that close Fitzgerald's *The Great Gatsby* (1925) and Hemingway's *The Sun Also Rises* (1926). Watson perhaps fancies himself as a late member of the Lost Generation, a Cold War descendant of those Americans in Paris, so disaffected, so alienated from their native land. Watson is spending a final day in Paris, taking a last look at the elegance of the Faubourg St. Honoré. Later that night he will celebrate his birthday. But now he wanders alone, "looking at the long-haired girls near St. Germain des Prés and knowing they were not for me" (131). The young man who has just published what many considered to be the greatest contribution to biology since Darwin can let himself savor a moment of self-pity. Unlike Gatsby, Watson knows his long-sought dream is already behind him, etched in the double-helix structure of DNA. So he laughs at himself in the book's final line: "I was twenty-five and too old to be unusual" (131).

When not invoking the Lost Generation, Watson's narrator gestures toward Huck Finn. With a knowing wink, Watson opens his book with the tale of a colleague greeting him on a hike with a sardonic question, "How's Honest Jim?" (7). Watson had once thought of titling his autobiography *Honest Jim*, and his colleague's mocking reference to the rumors that Watson had unscrupulously used Rosalind Franklin's crystallographic X-rays as the basis for his discovery, puts us on guard that this brash American narrator might, as Huck put it, "tell a few stretchers now and again." In any case, Watson establishes the kinship of his autobiography with several quintessential American fictions.

The relationship between autobiography and fiction – of a supposedly "factual" genre with the art of storytelling, in both senses of the word "story" – raises the kind of questions explored in the Chapter 4. Watson extends these questions into the practice of science. He has no doubt at all

about the *truth* of science. That is not his point . . . nor mine. But he does assert a bond between science and art. They are both "very human" endeavors, full of "the spirit of adventure"; and they are both shaped by "personalities and cultural traditions" (Watson 3). Watson is ardent about the beauty of scientific discoveries, and his research is guided "by the belief that the truth, once found, would be simple as well as pretty" (3). His stance in science is the same as his stance in literature.

The structure of DNA, which Watson and Crick discovered in 1953, may be seen as the highest achievement of what biologists call the modern synthesis. It is probably a coincidence that Watson reaches back to the Lost Generation of novelists in the 1920s when fashioning his narrator's point of view, but that was the decade when a group of scientists in the Bloomsbury circle helped pioneer the modern synthesis of evolution and genetics. These scientists, like Watson after them, fashioned a "scientific point of view" closely aligned with that of a novelist, one of their fellow Bloomsbury writers, Aldous Huxley. This shared stance between a small circle of scientists and artists in the 1920s is the topic of Chapter 5. It would be interesting to delve into the resemblance between James Watson and the authors of the modern synthesis, but here let me simply say that we have been too willing to accept the notion that science and literature must remain in separate worlds. Watson did not accept that, and neither did some of the influential scientists who worked on the modern synthesis. There are ties that bind the process of scientific discovery to the larger culture, and it enriches our understanding of both when we trace the densely interwoven threads.

CHAPTER 5

# *The Modern Synthesis*
## *Genetics and Dystopia in the Huxley Circle (Aldous Huxley, J. B. S. Haldane, Julian Huxley)*

Aldous Huxley's *Brave New World* (1932) has influenced public debates over genetics more profoundly than any other work of literature with the possible exception of *Frankenstein*. Both works have been misremembered, misunderstood, and misused in polemical contexts more often than not. In Huxley's case, the problem arises from readers' failing to admit that his satire cuts in more than one direction. The novelist was witness to the birth of the modern synthesis in biology, and he was a strong advocate of the biological sciences. But he was a moral relativist and a satirist too, and he was always ready to satirize the people he loved and the ideas he embraced. He had the curse of being able to see through everything. To grasp the real meaning of *Brave New World* for society today, we need to understand Huxley's relationship to both the modern synthesis and the art of satire.

To scientists, the "modern synthesis" names the shift in biology that occurred in the years between the two world wars when scientists brought together Darwin's theory of evolution with the new science of genetics. One of the pioneers of the modern synthesis was J. B. S. Haldane, a longtime friend of Aldous Huxley; another proponent was the novelist's older brother, Julian Huxley. Haldane (along with R. A. Fisher and Sewall Wright) demonstrated with compelling mathematical analyses that Darwin was correct to assert that natural selection was the primary cause of evolution. Adding genetics to the theory of evolution supplied one of the key elements missing from Darwin's concept, namely an understanding of how the inheritance of traits actually took place. The result was a powerful consensus, which prevails even today, that the evidence of genetics largely confirms Darwin's original insights.

In the first two decades of the twentieth century, Darwinism was in decline (Bowler, Eclipse of Darwinism).[1] Long under assault by religious opponents, Darwin's theory of natural selection came under renewed criticism by scientists too in the 1880s, and this trend only intensified

with the rediscovery of Mendel's work in 1900. Early Mendelians doubted that natural selection alone could account for the clear-cut differences among Mendelian factors that their model described. Additionally, some Mendelians such as William Bateson were saltationists who believed that large mutations, not the small continuous variations Darwin postulated, better explained species change. Evolution was seen as an account of inheritance – of how characteristics were transmitted across time. Genetics, by contrast, was a science of difference: it explained how individuals varied from one another. So pervasive was the impression that Darwin's ideas had been superseded that Haldane twice used the ironic epigraph "Darwinism is dead" for publications that showed Darwin's continuing relevance to modern biology.[2]

*Brave New World* represents a modern synthesis of a different sort. Dystopian fiction arises from the fusion of two radically opposed literary genres, naturalism and utopia. In an excellent treatment of contemporary dystopian films, Phillip Wegner proposes that in the early twentieth century, dystopia emerges when naturalism's "thoroughgoing pessimism about the present moment is suddenly transported into the otherworldly space of the utopian fiction" (118). Wegner, like Fredric Jameson before him, notes the historical conjuncture of late-nineteenth-century utopias such as Edward Bellamy's *Looking Backward* (1888) and William Morris's *News from Nowhere* (1890) with the naturalism of George Gissing and others.[3] Both Bellamy and Morris explicitly acknowledged that their novels were counterblasts to the pessimism of writers such as Gissing. Dystopia, which dates as a genre from the first decade of the next century, counters utopia's rebuke to naturalism with its own dark reply. Dystopia constructs a model society by extrapolating from the worst, not the best, features of the contemporary world. Its status as a generic synthesis is endorsed by a later giant of the tradition, George Orwell, who told the British publisher of *Nineteen Eighty-Four* that his book was a futuristic "fantasy, but in the form of a *naturalistic novel*" (quoted in Wegner, 122; Orwell's italics).

Aldous Huxley's close association with some of the principal biologists of the day prompts one to ask whether juxtaposing the modern synthesis in genetics with the literary synthesis that resulted in dystopia can reveal something new about each phenomenon. The prominence of evolutionary ideas in naturalism, Victorian utopias, and modern dystopias suggests it might. The role of determinism in both the genetics of the period and the plot structure of dystopian fiction offers another clue. Finally, the dense circuit of literary exchanges in the years 1927–1932 among novelists and

scientists who knew one another well – Haldane, Julian Huxley, and Aldous Huxley in particular, but also Haldane's wife, Charlotte Haldane, who anticipated *Brave New World* with her own novel about the future of genetics, *Man's World* (1926), and Bertrand Russell, whose *The Scientific Outlook* (1931) contains numerous anticipations of *Brave New World* – clinches the case for examining dystopia and early-twentieth-century genetics in tandem, as two modes of "modern synthesis."[4]

J. B. S. Haldane was a legend among twentieth-century biologists. He was the son of J. S. Haldane, a distinguished physiologist who invented the gas mask worn by British soldiers in World War I and who was famous for conducting experiments on himself in a sealed breathing chamber on his estate. The younger Haldane was such a precocious assistant in his father's research that he published his own scientific paper at the age of twelve. In adult life, he too became famous for experimenting on himself in a decompression chamber, but his most important contributions to science were his mathematical studies of natural selection that established him as one of the founders of population genetics. A committed socialist throughout life, Haldane withdrew from the communist party following the discrediting of the Russian geneticist Lysenko, but he never renounced his support for a world government and rational state.

Julian Huxley was a close friend and early collaborator with Haldane. Descended from Thomas H. Huxley on his father's side and Matthew Arnold on his mother's (as was, of course, his younger brother, Aldous), Julian Huxley spent his early career divided between evolutionary biology and avian ethology, a field that he helped create. During his years as chair of the newly founded biology department at Rice University, he hired Hermann J. Muller, who would soon do the pioneering experiments that demonstrated the effects of X-rays on the genetics of fruit flies, a breakthrough referenced in *Brave New World*. Later in his career, Julian Huxley largely gave up research to write popular science and to engage in political advocacy for environmental causes and the advancement of science. Like Haldane, he was a socialist and internationalist, and he became the first director-general of UNESCO and one of the founders of the World Wildlife Fund.

Haldane, Julian Huxley, and Aldous Huxley were all prolific essayists for newspapers and monthly magazines both in England and America. Haldane was a superb stylist, who wove personal anecdotes and strong opinions together with vivid imagery and wit. During the years when he was publishing the mathematical articles that were collected as an appendix to his landmark study *The Causes of Evolution* (1932), he also published

two of his finest volumes of personal essays, *Possible Worlds* (1927) and *The Inequality of Man* (1932) (issued the next year in America as *Science and Human Life*). Aldous Huxley's debt to Haldane's youthful essay "Daedalus, or, Science and the Future" (1923) has long been acknowledged by scholars of *Brave New World*. What is not well known is that many of the essays in *Possible Worlds* and *Science and Human Life* respond to or provoke a response from Aldous Huxley's copious essays of the same years, especially those collected in *Proper Studies* (1927) and *Do What You Will* (1929). The two old acquaintances appear to be feeding off one another at a distance, writing on the same topics, picking up ideas for articles, borrowing from one another, responding, and arguing, all mediated by Julian Huxley, whose conversations with his brother about genetics D. H. Lawrence overheard with outraged dissent when the three – Aldous, Julian, and Lawrence – were neighbors in Switzerland in the winter of 1928.[5]

The richness of this multisided exchange has only been remarked in passing by Huxley's biographers. Its significance, in my view, far exceeds the question of where Huxley derived his ideas for *Brave New World*.[6] It gives us a close-up view of a supremely intelligent novelist who knew more about the biological sciences than any fiction writer of his day. Huxley was fascinated by the biological sciences throughout his life.[7] His early novels are full of satiric but loving portraits of biologists and physiologists; their ideas, work habits, lab assistants, hobbyhorses, and domestic arrangements are described in comic detail (twice we meet biologists too immersed in their work to notice their wives' affairs). But the prevailing tone is that of affection. Huxley knew scientists well and admired their ways, not only from being around his brother and Haldane, but from Haldane's father, who was paterfamilias at Cherwell, the Haldane estate near Oxford where Huxley spent many a night while at university, and the model for the bumbling scientist Lord Tantamount in *Point Counter Point*. One summer while at Cherwell, Huxley, Haldane, and his younger sister Naomi acted a play that she wrote about genetics – eighteen full years before *Brave New World*.[8] In contrast to the impression of most casual readers that the author of *Brave New World* was a confirmed opponent of science, he proclaimed in a lovely essay from 1925, "A Night at Pietramala," that he would rather be a scientist like Michael Faraday than even Shakespeare.

The important question about this relationship is not who influenced whom – what matters is Huxley's immersion in a shared discourse about biology.[9] It often happened that Huxley published his opinion on, say, IQ tests, and Haldane took up the subject shortly thereafter, providing

information about research that Huxley does not consider.[10] In other instances, the two seem to draw on shared life experiences. Both tell stories of how their particular talent was allowed to flourish only because they were lucky enough to escape the Procrustean measures of England's educational system; both write portraits of the frenetic sweating experiments Haldane's father conducted at Cherwell.[11] Finally, there are the many occasions when Huxley catches a notion from Haldane and incorporates it in his essays or fiction. Haldane's "Daedalus," of course, is a treasure trove of ideas about pre-implantation genetic screening, artificial insemination, and ectogenesis (growing babies in a bottle), which inspired Huxley's account of the Central London Hatchery in *Brave New World.* Less well known are the many facets of Huxley's writing drawn from elsewhere in Haldane's works. The slow maturation of human children; the distinction between advanced science, which theorizes, and rudimentary science, which merely observes particulars; the potential for developing antiaging technologies; the use of hormones to delay menopause; the importance of nitrogen in agriculture; the need to be the right size for your evolutionary niche; the value of preventative medicine; antivivisectionists as enemies of science – these themes and more are common to both writers.

Attending to this shared discourse opens up important questions about what it meant to be modern in different intellectual spheres and the various functions of synthesis in the scientific and literary domains.[12] This chapter examines the unifying or synthetic mode of thinking that is common to both scientific modernity and Huxley's satire and then demonstrates that Aldous Huxley's satiric mode more closely reflects the views held by his scientific friends than the literary modernists of his day. It ends by turning to *Brave New World* to argue that Huxley's dystopian synthesis has largely been misinterpreted in popular culture as a warning against science when instead its satire unsettles certainties in much the same way that Haldane believed science should. As different as they appear, the modern synthesis in biology and the dystopian synthesis in literature helped define a moment in the early twentieth century when scientific rationality and literary satire felt like a shared response to the modern world.

## Synthesis, Science, and Modernity

The neo-Darwinian synthesis, at least insofar as one focuses on Haldane and Julian Huxley, was "modern" in a distinctive way.[13] In the early

twentieth century, the unification of the sciences was a widely shared goal. Julian Huxley describes the ideal at the beginning of *Evolution: The Modern Synthesis*:

> Biology in the last twenty years, after a period in which new disciplines were taken up in turn and worked out in comparative isolation, has become a more unified science. It has embarked upon a period of synthesis, until today it no longer presents the spectacle of a number of semi-independent and largely contradictory sub-sciences, but is coming to rival the unity of older sciences like physics. (26)

Haldane, who attended the Second International Congress for the Unity of Sciences, similarly takes physics as his model, citing the achievements of J. J. Thomson and Ernest Rutherford as evidence that "science is committed to the attempt to unify human experience" (*Causes* 84).

Synthesis did not mean the same thing to modern biologists that interdisciplinarity means to us today. Even though Haldane, Fisher, and Wright were remarkably interdisciplinary thinkers, what they meant by synthesis had to do with the end product of research, not its method. Nor did synthesis require dialectical thinking. The reconciliation of evolution and genetics would not emerge from the clash of thesis and antithesis. Rather, the effort was to discern the underlying unity between the two theories. The goal was to find a common ground, and the ambition was imbued with a sense of idealism and progress.

The impact of the modern synthesis in genetics and the dystopian synthesis in literature are related in important ways. First, they are both examples of the power of an idea to inaugurate a field for further work, to constitute what Foucault termed a discursive formation. The unification of Darwin's concept of natural selection with Mendelian genetics opened up experimental programs not only for geneticists but eventually for naturalists, morphologists, and paleontologists.[14] The dystopian synthesis was enormously fruitful as well. Yevgeny Zamyatin's *We* (1921), Huxley's *Brave New World* (1932), George Orwell's *Nineteen Eighty-Four* (1949), Ray Bradbury's *Fahrenheit 451* (1953), Anthony Burgess's *A Clockwork Orange* (1962), Margaret Atwood's *The Handmaid's Tale* (1985) and *MaddAdam* trilogy (2003–2013), Philip Kerr's *A Philosophical Investigation* (1992), Kazuo Ishiguro's *Never Let Me Go* (2005), Gary Shteyngart's *A Super Sad True Love Story* (2010), Chang-Rae Lee's *On Such a Full Sea* (2014), Gish Jen's *The Resisters* (2020) – these are just some of the highpoints of a genre that did not exist prior to the twentieth century.

Similarly, both syntheses exhibited a crucial aspect of modernity – a resolutely demystified vision of reality, what Weber just a few years earlier had called the "disenchantment of the world" (Weber 155). Haldane and Julian Huxley had no patience with metaphysical, religious, or pseudoscientific theories that attempted to mitigate the materialist foundation of the evolutionary synthesis. Haldane's demonstration that the natural selection of purely random mutations was the basis of all evolution, human and otherwise, made no compromise with mystical or idealist notions that postulated a guiding purpose to evolution. He inveighed against the folly of Henri Bergson's concept of "*élan vital*, or vital force, which pushed organisms forward along the path of evolution" (*Causes* 89). Russell, too, rejected fuzzy-minded ideas in the 1920s such as Arthur Eddington's postulation of a "mind-stuff" directing evolution or Lloyd Morgan's "emergent evolution" that suggested a "Divine Purpose underlying the course of evolution."[15]

A third unifying features of this circle was opposition to the still-vocal proponents of neo-Lamarckism, which I discussed in Chapter 3. The Huxley–Haldane circle was adamant in resisting any attempt to sugarcoat the materialist foundation of the modern synthesis. Haldane could not be more blunt: He declares the mind to be a "by-product or epiphenomenon of certain material systems" (*Causes* 87); the process of evolution "does not suggest the work of an intelligent designer, still less of an almighty one" (*Causes* 85); and natural selection leads to no goal. These attitudes mark a decisive break with the goal-oriented, willed evolution common in neo-Lamarckian fiction of the prior century.

Aldous Huxley writes against neo-Lamarckism as frequently as Haldane or Julian Huxley. In his second novel, *Antic Hay* (1923), Huxley mocks an earnest young biologist who tells his mentor that he has "found a way of making acquired characteristics ... heritable" (94). Everything in the scene, from the description of the young man's "dark protruding eyes, and staring, doggy nostrils" (94) to the preposterousness of the experiment that involved injecting pulped eyes of a dead rabbit into a pregnant rabbit, underlines how bogus Huxley finds such pseudoscience. In *Brave New World*, the necessity to genetically reengineer every generation and to reinforce behavioral modifications through lifelong psychological conditioning dramatizes that none of the artificially acquired traits were heritable.

To underline the cultural ramifications of the modern synthesis, Haldane, Julian Huxley, Bertrand Russell, and Aldous Huxley all explicitly attack the writings of Samuel Butler and George Bernard Shaw. Butler's

*Life and Habit* (1878) and *Unconscious Memory* (1880) remained touchstones for the neo-Lamarckian cause well into the twentieth century. Shaw's Preface to *Back to Methuselah* (1921) became even more widely known during the 1920s for its championing of neo-Lamarckism. Shaw maintained that humans were capable of developing new traits by willing them into existence. Evolution by "senseless accident" (Shaw xvi) seemed impossible to the playwright. Instead, he maintained (with no evidence whatsoever) that "the will to do anything can and does, at a certain pitch of intensity set up by conviction of its necessity, create and organize new tissue to do it" (xvi). The power of what he called "creative evolution" would be capable of extending the human life span to 3,000 years once we marshaled sufficient will to stimulate this organic change (xvi). Echoing a long line of neo-Lamarckian polemicists, Shaw asserted: "If you like eating the tender tops of trees enough to make you concentrate all your energies on the stretching of your neck, you will finally get a long neck, like the giraffe" (xxi). But he was frank in admitting that he did not have a clue as to why. "Nobody knows how: nobody knows why: all we know is that the thing actually takes place" (xxiii). Hence, the disdainful tone of Haldane's reply is hardly surprising: "[Shaw] admits that Darwinism cannot be disproved, but goes on to state that no decent-minded person can believe in it. This is the attitude of mind of the persecutor rather than the discoverer" (*Causes* 88).

The more interesting question was why serious scientists such as Haldane, Julian Huxley, and Russell felt that scientific amateurs such as Shaw and Butler needed rebutting. The answer lay in the cultural impact literary advocates of neo-Lamarckism continued to have long after its scientific credibility had been eroded. Had science policy committees existed in the 1930s, the importance of countering such distortions of genetics in literature and popular culture would have been evident.

Haldane's comments often have the fervor of a biologist today warring against theorists of Intelligent Design. Like Wells in *The Time Machine*, Haldane situates the nonteleological character of evolution in the context of the species' eventual extinction: "Most lines of descent end in extinction, ... [which] does not suggest the work of an intelligent designer, still less of an almighty one" (*Causes* 85). Further, Haldane sees the deplorable condition of the human species as a sign that the idea of directed evolution – whether by a creator or by the willed exertion of our faculties – is a sham. "If evolution, guided by mind for a thousand million years, had only got as far as man, the outlook for the future would not be very bright" (*Causes* 88).

In place of the neo-Lamarckian dream of progressive evolutionary time, Haldane develops a modernist rationale for what will become in our own day "genome time." He confronts the insignificance of the human time-scale with an unblinking gaze, but like many of the poets and artists of his era, he recuperates the experience in aesthetic terms. Where Victorian genre fiction had recuperated Deep Time through problematic teleology and deplorable eugenics, Haldane substitutes self-sufficing beauty:

> If I were compelled to give my own appreciation of the evolutionary process . . . I would say this: In the first place, it is very beautiful. In that beauty there is an element of tragedy. On the human time-scale the life of a plant or animal species appears as the endless repetition of an almost identical theme. On the time-scale of geology we recapture that element of uniqueness,. . . which makes the transitoriness of human life into a tragedy. In an evolutionary line rising from simplicity to complexity, then often falling back to an apparently primitive condition before its end, we perceive an artistic unity similar to that of a fugue, or the life work of a painter of great and versatile genius like Picasso . . .. Possibly such artistic work gives us a good insight into the nature of the reality around us as any other human activity. To me at least the beauty of evolution is far more striking than its purpose. (*Causes* 90)

In his account of the duality of time, Haldane articulates an aesthetic appreciation of genome time, the simultaneous embrace of both human and geological timescales, one tragic, the other "fugue-like" in its beauty. It is anachronistic, of course, to use a term like "genome time" in conjunction with Haldane, but his perspective is one that will become more widespread once genomics emerges. To value the beauty of evolution more than its supposed goal is to join Darwin (rather than neo-Lamarckians) in celebrating the "endless forms most beautiful" in the cycle of life and death. What unites this pioneer of the modern synthesis with a pioneer of modern art like Picasso is an appreciation of the unity between form and content – the beauty of evolutionary time is that its formal shape reveals a fundamental truth about reality. That is why Haldane suggests that an artistic work might give us as much insight into reality as science.

As we saw in Chapter 1, Ian McEwan's neurosurgeon in the novel *Saturday* believed much the same thing. He found beauty in the "unimaginable sweep of time" (McEwan 54) because Darwin's "creation myth" had "the unprecedented bonus of this story happening to be demonstrably true" (54). McEwan has been called a "metamodernist" for the way he repurposes formal solutions from the modernist period for the twenty-first century (James and Seshagiri). But neither Haldane's nor McEwan's

treatment of evolutionary time reflects the autotelic values of the modernists Aldous Huxley rejected. The difference lies in the homology that all three see between form and content.

Ortega y Gasset's classic essay from this same decade, "The Dehumanization of Art" (1925), can help clarify the difference between Haldane/Huxley and other modernists. Discussing what he saw as a modernist tendency to subordinate the content of a work of art to its form, Ortega writes, "That can be done only if the artist repudiates reality" (48). I am not sure that Ortega is correct in thinking that modernist writing repudiated reality, but Aldous Huxley clearly shared Ortega's view.[16] Aldous Huxley was impatient with what he saw as the empty formalism of his modernist peers and emphasized the importance of the "subject-matter" or "content" of his fiction (Serpieters 231). Haldane did not parse modernists with the same passion as Aldous Huxley, but he too thought that the artistic quality of evolution came from what its form revealed about reality, not from the repudiation of reality.

Haldane's views about the beauty of evolutionary time take on an additional importance because of the bearing they have on his recommendations for science policy. Haldane opens his 1932 collection of essays, *Science and Human Life*, with a forceful policy statement about the role genetics should play in society:

> If we are to control our own and one another's actions as we are learning to control nature, the scientific point of view must come out of the laboratory and be applied to the events of daily life. It is foolish to think that the outlook which has already revolutionized industry, agriculture, war, and medicine, will prove useless when applied to the family, the nation, or the human race. (1)

This forthright advocacy of an instrumental use of the biological sciences on the family, nation, and species echoes attitudes of others in his circle. Here is Russell sounding a similar note: "Science first taught us to create machines; it is now teaching us by Mendelian breeding and experimental embryology to create new plants and animals. There can be little doubt that similar methods will before long give us power, within wide limits, to create new human individuals differing in predetermined ways from the individuals produced by unaided nature" (204). Neither figure shies away from recommending policies that would allow human genetic engineering.

The link between Haldane's views on time and his recommendation that science guide social policy lies in how what I am calling "genome time" enables scientists to put transient creatures and nearly ageless natural

phenomena on the same plane: "A good scientist will be impartial between Mr. Smith, a tape-worm, and the solar system" (*Science* 2). Haldane calls this stance the "scientific point of view" and characterizes it as ethical in distinctive ways:

> This attitude includes a high (perhaps an unduly high) regard for truth, and a refusal to come to unjustifiable conclusions which expresses itself on the plane of religion as agnosticism. And along with this is found a deliberate suppression of emotion until the last possible moment, on the ground that emotion is a stumbling-block on the road to truth. So a rose and a tapeworm must be studied by the same methods and viewed from the same angle, even if the work is ultimately to lead to the killing of the tapeworms and the propagation of roses. The scientific point of view involves the cultivation of a scientific aesthetic which rejoices in the peculiar forms of beauty which characterize scientific theory. Those who find an intimate relation between the good and the beautiful will realize the importance of the fact that a group of men so influential as scientific workers are pursuing a particular kind of beauty. Finally, since the scientist, as such, is contributing to an intellectual structure that belongs to humanity as a whole, his influence will inevitably fall in favour of ethical principles and practices which transcend the limits of nation, colour, and class. (*Science* 101)

Scientific impartiality requires the suppression of emotion, but this dispassionate temperament is not incompatible with the pursuit of a particular kind of beauty. Why? Because the apprehension of scientific beauty, in Haldane's view, is cultivated by facing both the insignificance and the grandeur of humanity's place in nature.

The *dispassionate* character of this impartiality will turn out to be a key to understanding the satiric streak in Aldous Huxley's fiction. It is the single most prominent characteristic these writers share. In the next section, I turn to Aldous Huxley's fiction written in the years leading up to *Brave New World* to show that his satiric vision brought him closer to the scientific point of view than to the standpoint of his modernist literary peers. The stance of a disillusioned ironist, seeing through everyone and everything, was his means of fashioning an aesthetic correlative of the scientific viewpoint he shared with Haldane, Julian Huxley, and Russell. When he came to write *Brave New World*, an enduring critique of the *misuse* of science, he did not reject the emotional impartiality that he had cultivated in the twenties. Instead, he turned that emotional impartiality on the scientific viewpoint itself.[17] The resulting satire, so different in tone from his earlier novels, stems from the simplification in style and theme that are the hallmarks of the generic synthesis that we call "dystopia."

## Modernism or Satire?

Aldous Huxley was a perilous man to know in the 1920s. Scraps of his friends' lives and habits lay scattered throughout his early novels, particularly *Crome Yellow* (1921), *Antic Hay* (1923), and *Point Counter Point* (1928). Lady Ottoline Morrell felt terribly betrayed by the caricature of her and her husband at their country house, Garsington; Huxley's father was aggrieved by what he called the novelist "botanizing on [his] mother's grave" (A. Huxley, *Letters* 224); Lawrence shrugged off being cast in *Point Counter Point* as the writer Mark Rampion, whom he thought a "boring character" and "a gas-bag," but he worried Huxley's wife Maria might have been hurt by the death of a fictional child modeled on their own son's death (Lawrence, *Letters of D. H. Lawrence* 766, 791); Wells and Russell seemed not to have minded their ideas about a Rationalist State being burlesqued; nor did the Haldanes, father and son, who appeared in separate novels as obsessed biologists with wandering wives;[18] John Middleton Murry couldn't have enjoyed being portrayed as a hypocritical philanderer, and Wyndham Lewis must have gnashed his teeth at his portrait as a bombastic, untalented artist-poet; but Nancy Cunard relished her repeated appearances as a heartless siren in her one-time lover's novels. These and other friends are wickedly satirized in the early fiction, as are the intellectual pretentions, the fashions of the day, prominent politicians, artists, smart society, journalism, advertising, industrialists, urban existence, and above all, the sexual mores of the Bloomsbury set with which the novelist had extensive acquaintance.

It often surprises readers to learn that Huxley was so immersed in the elegantly bohemian world of Bloomsbury. Huxley knew everyone in the circle – not only the friends named previously but also Virginia Woolf, John Maynard Keynes, Katherine Mansfield, Lytton Strachey, Roger Fry, Dorothy Brett, and more. He met his wife Maria at Garsington just like his brother Julian, who met his wife Juliette there. Aldous and Maria had an intense, secretive ménage à trois with Mary Hutchinson, a married woman who was already having another affair with Clive Bell; Aldous and Maria duplicated this arrangement with the woman who would become Huxley's first biographer, Sybille Bedford (Murray 140–47). It seems Maria would seduce women for her husband and bring them to him, a practice that Huxley records in *Point Counter Point*, where Elinor, the character modeled on his wife, reflects: "[O]n more than one occasion, seeing him look admiringly at some young woman or other, she had gone out of her way to establish for him the personal contact which he would never have been able to establish for himself" (78).[19]

Huxley's surprising involvement in the Bloomsbury world is significant for several reasons. First, it alters the image some people have of Huxley, chiefly those who only know him from *Brave New World*. Neither in his personal life nor in his fiction was he the didactic moralist many take him for. Rather, moral relativity is the watchword of his early novels. Second, Huxley knew the British literary modernists well, which accentuates the conscious choice he made to take up an alternative stance toward modernity. During the teens and 1920s, Huxley witnessed the full flowering of what literary historians once confidently labeled "modernism" in the fiction of Richardson, Joyce, Woolf, and Mansfield. Although today this limited canon of writers is regarded as an inadequate account of global modernism with its diverse artistic responses to uneven economic development, colonialism, gender, race, and sexuality, this group of Huxley's immediate predecessors and peers establishes the contrast I am drawing.[20] Huxley sought a different approach toward the modern from the kind of formal innovations in language and structure that these authors emphasized. Huxley wanted to be modern, but he wanted no part of the version of modernism he saw around him.

The alternative nature of Huxley's ambition was apparent from the start. An anonymous reviewer of his first novel, the roman à clef *Crome Yellow*, called it "a Cubist Peacock," a nice aperçu, for it captures both the attempt to be modern and the novel's homage to an older satiric tradition (Williams-Ellis 60). *The Nation* grasps the modernity of the novel's scientific views, mentioning Wells's Rationalist State and Freud's concept of repression but is more interested in the book's distance from the works of literary modernists, commenting that Huxley "lives in a different world from that of D. H. Lawrence or James Joyce or Dorothy Richardson" (Lewisohn 63). Of course, Huxley did *not* live in a different world; he just depicted the milieux he shared with the Bloomsbury circle in a very different way.

Huxley's next novel, *Antic Hay*, is a roman à clef too, but its form is more disjunctive. The novel shifts scenes and perspectives at will, cross-cutting a set of stories that range in tone from the ridiculous (a scheme to get rich on inflatable underwear), to the romantic (helpless love for a femme fatale), to the sordid (seducing a friend's wife, then sharing her around), to the bathetic (a failed art exhibition), to the phantasmagoric (a nighttown episode at the burlesque), to the tragic (suicide of one character and manic despair of another). In its formal disjunctiveness, the novel participates in one of the durable characteristics of satire, its refusal to be constrained by a unified structure.[21] Writing to his father (A. Huxley to

Leonard Huxley, *Letters*), who disliked the novel's satiric tone, Huxley justified his method both as a reflection of the modern world and as an artistic experiment:

> I am sorry you should have found my book so distasteful . . .. I will only point out that it is a book written by a member of what I may call the war-generation[,] . . . an age which has seen the violent disruption of almost all the standards, conventions and values current in the previous epoch . . .. Artistically, too, it has a certain novelty, being a work in which all the ordinarily separated categories – tragic, comic, fantastic, realistic – are combined so to say chemically into a single entity, whose unfamiliar character makes it appear at first sight rather repulsive. (224)

In his next novel, *Those Barren Leaves* (1925), Huxley puts a similar defense of genre mixing in the mouth of a female novelist: "I'm trying to do something new – a chemical compound of all the categories. Lightness and tragedy and loveliness and wit and fantasy and realism and irony and sentiment all combined" (46). The disillusioned irony, the sexual frankness, the lacerating exposure of self-delusion and posturing were above all a way to be modern, Huxley's way, and one that his generation recognized as its own. Isaiah Berlin remembers how the "social and moral courage" of Huxley's fiction galvanized him and his friends: "[M]embers of my generation were assisted to find themselves by novelists, poets and critics," adducing not only Huxley but (beautifully in the context of this chapter) J. B. S. Haldane, Wells, and Russell (144).

*Point Counter Point* is the masterpiece of this group of novels. Like Huxley's other novels of the twenties, it has an ensemble cast, but a pair of characters, a novelist, Philip, and his wife, Elinor, who are transparent versions of Aldous and Maria Huxley, create a central thread in the narrative. Around the story of their relationship – his writing and affairs, her susceptibility to the abusive sexuality of the rising star of the British fascist party (modeled on Oswald Mosley), and the sudden death of their child from meningitis – other stories about friends are interwoven more plausibly than in any of Huxley's novels to date.

Three points about this novel can help characterize Huxley's stance toward science in the years leading up to *Brave New World*. First, Philip's ironic detachment from the world around him had become, by the time of *Point Counter Point*, Huxley's signature way of being modern. Philip's wife Elinor blames it for an emotional aridity in his fiction: "[F]or the sake of the novelist he might be, she wished he could break his habit of impersonality and learn to live with the intuitions and feelings and instincts as well as with the intellect" (*Point Counter Point* 78).

Second, Philip compensates for his emotional impersonality by relying on his protean intelligence. Like a chameleon, he can sympathize with any position. His analytic gifts allow him to grasp the logic of the most extreme attitudes and beliefs: "It was so easy for him to be almost anybody" (193). The ability to inhabit other perspectives is the key to his new way of writing and his response to his age. Huxley achieves this multiplicity of perspectives by relying on the emotional impartiality that was the hallmark of the scientific viewpoint. It is what allows him to skewer himself and his friends with equal impartiality. What Haldane says about the scientist scrutinizing "Mr. Smith, a tape-worm, and the solar system" with the same impersonal gaze, regardless of whether the scientist wants to improve the life of one, eradicate the other, or understand the astronomical behavior of the third, describes Huxley's satiric method too (*Science* 2). Here is the novelist treating a fetus growing inside the womb with the same emotional impartiality that one might use for a tapeworm:

> A cell had multiplied itself and become a worm, the worm had become a fish, the fish was turning into the foetus of a mammal .... Fifteen years hence a boy would be confirmed. Enormous in his robes, like a full-rigged ship, the bishop would say: "Do ye here in the presence of God, and of this congregation, renew the solemn promise and vow that was made in your name at your baptism?" And the ex-fish would answer with passionate conviction: "I do." (*Point Counter Point* 147)

Third, Rampion's frequent attacks on emotional impartiality and modern science, reminiscent of Lawrence's impatience with evolutionary theory, do not cancel out – in fact, coexist comfortably with – Huxley's rejection of moral certainties.[22] Rampion is a writer turned artist who celebrates instinct, the life of the emotions, and "noble savagery." In one diatribe, Rampion denounces two of the bugbears of Huxley's later dystopia, Alfred Mond and Henry Ford. Those apostles of "science, progress, and human happiness" will destroy "initiative and creativeness" and replace "all the vital and fundamental things in human nature" with "ready-made and unindividual amusements" (*Point Counter Point* 298–99). These are the Savage's objections to Mustapha Mond, the World Controller in *Brave New World*, and the similarities between Rampion and the Savage's attitudes should be a clue that Huxley does not unequivocally endorse the Savage's position. This parallel is not surprising when we remember Huxley's winking allusion to Lawrence in that later novel: the Savage comes from a reservation near Taos, New Mexico, the place where Lawrence lived near the end of his life. What Rampion wants instead of progress and industrialization is to live instinctually and to trust in one's physical and emotional being. The emotional

impartiality that allows scientists to examine humans and tapeworms with the same neutral objectivity is anathema to him. Huxley agrees with Rampion about Mond and industrialization, disagrees with his rejection of evolution and modern biology, yet the novelist satirizes both positions with equal glee.[23]

Philip understands his intellectual flexibility as cognate with the modern relativity of values. He sees all sides. At extreme moments, he wonders if the "essential character of the self consisted precisely in that liquid and undeformable ubiquity; in that capacity to espouse all contours and yet remain unfixed in any form" (*Point Counter Point* 194). If this is the satiric self, it is also how the Haldane–Huxley set understood the modern scientific self, a viewpoint that can see all sides objectively and eviscerate them all with emotional impartiality.

*Brave New World*, Huxley's next novel, represents a radical paring down and distillation of Philip's urge to see all sides of an issue. In this story, the sides have been reduced to two stark opposites: a world state that bestows universal peace, stability, and freedom from poverty, disease, and suffering, on the one hand, and a society that values free will, art, imagination, scientific inquiry, and the human spirit, on the other. Huxley tries to give each side its due in the chapters where the Savage debates the World Controller, but the contest is uneven and most readers have taken the Savage's side as their own. As a result, the very phrase "brave new world" has become the watchword of those who caution against scientific hubris. But that was not Huxley's point, and an oversimplification of the book has made Huxley famous. Most people know nothing else about him.

## Dystopian Synthesis

*Brave New World* is another experiment in satire, but it is far more unified in tone and theme than any of Huxley's earlier novels. It no longer juxtaposes discordant genres but blends its multiple satiric intentions into a powerful gestalt. It combines the simplicity of a moral tale for the young with the force of a jeremiad against contemporary society. The resulting satire has more affinities with scientific modernity than with literary modernism.

The gestalt owes much of its success to the dystopian synthesis of utopia and naturalism, to return to Wegner's insight. *Brave New World*'s limitations and strengths both stem from this source. Utopia, a common vehicle for satire, is totalizing and narratively static. There is little to propel the story other than the critical comparison it draws between a degenerate

present and an ideal future.[24] Description is its métier . . . and its Achilles heel. The protagonists are often flat characters, naïfs like the Savage, and the denizens of the new world – typically a guide, a love interest, and an opponent – serve transparent narrative purposes. The intellectual clarity of its message depends on this kind of simplification.

Naturalism, on the other hand, specializes in relentless plots, which grind down the characters under forces beyond their control. As Richard Chase puts it, "the naturalistic novel took a bleakly pessimistic view when considering the ability of the individual to control his fate" (186). Émile Zola, Henrik Ibsen, George Gissing, and Theodore Dreiser, in very different ways, thought of themselves as writing scientific examinations of the ills of society.[25] External forces – poverty, sexual oppression, syphilis, alcoholism, drug abuse, racism, and other forms of injustice – often seem to determine the fate of their protagonists. Social Darwinism was an important component of this "scientific" understanding of fiction's purpose. Description is grittily realistic, far more so than in utopian fiction. Characterization also relies on realistic conventions. The protagonist is trapped within the belly of the beast, not a visitor from another world. The tormented response of the characters produces the effect of an agonized inward life, although at times the protagonist can seem so fully under the control of external forces as to be little more than a miserable puppet of fate. The power of the work also depends on a vast simplification of human experience, but the desolate depiction of reality sometimes masks how much has been simplified.

Dystopia flourished in the twentieth century by merging elements of these opposed genres, utopia and naturalism, into a new synthesis. The genre combined accounts of a future, alternative society (utopia) with a strong narrative line that featured an individual struggling against overwhelming conditions (naturalism). The inequality of this struggle enhances our sympathy with the solitary rebel, lending realism to the protagonist's desperate subterfuges, especially since we fear that these rebels are doomed to failure.

The synthesis of utopia with naturalism is dialectical. The pessimism of the naturalist genre dialectically negates the idealism of utopia as it generates a nightmare vision of what the future might hold. Yet, as Jameson emphasizes, dystopia carries forward the revolutionary energies of utopia in that very negation. In this respect, the dystopian synthesis might seem to differ fundamentally from the modern synthesis in biology. The connection, however, comes from the particular form that dialectic takes in *Brave New World*. Huxley's novel incorporates and sublates the

emotional impartiality that characterized the modern conception of science for the Haldane–Huxley circle and generalizes it to the entire totalitarian future. In doing so, Huxley establishes a convention that the genre will frequently honor – the internalization of this emotional impartiality in the novel's antagonist (the World Controller in *Brave New World*). The debate between the impassioned Savage and the dispassionate World Commander in chapters 16 and 17 of *Brave New World* (which was itself modeled on the Grand Inquisitor chapter in Dostoyevsky's *Brothers Karamazov*) has become paradigmatic of the didactic core in much dystopian fiction: think of the debates between Winston and O'Brien in *Nineteen Eighty-Four* or Montag and Captain Beatty in *Fahrenheit 451*. Witnessing the hypocrisy of characters like the Controller is infuriating, which means that the overall tone of novels in the genre is anything but emotionally neutral. All the same, emotional impartiality contributes formally as well as thematically to the genre because the impact of the totalitarian future depends on the cold logic of extrapolation from contemporary trends. There is an instrumental rationality in the prophetic gaze that the novelist turns on the present.

The biological nightmares of *Brave New World* span the entire human life cycle from conception, maturation, and adulthood to death. Conception relies on entirely artificial means: eugenic selection of parents, pre-implantation genetic screening, *in vitro* fertilization, embryo sorting, selective sterilization, the Bokanovsky Process (or cloning), ectogenesis, and chemical and x-ray assaults on the embryo. From the nursery through the end of one's school days, the child receives extensive behavioral conditioning in accordance with the theories of Pavlov and J. B. Watson, author of *Behaviorism* (1924). In adulthood, daily doses of mood-altering drugs and antiaging therapies are provided free to all. Finally, there is hospice care for the seriously ill and euthanasia for everyone at the age of sixty. Of course, other aspects of the world state are objects of satire too: advertising; commercialism; industrialization; films that border on virtual reality; the erasure of history, art, and literature; the attack on the family and romantic love; the suppression of authentic science; and the use of sexuality and pseudoreligious experiences to release disruptive social energies. But biological concerns hold a preeminent place in Huxley's mind. In the "Foreword" he wrote for the 1946 reprinting of the novel, he notes: "The only scientific advances to be specifically described are those involving the application to human beings of the results of future research in biology, physiology, and psychology. It is only by means of the sciences of life that the quality of life can be radically changed" (ix – x).

Huxley's dystopia has had enormous cultural impact. Every one of the biotechnologies Huxley described has been held up by subsequent commentators as an emblem of science run amok. Procedures that are today routine, such as pre-implantation genetic screening, *in vitro* fertilization, and hospice care, were greeted by their critics as heralding a "brave new world." So too, today, are interventions such as psychotropic and performance-enhancing drugs, and euthanasia for the terminally ill. The most severe condemnation has been reserved for some of the biotechnologies that remain on the horizon, such as human reproductive cloning and ectogenesis.[26] All have been accused of being examples of a "brave new biology."

The most viscerally disturbing of the genetic marvels described in the book is cloning. Bokanovsky's Process involves the artificial budding of the developing embryo to produce multiple identical twins, anywhere from eight to ninety-six from a single fertilized cell. The public today associates cloning with the technique of somatic cell nuclear transfer used in animal cloning and stem cell research. This was the procedure employed to create the most famous cloned animal, Dolly the sheep. But embryo splitting, which is how identical twins occur in nature, is another method of producing a clone. When induced in the lab, it involves manually dividing the embryo at the eight-cell stage into two separate embryos of four cells each. Bokanovsky's Process can be thought of as an early vision of how embryo splitting might be induced. Huxley imagines a procedure in which the eight-cell embryo is subjected to successive treatments with radiation and alcohol, which cause the embryo to split in two (or "bud") multiple times. The process Huxley describes can be used to induce embryogenesis in some plants, but it sounds unthinkably brutal when applied to the human embryo. But the potential insult to the developing fetus from such harsh treatment is irrelevant to the social planners in Huxley's future because they use the process only on the lower echelons of society.

The results of Bokanovsky's Process are large cohorts of identical humans, suitable for all the menial tasks an industrial society requires. These clones repel the Savage more than any other aspect of biology in the world state – only female sexuality provokes an equally emotional response. The fact that Huxley opposes sexual repression – in his own life and in society too – might suggest that he is treating the Savage's instinctual revulsion from clones with similar irony and that Huxley actually favors a more impartial assessment of the technology. Both Russell and Haldane did. The Savage's repugnance arises involuntarily the first time he sees the clones when he is so repelled he becomes physically ill.

Thematically, it serves the interest of the novel's attack on mechanization; Huxley associates cloning with a Fordist model of production.[27] In the Central London Hatchery, clones are produced on a conveyor belt, like cars rolled off an assembly line. The linkage with mass production has proved so powerful that in subsequent years the notion of cloning has become synonymous with "manufacturing" a human being.

The Savage's response goes far beyond objecting to the procedure. He is overwhelmed with loathing and fear. His emotional response is akin to xenophobia or racism. The imagery evokes mindless drones, the horror of hive societies. Observe his reaction in this description of cloned children:

> Twin after twin, twin after twin, they came, a nightmare. Their faces, their repeated face – for there was only one between the lot of them – puggishly stared, all nostrils and pale goggling eyes .... In a moment, it seemed, the ward was maggoty with them. They swarmed between the beds, clambered over, crawled under, peeped into the television boxes, made faces at the patients. (137)

They are not human beings but insects meant to evoke all the repulsion of maggots. Twice more, in a passage as full of irrational repugnance, the Savage compares them to maggots, and a third time he calls them lice. These are human beings, however, and cloned humans, even if intentionally impaired as these are, would deserve the same respect for persons accorded to twins today. Only the Savage's sexual self-loathing and flagellation at the end of the novel equals the excessive emotional charge he feels toward these clones.

Leon Kass has urged that public policy should listen to this feeling of revulsion toward genetic creations like chimeras and clones. In his much-cited article, "The Wisdom of Repugnance," Kass specifically invokes *Brave New World* as an example of how instinctive or spontaneous repugnance should guide us in deciding whether to allow genetic engineering of humans (18).[28] Steven Pinker, in a powerful rejoinder, inveighs against Kass's "disconcerting habit of treating fiction as fact" (29). The problem, Pinker continues, is that "*Brave New World*, a work of fiction, is treated as inerrant prophesy. Cloning is confused with resurrecting the dead or mass-producing babies. Longevity becomes 'immortality,' improvement becomes 'perfection,' the screening for disease genes becomes 'designer babies' or even 'reshaping the species'" (31). Pinker is right. Fiction is not inerrant prediction, and if it is to play a role in bioethics, it must be to enrich our understanding of complex problems, not simplify them into a one-dimensional moral.

The Savage's horror at the repeated faces of twin after twin constitutes more of a critique of mass production in Huxley's day than of future

reproductive technologies. It resembles Rampion's (and Lawrence's) irrational condemnation of biology rather than Philip's emotional impartiality. If the Savage's sexual repression is attributable to the primal scene in his youth of witnessing his mother in bed with her lover, as the novel clearly establishes, then his emotional response to cloning, which also reaches a peak at his mother's bedside, should be read as psychopathology too. In any event, it should not be taken as a warning about advances in genetics, as so many commentators have done. Tom Moylan identifies this kind of misreading as a violation of the spirit of the genre itself. "Formally and politically . . . the dystopian text refuses a functionalist or reformist perspective. . . . No single aberration can be privileged as the one to be fixed so that life in the enclosed status quo can easily resume" (xii).

Huxley would agree. "Science in itself is morally neutral," he said in the same year as *Brave New World* was published; "it becomes good or evil according as it is applied" (rpt. in Bradshaw, *The Hidden Huxley* 114). To use the power of science to produce a society such as the World Controller's future is a more far-reaching evil than any practice or technology that can be isolated as problematic. That is how Huxley's satire complicates our understanding – not by warning against new reproductive technologies but by dramatizing how science could be misused by a society in search of safety and stability.

Satire is a capricious weapon, however. Its sharp edges cut in many directions. Huxley kept rediscovering this point throughout his career. His early novels wounded friends that he had not expected to hurt. The thrust of *Brave New World* surprised him in a different way. The dystopian synthesis narrowed the options it presented to two choices, neither of which he meant to be acceptable. Science without a conscience was unacceptable; a world with art, literature, family, and God, but at the price of poverty, disease, war, and mental illness was equally unacceptable. Huxley lamented that readers took his novel's simplifications so much to heart. They accepted the choices they were given as the only available options: "The Savage is offered only two alternatives," Huxley commented in his 1946 "Foreword," "an insane life in Utopia, or the life of a primitive in an Indian village, a life more human in some respects, but in others hardly less queer and abnormal" (vii). Perhaps he assumed readers would see through this false opposition. After all, it is the World Controller who insists that these options are the only possible alternatives: "God isn't compatible with machinery and scientific medicine and universal happiness," Mustapha Mond claims. "You must make your choice" (*Brave New World*, 159). Mond is wrong, however. Society does not have to choose

between such draconian options. Mond's logic is the either/or that an authoritarian state uses to justify its rule. But other alternatives exist beyond the covers of a dystopian novel. The wise use of technology is the option Huxley preferred: "It rests with us and our descendants to decide whether we shall use the unprecedented power which science gives us for good or bad purposes. It is in our hands to choose wisely or unwisely" (rpt. in Bradshaw, *The Hidden Huxley* 114).

In 1932 Huxley the satirist was pleased by the prospect of a novel that offered its protagonist an impossible choice. "At the time the book was written," Huxley recalled, "this idea, that human beings are given free will in order to choose between insanity on the one hand and lunacy on the other, was one I found amusing and regarded as quite possibly true" ("Foreword," vii–viii). The moral relativist of the twenties lives on even when the dystopian synthesis mandates a despairing end. "At the close, of course," Huxley continued, the Savage's "native *Penitente*-ism reasserts its authority and he ends in maniacal self-torture and despairing suicide. 'And so they died miserably ever after' – much to the reassurance of the amused, Pyrrhonic aesthete who was the author of the fable" (viii). A Pyrrhic victory is an engagement won at horrific cost. When Huxley calls himself in retrospect a Pyrrhonic aesthete, he acknowledges that there was no earth he would not scorch for his art, no person or idea he would not sacrifice on the altar of satire. It is ironic to realize that the moral relativism and emotional impartiality of an amused, Pyrrhonic satirist has become the touchstone of present-day moralists who want to halt some forms of genetic engineering.

Commentators who invoke the specter of *Brave New World* to argue against one biotechnology or another (and they are legion) are offering the counsel of Mustapha Mond. They suggest that if we go down a particular path, it will inevitably lead to the kind of dehumanized world Huxley depicts. This rhetorical tactic gains power from one of the key features of the dystopian synthesis: the determinism of its plots. The solitary rebel is doomed from the start. Hence, the argument that we must not go down a certain path gains added force not only from Huxley's powerful imagery but also from our sense that this kind of story (dystopia's story) rarely ends well. The allusion to dystopia by commentators on science supports a slippery slope argument with cultural evocations that few readers will spend the time to analyze. By invoking *Brave New World* as if its message were simple and unambiguous, commentators either show their ignorance of literature or rely on their audience's inability to see through a devil's bargain.

At the outset of his career as a satirist, Huxley predicted that his age would produce a new synthesis, which would look to irony, the comedy of Rabelais, Goya, and Daumier, to produce an artistic whole out of the ruins of the modern world. "The new synthesis that will reassemble, in an artistic whole, the shattered values of our post-war world, the synthesis that will reflect the disintegration in an artistic unity, will surely be a comic synthesis. The social tragedy of these last years has gone too far and in its nature and origin is too profoundly stupid to be represented tragically" ("The Modern Spirit" 33). The synthesis that unified the field of biology, in one quarter, and gave birth to the genre of dystopia in another, was modern in ways that twenty-first-century readers do not always understand. The unflinching honesty, the confidence that a unified vision would emerge from rational scrutiny, demystification, and emotional impartiality, was strangely hopeful. It forms a striking contrast to the method of some of his modernist compatriots who shored up fragments against the ruins. Both types of modern synthesis – Haldane's and Aldous Huxley's – offered "resources of hope" for their time, to use Raymond Williams's resonant phrase, modes of thinking and being in the world that had not previously been available.

CHAPTER 6

# *The Ridicule of Time*
## *Science Fiction and the Posthuman (Robert A. Heinlein to Octavia Butler)*

Suppose you were a science fiction fan, a Trekkie, and a transhumanist; you once paid to attend a seminar with Raël, knew all about Extropy back in the day, and subscribed to Longevity Meme Newsletter; you have read articles about an "immortality gene" and were thrilled to see *Science* publish a genomewide association study in 2010 identifying 150 genes that might improve your chances of living to 100; and you practice extreme caloric restriction while spending a fortune on dietary supplements. Over the years, you have zealously collected the following quotes but have forgotten the sources. Which of them do you think came from classic 1950s works of science fiction and which from publications by distinguished scientists, doctors, philosophers, and law professors?

1. We, or our descendants, will cease to be human in the sense in which we now understand that idea.
2. By the standards of evolution, it will be cataclysmic – instantaneous. It has already begun.
3. The new immortals, in the decisive sense, would not be like us at all.
4. Man will go into history along with the Java ape man, the Neanderthal beast man, and the Cro-Magnon Primitive.
5. Unlike the saber-toothed tiger . . . *Homo sapiens* would spawn its own successors by fast-forwarding evolution.
6. With the great lizards, with the sabertooth tiger and the bison, [humanity's] day is done.
7. We will see them as a threat to us, and thus seek to imprison or simply kill them before they kill us.
8. We evolved. We're the next step up.

The odd numbered quotations are by prominent academics: John Harris, Alliance Professor of Bioethics at the University of Manchester law school; Leon R. Kass, Harding Professor of Social Thought at the University of Chicago; Gregory Stock, former director of the Program on Medicine,

Technology and Society at UCLA medical school; and George Annas, Warren Distinguished Professor at Boston University. The even numbered quotations are by some of the most revered figures in science fiction (SF): Arthur C. Clarke, Robert A. Heinlein, A. E. van Vogt, and Theodore Sturgeon.[1]

The boundary between science fiction and fact is often at issue in contemporary debates over the "posthuman." Genetic enhancement and longevity research provoke fervent debate between those who favor such research and others who think it is wrong to tamper with fundamental aspects of the human. Each side thinks that distinguishing realistic possibilities from wild speculations is a priority. Comically, though, each side uses the epithet "science fiction" as a way of trivializing the positions of the other while proclaiming that the research they cite is on the verge of transforming human nature and that the future scenarios they describe are plausible and impending. This chapter brings the bioethical debate about posthumanism into contact with a massive, culturally significant body of writing on the topic, popular science fiction from the mid-twentieth through the twenty-first centuries. The nightmares of science fiction haunt the bioethical imagination, exerting a pervasive but unexamined influence on its analyses. But the failure of bioethicists to examine the images, metaphors, and storylines of the science fiction that they so frequently invoke distorts their findings and recommendations.

As is perhaps unsurprising, almost none of the people who employ SF as an epithet have the foggiest idea of what they are talking about. Most give no sign of ever having read any science fiction, unless you count *Brave New World*, which everyone invokes without fail. In addition to Huxley's dystopia, they may have read well-publicized mainstream dystopias by established literary figures, such as Atwood's *Oryx and Crake* and Ishiguro's *Never Let Me Go*; most have seen a few dystopian movies (*Gattaca* is the most frequently mentioned); but there is little evidence that they have delved into other forms of SF. Hence, you see over and over again the mistaken notion that SF warns against the consequences of biotechnology. Some does, of course, particularly dystopian fictions. But dystopia is only a small sector of the science fiction galaxy, and the nightmare worlds of *Brave New World* and *Oryx and Crake* are the exceptions, not the rule, in the larger universe of SF. Popular cinema is a misleading indicator too, since the film industry relies on thriller conventions of conspiracy and disaster far more than written forms of SF. Ronald Green conveys the typical assumption when he writes, "the take-home lesson about human gene modification [in science fiction] is wholly negative" (7).[2] Nothing could be farther from the case.

Science fiction is overwhelmingly positive about the possibility of transforming the human. The titles of two famous works in the field capture the spirit in which SF approaches the topic: Arthur C. Clarke's *Childhood's End* and Theodore Sturgeon's *More Than Human*. These works, like so many others, look forward to the day when humans leave the childhood of their species behind and become more than human.[3] Let me emphasize one point, however. The interest of SF does not lie in its "take-home lessons," whether positive or negative. Nor does the interest lie in whether the genre possesses aesthetic merit. Rather, the interest for policy lies in what the genre shows about the historical contexts that produced it and in the cultural attitudes the genre reveals. Thus, it is important to focus on what Darko Suvin identifies as the "popular, 'low,' or plebeian literary production of various times," the "paraliterature" of SF (vii), as I do here. Suvin writes:

> 90 or 95 percent of SF production is strictly perishable stuff, produced in view of instant obsolescence for the publisher's profit and the writer's acquisition of other perishable commodities. But even this 90 or 95 percent is highly significant from a sociological point of view, since it is read by the young generation, the university graduates, and other key strata of contemporary society. (vii)

It matters whether the people who dismiss science fiction actually understand the question at hand. The erroneous belief that the genre is largely negative about biological enhancement mischaracterizes a significant strand in our culture.

The ease with which accusations of writing science fiction fit the rhetorical purposes of bioethicists is revealing. It illustrates the pervasiveness of what Istvan Csicsery-Ronay has called "science-fictional habits of mind" (2). The reach of technology into every aspect of our lives has so saturated consciousness "that we no longer treat sf as purely a genre-engine producing formulaic effects, but rather as a kind of awareness we might call *science-fictionality*, a mode of response that frames and tests experiences as if they were aspects of a work of science fiction" (2, italics in original). Others have pushed this point further. Colin Milburn argues that the field of nanotechnology "should be viewed as simultaneously a science and a science fiction" (25) not only because it employs many of the same rhetorical tropes, conventions, and narrative strategies in its promotional literature and venture capital funding proposals but also because the speculative worlds it imagines as a consequence of as yet uninvented nanotechnology help drive much of the research it undertakes. As a

consequence, nanoscientists often have to labor to disentangle their field from charges that its claims smack of science fiction. Their efforts are self-defeating, however. Milburn demonstrates at length that the very "rhetorical strategies intended to distance their science from the negative associations of science fiction . . . end up collapsing the distinction, reinforcing the science fiction aspects of nano at the same time as they rescue its scientific legitimacy" (24).

Much of the ethical discourse surrounding genetic enhancement is inflected with "science-fictional habits of mind."[4] My point is not that the science of genetics is itself constitutively related to science fiction, as Milburn argues about nanotechnology, but that some of the ethical discourse surrounding genetic enhancement is. The bioethicists examined here rely on sweeping analogies and engage in the kind of extrapolation that is the hallmark of SF. Their underlying syntax is the question "what if?" They ask us to "frame and test experiences as if they were aspects of science fiction" (Csicsery-Ronay) while enjoying the trust accorded to nonfiction. They constitute a rhetorical genre of science writing, the nonfiction cousin of science fiction, while borrowing their authority from the social sciences.[5] We should be wary of drawing ethical conclusions from science fictional habits of mind without acknowledging their character and understanding their provenance.

The ethical and policy discourse on posthumanism differs from the critical reflection on biopower and biopolitics that dominates literary studies of the topic. Literary theorists of the posthuman typically trace their lineage to a few foundational sources: Foucault's late lectures on biopower, Donna Haraway's writing on transgressive, hybrid creatures (both cyborg and transgenic), and N. Katherine Hayles's work on the interpenetration of the cybernetic with the human. By and large, this body of thought wants to break down the boundaries between fiction and cultural analysis, which is very much not the case in bioethics. For example, literary critic Cary Wolfe insists that we must challenge the norms of critical analysis, putting into question categories of rationality before we can come to terms with the posthuman: "the nature of thought itself must change if it is to be posthumanist" (xvi). Wolfe's work draws on animal studies, gender and race theory, Lyotard and Derrida on the nonhuman, Luhmann's systems theory, as well as Foucault's influential texts on biopower. Similarly, Bruce Clarke invokes Gregory Bateson's remark that "the whole of logic would have to be reconstructed for recursiveness" (qtd. in Clarke 5) in justification for his belief that only systems theory can come to terms with the radical potential of posthuman

metamorphosis. This vein of theory has become virtually hegemonic in literary and cultural studies of the posthuman.

By contrast, bioethicists and policy experts mean something quite different when they speak of *Our Posthuman Future*, to use the title of Francis Fukuyama's 2002 book. Bioethicists are more likely to draw on economists, social scientists, and moral philosophers than Foucault, Haraway, Lyotard, Derrida, or Luhmann. Although few literary critics pay much attention to bioethics as a field, it is a powerful discourse in today's society, influencing important policy decisions in government agencies, medical care, human subjects research, pharmaceutical corporations, agricultural regulations, and much more.[6] The debate in this area turns on issues of human dignity, freedom of choice, personal autonomy, patient privacy, and informed consent, not the deconstruction of the subject. For Fukuyama, posthumanism is what you get when you threaten our shared "human nature" (129), the "human essence" (150) that "entitles every member of the species to a higher moral status than the rest of the natural world" (160). Hence, the stakes are high in suggesting a kinship between Fukuyama's conception of the posthuman and science fiction.

In the pages that follow, I trace two different phases of SF's engagement with the posthuman, showing how those phases were responses to their different historical moments and what they reveal about attitudes toward transforming the human. During WW II and the decade afterward, the so-called golden age of SF, a whole raft of short stories and novels dealt with the advent of a new species of human, what today we would refer to as the posthuman.[7] A second wave, equally remarkable for its coherence and prominence, began appearing in the late 1970s and 1980s, culminating in the years immediately preceding the millennium. The typical plot form in both eras involves the persecution of the emerging minority species by a terrified majority, the soon-to-be extinct *Homo sapiens*. Invariably, evolutionary change is depicted as sudden and teleological in character, resulting in a decisive step forward to a higher evolutionary stage. I conclude the chapter by discussing another wave of texts, this time speculative nonfiction works published since 2002. These works fall into two groups, jeremiads by opponents of enhancement, Francis Fukuyama, Leon R. Kass, and Michael J. Sandel – three scholars who served together on the President's Council on Bioethics. The second group endorses biological enhancement. They write in a genre of futurology for which we lack a name, but we might refer to these works as "encomia" or "anticipations" after H. G. Wells's book of that name, which inaugurated

the twentieth-century tradition of scientific futurism (Wagar).[8] With titles like *Redesigning Humans* (Stock 2002), *Radical Evolution* (Garreau 2004), and *Enhancing Evolution* (Harris 2007), these anticipations inflect bioethics with "the ludic pleasures of estrangement" characteristic of science fiction (Suvin ix).

## Around 1953

In Anglo-American SF, 1953 was a banner year. The culmination of important trends in hard SF that took their impetus from John W. Campbell's editorship of the pulp magazine *Astounding Science Fiction*, the year also marked the beginning of important trends in paperback publication of SF and the professionalization of its writers. Ballantine Books published the first of its science fiction original paperbacks in 1953, Frederik Pohl and C. M. Kornbluth's *The Space Merchants*, and ACE followed that same year with its own line of SF originals (Gary K. Wolfe 105–6). The Hugo Award for the best science fiction novel of the year was first given in 1953 to Alfred Bester's *The Demolished Man*, beating out Ray Bradbury's *Fahrenheit 451* and other classics of the genre, including three of the books considered here: Clarke's *Childhood's End*, Sturgeon's *More Than Human*, and Lewis Padgett's *Mutant* (all but Bester's novel published by Ballantine). Van Vogt had inaugurated the spate of fiction about mutants in 1940 with *Slan*, and Heinlein had published the stories that would become the fix-ups *Beyond This Horizon* and *Methuselah's Children* in *Astounding* in 1941 and 1942, while Padgett's "Baldie stories," the core of *Mutant*, appeared in the same magazine in 1945. But 1953 may serve as a symbolic climax for the first wave of SF about evolutionary change in humans. The publication of Watson and Crick's landmark article describing the double helix structure of DNA in April 1953 appears to have prompted SF writers to shift their focus when writing about evolution in ways that will shortly become clear, and by the end of the decade, the genre had moved on to other concerns.

I focus exclusively on Anglo-American SF for two complementary reasons. First, the genre fiction in this line was directly shaped by the emphasis of the pulp magazines of the 1940s with which the name Campbell is closely associated. Campbell emphasized "hard science" in his magazine and encouraged writers who speculated about a posthuman species to ground their work in current understandings of evolution. Mark McGurl has noted something important about the genre status of these works: "the term *genre fiction* (its science fiction and horror variants in

particular) . . . names those literary forms willing to risk artistic ludicrousness in their representation of the inhumanly large and long" (539). That ludicrousness makes the juxtaposition with policy analysis all the more startling. Second, the threat of totalitarianism – first from the fascist right, and during the Cold War years, from the communist left – shaped the rebellious youth culture that consumed American pulp science fiction in ways that I shall shortly explore.

In the 1940s, the lack of knowledge about DNA's role in evolution left SF writers with two chief mechanisms for imagining genetic change: eugenics and mutation. Eugenics had loomed large in the American consciousness in the first half of the twentieth century with debate about selective breeding, sterilization, or extermination of the unfit intensifying in the 1930s as Nazi eugenics campaigns drew increasing notice. After WW II, when word spread about the effects of radiation on survivors of the bombing of Hiroshima and Nagasaki, mutations caused by nuclear warfare became an obvious plot device for fiction about evolution.

For Heinlein, eugenics was the method of choice for changing the human species. A committed social Darwinist, a libertarian who championed freedom of the individual above all other values, and a believer (like Wells before him) in the innate aristocracy of the gifted few, Heinlein vigorously advocated only "positive" eugenics, which encouraged selective breeding through incentives rather than "negative" eugenic policies involving coerced sterilization or extermination. Self-interest and merciless competition for survival would weed out the unfit, or so Heinlein's rugged heroes proclaimed in story after story.[9]

In his antipathy for coercive measures, Heinlein was in step with the growth and eventual dominance of "reform eugenics" in England and America from the mid-1930s onward (Kevles 164–75; Stern 3–4, 16–18). *Beyond This Horizon* imagines a future society where the best genetic lines are encouraged by Moderators from the Eugenics Board who employ family pedigrees and chromosome charts to encourage "star lines" to interbreed. The only genetic interventions that occur involve preimplantation screening of embryos to select the optimum combination of genes. In imagining this future office, Heinlein reflected the cutting edge of reform in eugenics; the 1940s saw a shift away from large-scale better-breeding programs and racial hygiene, which had already become tainted by association with German eugenics, toward marriage counseling, family planning, and beginning in 1946, genetic counseling (Kevles 254). *Methuselah's Children* similarly features incentive programs for people from chosen genetic lines marrying one another. The novel imagines the

establishment of the Howard Foundation in 1875 to support a selective breeding program for longevity. By 2136, when the novel opens, the hero Lazarus Long is 215; although we learn later that he possesses a rare favorable mutation, others in the family lived almost as long.

Suspicion of genetic engineering runs throughout the first wave of SF novels, coexisting uneasily with enthusiasm for the arrival of a posthuman stage. Both Heinlein and van Vogt inveigh against tampering directly with the germ line. Although their genetics fiction was written in 1940–42, before most of the Nazi medical atrocities had become public knowledge, the antipathy toward genetic engineering seems aimed at warding off the specter of German eugenics. Nazi coercive measures clearly ran against Heinlein's grain. *Beyond This Horizon* contains a long, clumsy passage of exposition recounting the horrors of the genetic experiments of past centuries, when the "race acquired the techniques of artificial selection without knowing what to select" (26). No free, individualistic society, we are told, would tolerate engineering humans for particular traits, which would lead either to homogenization of the species, or its opposite, over-specialization. "Only under absolutism could the genetic experiments . . . have been performed, for they required a total indifference to the welfare of individuals" (27). Similarly, van Vogt's *Slan* alludes to the infamous "blood libel" against Jews – the slans are accused of kidnapping human babies for experiments designed to create more slans – a libel that dates back at least to the middle ages but was given new life by National Socialism. To dispel such charges against his slans, van Vogt repudiates the existence of any means of artificially tampering with genes. A crucial turn in the plot reveals that "All slans are natural mutations" (175), not the product of experimentation.

A second reason for the avoidance of genetic engineering was confidence that evolutionary pressures alone would do the trick. This confidence in natural selection, though, reveals its own set of ideological confusions: like so many people of the time, SF writers saw evolutionary change as teleological, a progressive movement toward ever higher stages of life. Nature was viewed as working according to a plan, purposefully directing human evolution toward a superior species. "Our mutation wasn't due for another thousand years" (140), a character remarks in Padgett's *Mutant*, and another explains that radioactive fallout "brought us telepaths into being ahead of our normal mutation time" (146). Sentences such as these could have appeared in virtually any of the SF from the period that dealt with evolution.

A related confusion led authors to envision species change as sudden, occurring over one generation. Recall the Arthur C. Clarke quote with

which this article began (#2 in the list at the beginning of the chapter): "it will be cataclysmic – instantaneous" (181). The passage in *Childhood's End* continues: "yours is the last generation of *Homo sapiens*. . . . You have given birth to your successors" (181). In these novels, bewildered parents discover that they have nurtured mutants with dramatic new powers. It happens not only in Clarke's *Childhood's End*, but also van Vogt's *Slan*, Heinlein's *Beyond This Horizon,* Sturgeon's *More Than Human*, Padgett's *Mutant*, and Judith Merril's classic story "That Only a Mother."

Without exception, the "upgrade" to the species is a mental power, usually telepathy. Clarke's children move quickly beyond telepathy to telekinesis.[10] Van Vogt's *Slan* and Padgett's *Mutant* feature two rival species of telepaths battling for dominance in the posthuman world while hiding from human pogroms. The Howard Families in *Methuselah's Children* contains telepathic "sensitives" among their offspring, and when the reluctant hero from the "star line" in *Beyond This Horizon* finally marries his eugenically selected partner, they produce the telepathic child the Eugenics Board had been seeking. Sturgeon could be summing matters up for all his fellow authors when he writes: "The next important evolutionary step in man would be in a psychic rather than a physical direction" (109).[11]

Telepathy turns out to be a means to another end in most of the works: merging individuals into a larger collective mind. Clarke is the most radical. He envisions a single Overmind of all the telepathic children on earth, possessed of such awesome powers that they eventually consume the planet itself and move out into space as a disembodied being (shades of the Arisians in E. E. Smith's Lensmen series, 1934–1948). Sturgeon explores the concept of minds merging in more psychological terms. Sturgeon's novel consists of three long parts, a central section, "Baby Is Three," that was a Hugo award-winning story about the workings of trauma, repression, and memory recovery through psychoanalysis, and two flanking narratives, somewhat awkwardly constructed to give "Baby Is Three" a backstory and a conclusion. The climax of the book is the achievement of a fused multiple identity called *Homo Gestalt* (170). Heinlein, who loathes the idea of subordinating human individuality to a larger unit, has his long-lived Howard Families spurn an alien species' offer to join them in "rapport groups" of ninety or more minds in return for enormous power (Franklin 42–43).

The fact that science still understood little about the actual mechanism of heredity did not dim SF's enthusiasm for plots of species evolution. Until Oswald Avery's work in the mid-1940s, it was not even clear that DNA was the part of the chromosome that mattered in inheritance.[12] The

very confusions of the novels – such as their vision of evolutionary change as progressive – served the plot requirements of an action genre that had long relied on wars between alien species (the plot, complete with evolutionary themes, dates back to Wells's *The War of the Worlds* [1898]). Genetics merely gave a new air of authenticity to an old storyline. Belief that survival of one species and the extinction of another vindicated the superiority of the winner had been a common confusion since Darwin's day. Genetics allowed novelists to transpose the conflict inward. Rather than externalizing the struggle among species to interplanetary warfare, SF could bring the battle down to earth, as it were, shifting the strife to the personal realm and locating superiority in mental attributes.

The animus against genetic engineering would not survive the excitement surrounding Watson and Crick's discovery of the structure of DNA. SF quickly adopted gene "modding" as the chosen method of creating a posthuman species. James Blish's *The Seedling Stars* (1957), the last composed of this wave of SF about genetics, employs a more informed technical vocabulary and describes in detail the techniques of modifying the germ line to produce new species of humans – so-called "Adapted Men" – for extraterrestrial life on nonearthlike planets.[13] Blish, who trained as a biologist at Rutgers and worked for Pfizer, may have been especially attuned to the significance of Watson and Crick's breakthrough, but even Heinlein became interested in biomedical interventions that might change the species. In the only significant revision to the 1941 serial version of *Methuselah's Children* prior to its first book publication in 1958, Heinlein alters his explanation of how normal humans discovered the secret of longevity, which the Howard Families had achieved via eugenics. In 1941, the secret lay in altering the "radioactive qualities" of certain vitamins ("Methuselah's," pt. 3, 161). In 1958, the secret has become biomedical, the transfusion of new blood produced in vitro from bone marrow (*Methuselah's* 154–55).

What is it about this particular nexus of themes that attracted SF writers in the years 1940–1953? Why do fantasies of teleological evolution, species change, longevity, psychic powers, collective minds, the persecution of minorities, and the extinction of humanity come to be associated in work after work? How does this constellation of ideas reflect public knowledge of genetics at the time and what can such confused notions about genetics contribute to bioethical debates today?

One way to answer these questions is to approach science fiction as addressing larger cultural anxieties. Like the myths studied by Claude Lévi-Strauss, the books offer imaginary solutions to real social problems.

The roles of telepathic communication and collective identity have sometimes been attributed to the interest of John W. Campbell in parapsychology (Luckhurst 410). This may be the case: Luckhurst quotes Campbell's remark that he used *Astounding Science Fiction* to promote fiction about E.S.P. But the fantasy of mental communion with others responds to a wider cultural condition, the ambivalent attraction to authoritarian structures that Erich Fromm so memorably charted in his 1941 book *Escape from Freedom*. SF's depiction of merged identity speaks to both the longing and the fear provoked by the spectacle of a world confronting totalitarian regimes, whether fascist or communist, which submerged the good of the individual to that of the group. Passionately idealistic, as much SF tended to be at the time, these works responded to the urge for communal identity but simultaneously paid homage to rebellion and nonconformity. Readers felt themselves part of a communal group but only because they were among the special few. The fusion of these contradictory impulses was a major part of the genre's appeal. It was a haven for people who saw themselves as farsighted, misunderstood nonconformists persecuted by an uncomprehending majority, but who paradoxically banded together in tight-knit fan communities of fellow believers (Mendlesohn 10). Witness the subcultural phenomenon of "slan shacks," group living arrangements for SF fans who used to refer to outsiders as "mundanes" (Coger). The constellation of ideas surrounding species change spurred generic innovation in the field of SF while serving as a vehicle for the contradictory affects of the post-WW II era.[14]

This incoherent affect was not unique to the world of SF but surfaced as a current in other sectors of society: beat poetry and jazz circles, popular films such as *Rebel without a Cause* (1955), mainstream bestsellers such as *The Lonely Crowd* (1950), *The Man in the Grey Flannel Suit* (1955), and *The Organization Man* (1956), and fiction favored by teenage nonconformists such as *The Catcher in the Rye* (1951) and *Siddhartha* (1922; U.S. publication, 1951). Such phenomena help us recognize SF's vogue for telepathic union as what Jameson calls an "ideologeme," a unit of narrative that "transmits a historical or a social message" (*Archaeologies* 322). Fantasies of a new species, born of the union of extraordinary individuals, played to idealism about a collective society but stripped the idea of its threat to the individual and of its political dimension. The same was true of the racial allegory that ran through many of these texts. Their repudiation of racial prejudice, frequently thematized in characters who marveled at bias based on something as "trivial" as skin color, catered to the fantasy of reconciling the races without political struggle.

The ideologeme of post-WW II SF about evolutionary change thus does not have the meanings commonly attributed to it in bioethics today. Neither does the genre's short-lived antipathy to genetic engineering. Both responded to social and political concerns far removed from arguments about genetic enhancement in the twenty-first century. The temptation to use SF as a prop for advocacy for or against biotechnology fundamentally mistakes the cultural message of the genre around 1953. What the first wave of SF about genetics reveals, instead, is the importance of understanding scientific developments in their full social, political, and cultural contexts. The field of bioethics could benefit from literary approaches to science, but few of us engage with the issues that confront science policy today.

After Blish's *The Seedling Stars* (1957), there was little SF about genetics for more than twenty years. A review of "Science Fiction and the Life Sciences" by Slonczewski and Levy suggests that a growing interest in environmentalism, which intensified after publication of Rachel Carson's *Silent Spring* (1962), stimulated SF writers to turn their attention to ecological issues, producing imaginative explorations of alien ecosystems such as *Dune* (1965) and *The Left Hand of Darkness* (1969). Another likely factor was the rise of the counterculture and new social movements concerned with minority and gender issues, which led to increased emphasis on fiction about altered states of consciousness and changed racial and sexual norms, especially in New Wave SF. In any event, almost no science fiction confronted questions of evolution and genetics in any depth until the excitement about recombinant DNA reignited interest in the mid-1970s.

## Approaching the Millennium

The same themes of human species change, extrasensory communication, and collective modes of experience reappear, updated for a genomic age, in the SF published in the years leading up to the millennium. There are two crucial shifts of emphasis, however. First, because species change is brought about by deliberate genetic manipulation, there is less stress on a teleological conception of evolution. The ability to modify the genetic code means that alterations in the human form are chosen and are not the result of evolution, whether blind or directed. (Greg Bear's novels are an important exception, as we shall see). These books have fully assimilated the notion that "With our biological research we are taking control of evolution and beginning to direct it," to quote one of the bioethicists from

the beginning of this chapter (Stock 17). Second, diversity of form *within* the species is prominent. An obvious thematization of multicultural racial diversity, the plea for biologically diverse beings to find areas of commonality is framed as the only hope for descendants of humanity in a hostile universe. Transformation and species diversity are seen as survival characteristics; continuous adaptation and flexibility about the boundaries of the acceptable are primary values.

Both of these developments – acceptance of artificial reproduction and respect for diversity – are signs of how the subculture of SF had joined other new social movements such as feminism, queer and transsexual politics, disability rights, and multiculturalism to stake out a distinctive, countercultural position in opposition to prevailing trends in the Nixon–Reagan years. Although many women active in feminist causes reacted against invasive biomedical technology in matters of reproduction, SF emphasized the thematics of reproductive choice to align its positive attitude toward genetic engineering with women's rights. Octavia Butler's more complicated portrayal – the Xenogenesis trilogy supports genetic manipulation of the species but does not hide this intervention's kinship with other kinds of violence against women – stands out in contrast to some of the other SF of the period. In the 1990s, transgender, transsexual, and prosthetic choices grew in prominence, particularly in cyberpunk fiction, though this theme had influential precursors in the fiction of Ursula K. Le Guin and Joanna Russ. The advocacy for diversity *within* the species was less conflicted. If the racial politics of the first wave of posthuman SF was predominantly liberal (or sometimes libertarian) in its advocacy of equal rights and tolerance, the sexual and racial politics of the second wave reveals its affinities with the new left in its embrace of hybridity.

Both the continuity and the difference between the two phases can be brought out by comparing the last of the fifties SF in this vein, James Blish's *The Seedling Stars* (1957), with an early example of the later phase, John Varley's *The Ophiuchi Hotline* (1977). Blish's Adapted Men did not evolve through natural selection but were engineered in the laboratory for survival in alien environments. Outlawed and hunted on Earth, they become the pioneers of humanity's expansion into space. Foreshadowing later SF motifs, they prosper in all their myriad forms, growing into the majority and leaving the "basic human type" (Blish 156) behind. The moral could not be stated more plainly: "It's only sensible to go on evolving with the universe" (151).

Varley's novel opens with criminal charges alleging that the heroine "did willfully and knowingly conduct experiments upon human genetic

material ... [and] produce human blastocysts and embryos reflecting potential structures atypical of the permitted spectrum of Humanity" (*Ophiuchi* 1). This felony is one of the few offences punishable by death and the total eradication of all copies of the criminal's genotype, preventing future cloning of the miscreant. The ban on radical genetic experiments had been meant to be only a moratorium, but it had hardened into a prohibition that lasted for 500 years. (This detail alludes to the voluntary moratorium on recombinant DNA research that led up to the historic Asilomar Conference of 1975, a gathering of scientists and ethicists that developed guidelines for how to pursue further research in the area safely.) As any veteran SF reader would anticipate, the rebel against the novel's genetics laws turns out to be one of the saviors of humanity, which was dooming itself in its struggle against alien invaders by clinging to human racial purity. The moral in this case is as plain as in Blish's earlier novel: "You will have to cease defining your race by something as arbitrary as a genetic code, and make the great leap to establishing a racial awareness that will hold together in spite of the physical differences you will be introducing among yourselves" (Varley 159).

The renewed surge of interest in genetics picked up speed in the second half of the 1980s with the publication of influential fiction by Bruce Sterling (*Schismatrix* [1985] and five related stories) and Octavia E. Butler (Xenogenesis trilogy, 1986–1988). Sterling, one of the cofounders of the cyberpunk movement, and Butler, a noted African American feminist writer, stretched the boundary of the genre in several ways. Sterling's future interplanetary society, nicknamed the Schismatrix, is divided between posthumans who have used cyborg implants to transcend the human body and others who have used genetics to the same end. Warring with one another, the two camps (and other splinter factions) live in the shadow of alien Investors, possessing vastly superior technology that they use to promote their interstellar trading empire. Bruce Clarke reproaches Sterling for retailing "an all-too-human oppositionalism" in the war between the two camps (160), reflecting the tendency of literary theorists of posthumanism to evaluate SF according to how staunchly it resists the tendency to fall back into humanism (Milburn levels similar charges against Blish's "Surface Tension," 96–106). But Sterling's solution to the dilemma of unifying the species after it has splintered apart into incommensurate posthuman forms rejects this "oppositionalism" and adopts instead a posthuman philosophy developed by the (real-life) complexity theorist, Ilya Prigogine (1917–2003). Prigogine's version of complexity offers the characters in the fractured world of the Schismatrix a

model of self-organizing structures, which become intelligible only from the perspective of a higher level of organization. "By the term *we*, I don't mean . . . humanity," one character remarks (Sterling, "Cicada" 273). *We* can be applied to any group of beings that has organized itself on a sufficient level of complexity, regardless of their external form. "It's time we learned to stop looking for solid ground to stand on. . . . Posthumanism offers fluidity and freedom" ("Cicada" 274).

Butler's Xenogenesis series adopts the motif of interstellar Traders too (a familiar topos in SF, not a borrowing from Sterling). The Oankali travel the galaxy in search of interesting genomes with which to merge their own. "We trade the essence of ourselves. Our genetic material for yours," one of the Traders explains. "We do what you would call genetic engineering. . . . It renews us, enables us to survive as an evolving species instead of specializing ourselves into extinction or stagnation" (*Dawn* 39). They create new, hybrid species, a mixing that captures the spirit of postmodern theories of deterritorialization, fluid economies, and hybridity, as Gabriele Schwab and many others have pointed out (Schwab 215).[15] The unfortunate consequence, from the humans' perspective, is that humanity disappears as a species, merging into the new Oankali/human hybrid. (Echoing the resolution of other SF works in this vein, a tiny remnant of old humanity is given the option of going its own way by being transported to Mars.) Butler's novels embrace this prospect for humanity, welcoming a posthuman future as the only possible mode of survival for a species that has already destroyed the planet through nuclear warfare and is on the verge of extinction. Humanity is doomed because of its deadly combination of intelligence and the instinct for hierarchy.

By now, it should be apparent that acceptance, even advocacy, of a posthuman future is the norm, not the exception, in SF. We have seen it throughout the first and second periods of interest in this topic – perhaps most memorably enshrined by the conclusion of Clarke's *Childhood's End*, when humanity's child, the Overmind, consumes all the substance of Earth and sets out for the stars.[16] At the end of the third volume in Butler's series, the hybrid descendants of what used to be the Oankali and human species accept a similar fate for Earth – they will consume the planet for fuel, leaving behind a cold, lifeless husk when they depart for the stars. What is distinctive about Butler's handling of this plot is how nakedly she depicts the violence of these conflicts, the racial hatred, the fear of difference, the brutality of strong against weak, the ineradicable stain of sexual violence, the hierarchical impulse that condemns the old species, our species, to extinction.

The great anomaly among the second phase of SF novels about genetics is Greg Bear's two-part series, *Darwin's Radio* (1999) and *Darwin's Children* (2003). Although the novels incorporate all three of the main thematic concerns – sudden species change, extrasensory communication, and group consciousness – and feature plots involving persecution of the posthuman minority by humanity, they differ from their contemporary peers by attributing species change not to genetic engineering but to evolution and by reasserting the directed nature of speciation. Bear updates the evolutionary paradigm by recourse to cutting-edge but sometimes controversial research; the result is an effective appearance of a scientific rationale for directed evolution. In an afterword, Bear forthrightly admits that "it is very likely that many of the speculations here will turn out to be wrong" (*Darwin's Radio* 527), but the speculations stem from extrapolations from current research.

Bear's novel was billed as a crossover work, a techno-thriller in the mode of contagion narratives such as Michael Creighton's *The Andromeda Strain* (1969) or Robin Cook's *Outbreak* (1989) rather than a work of science fiction, but the SF community was not about to let such an accomplished work go unclaimed and gave it the Nebula Award for 2000.[17] Scientific thrillers give authors more latitude for expository conversations among researchers and government bureaucrats than SF because the technical information itself is seen as a source of the genre's appeal, and both of Bear's novels end with glossaries of scientific terms. Thriller conventions differ as well from mainline SF in featuring capsule character sketches whenever a new actor comes on the scene; gratuitous sex scenes; point of view shifts to facilitate speed of narration; and quick cuts between exotic locales, each labeled with a place heading (the Alps, Tbilisi, New York, NIH headquarters, the CDC, an archaeology dig in Washington state). I bring up the presence of these thriller conventions in Bear's series not only as an aesthetic issue but to underline the point that this fictional genre – like SF with its reliance on different narrative formulas – is immediately recognizable *as* fiction despite its parade of scientific information.

The truth is, scientific thrillers and SF are better suited to this kind of thought experiment than most of the nonfiction about posthumanism that aims to influence public policy. The formal conventions of fiction alert readers to the provisional nature of analogy and extrapolation. As many critics have pointed out, SF does not pretend to predict the future or give prophecies of things to come. By contrast, nonfiction anticipations of the posthuman do exactly that: they specialize in prophesies and predictions.

This difference is part of what is at stake in emphasizing SF's fictionality. Coleridge famously wrote that literature required a "willing suspension of disbelief," but the act of willing oneself to enter an imaginary world affords a safeguard against taking *possible* futures as inevitable (or even probable in any testable way). Fiction does not have to pass a test of verifiability; it has its own procedures for establishing what counts as plausible, and one rarely mistakes those procedures for truth claims. Ironically, nonfiction about the posthuman is more susceptible to the ridicule of time than works of SF.

In the next section, I turn to nonfiction prophecies of the coming posthuman age. The purpose of this juxtaposition is both to demonstrate their kinship to SF and to note the poor use they make of SF's formidable powers of world building. The truth is that these nonfiction texts fail to employ the narrative resources literature has at its disposal. Their future scenarios are thinly imagined. They lack the narrative coherence, the careful development of motifs, and the richly textured world building that gives plausibility – even integrity – to good fiction. Yet these nonfiction texts rely utterly on the expectations that readers bring to their future scenarios from SF. The grounds of comparison lie in the rhetorical dependence of this body of nonfiction on modes of reality testing and future thinking developed by science fiction.

## Jeremiads and Anticipations

> Prophecy courts the ridicule of time, and those who dream of tomorrow often wake to laughter.

In a celebrated work of American studies, Sacvan Bercovitch coined the phrase "American jeremiad" to describe an eighteenth-century genre of political sermon that set the tone for much brooding upon the destiny of our nation for the next two centuries. The New England Puritans intended their mode of public exhortation "to join social criticism to spiritual renewal, public to private identity, the shifting 'signs of the times' to certain traditional metaphors, themes, and symbols" (Bercovitch xi). The result was to construct a "myth of America" and "clothe history as fiction," but the myth succeeded "in proportion to its capacity to help people act in history. Ultimately, its effectiveness derive[d] from its functional relationship to facts" (Bercovitch xi).

Bercovitch's account of the American jeremiad indicates what I mean by calling the writings on posthumanism by Leon Kass, Michael Sandel, and

Francis Fukuyama "jeremiads." The rhetoric is fierce enough to qualify. Kass compares "posthuman Brave New Worlders" to "inhuman Osama bin Ladens" and maintains that genetic engineering fosters a "soft dehumanization" as pernicious as "the cruel dehumanization of Nazi and Soviet tyranny" (*Life* 4, 7); Sandel talks of "designing parents," of "hubris," and of "the one-sided triumph of willfulness" (Sandel 46, 85); Fukuyama chooses "Transhumanism" as his contribution to a series on "The World's Most Dangerous Ideas." But it is not merely fierce rhetoric that revives the spirit of the Old Testament prophet; it is the ambition to spur spiritual renewal through social criticism and to counter shifting signs of the time – genetic enhancement, longevity research – by recourse to traditional metaphors, themes, and symbols.

The new wrinkle that scientific jeremiads bring to the genre is their covert relationship to SF. The works' ability to spur people to act in history depends on inducing readers to frame and test experiences as if they were aspects of science fiction (Csicsery-Ronay). Their effectiveness depends on a certain *functional* relationship to facts, as Bercovitch said of the Puritan sermon. That functionality relies on readers who are accustomed to taking fantastic futures seriously. The power to mobilize citizens comes from the ease with which readers have learned to extrapolate from facts that could entail an imagined future. Of course, the same facts could entail a radically different future or be largely irrelevant to what eventually occurs. But the call to action in scientific jeremiads elides such possibilities.

There is an important place in bioethics for thinking about the consequences of new technologies, of course. But researchers in the field expect predictions about the social implications of scientific developments to be grounded in evidence and to employ testable methods such as economic modeling, surveys of attitudes and trends, studies of how technologies are used by different populations, or historical analyses of medicine and science. Research-based attempts to forecast future trends are often framed in a distinctive vocabulary: they are termed projections, and their predictive character is subject to disconfirmation by new data.[18] By contrast, scientific jeremiads rarely restrict themselves to the evidence base or to projecting trends. They are the "scare-mongering" pole (Carter, Bartlett, and Hall) of what has variously been called "anticipatory" or "speculative bioethics" (King, Whitaker, and Jones; Brey; Racine et al.; Schick). Instead of using forecasting methodology, they rely on blurring the genre between research-based projections and scientific fictionality.

One sees the power of scientific extrapolations when one comes up against communities in our nation who do not give them credence. Think

of how bewildering it strikes most Americans when climate change skeptics deny the long-term forecasts of environmental science or fundamentalists espouse an eschatological vision involving imminent Rapture. Trust in a scientific vision of the future, though, has never depended on one's ability to assess the science itself, something beyond the reach of most people. Rather, it comes from the "willing suspension of disbelief" in extrapolation, a suspension Coleridge saw as crucial to our response to fictive, not factual, writings. Climate skeptics treat scientific projections as if they were fictions they can choose to "believe" or not. Authors of scientific jeremiads treat fictions as if they were scientific projections.

For jeremiads about genetics, perhaps the chief rhetorical tactic is to counter the science fictional metaphors of posthumanism with rival metaphors derived not from the future but from the past, metaphors chiefly concerning human nature, natural rights, and human dignity. As philosophers and political theorists, these writers give accounts of their central terms as *concepts*, not metaphors, and the extensive debate about their work has largely taken them at their word, investigating conceptual flaws in their arguments.[19] But the rhetorical power of these terms functions independently from their logical coherence.

The rhetorical tropes in the works are legion: hyperbole, personification, analogy, guilt by association, symbolic opposition, performative speech acts, leading questions, organic metaphors, and more. But all writing is figurative, and identifying such tropes will hardly surprise readers. It is not the constitutive role of figurative language in the jeremiads that matters, but the functional motivation of these tropes. Scientific jeremiads attempt to motivate people to act in history – to resist a feared future – by conjuring a "novum," to use Darko Suvin's term for the novel reality SF creates. These jeremiads warn against an "alternate reality logically necessitated by and proceeding from" a fiction (Suvin 75). This totalizing rhetorical strategy, as effective in nonfiction as in science fiction, can only be tested by recourse to the sensibilities that one uses to judge SF. Is the novum believable? The jeremiad, however, has designs on the reader – it calls on one to accept a SF novum as a reason to act in history.[20]

The rhetorical strategies these jeremiads about genetics use to create a novum can be reduced to three basic forms: (1) performative speech, (2) symbolic oppositions, and (3) metaphors of organicism. Sandel is the great practitioner of performative rhetoric. Again and again, dozens of times in his very short book, *The Case against Perfection*, Sandel states that "we" are made uneasy by some aspect of genetic enhancement, asserting in a performative speech act what he ought to be proving. The basic rhetorical

move goes like this: "And yet something about the ad leaves a lingering moral qualm" (3); "And yet there is something unsettling about the prospect of genetically altered athletes" (8); "There is something unsettling about the specter of genetically altered athletes lifting SUVs or hitting 650-foot home runs or running a three-minute mile" (12). He never makes any effort to document that people are made uneasy by such phenomena. Some people may be, although it is clear from the clamoring voices in favor of enhancement that many are not. Hence, it is incumbent on Sandel to demonstrate rather than just assert that "we" are queasy. Instead, he immediately follows up these assertions with leading questions: "But what exactly is troubling about these scenarios?" (12); "Is the scenario troubling because the unenhanced poor are denied the benefits of bioengineering, or because the enhanced affluent are somehow dehumanized?" (15–16). Any possible answer grants his premise.

Kass deploys symbolic oppositions pitting "us" against "them" with similar fluency. One of his favorite moves is to sort those who agree with him into a valorized group and those who disagree into people "who can't see or don't care about what lies ahead" (*Life* 10). The latter is made up of "scientists and biotechnologists, their entrepreneurial backers and a cheering claque of sci-fi enthusiasts, futurologists and libertarians" (*Life* 6). His side, by contrast, "sees all too clearly where the train is headed"; his side "can distinguish cleverness about means from wisdom about ends, and we are loath to entrust the future of the race to those who cannot tell the difference" (*Life* 6). If one differs from Kass, then one is either blind or uncaring, and in any event, cannot tell the difference between means and ends. The passage concludes with a ringing tautology: "No friend of humanity cheers for a posthuman future" (*Life* 6).

Kass's oppositional rhetoric is apiece with the underlying time structure of scientific jeremiads. His temporal model conforms to the paradigm that Catherine Gallagher has described as a "Y-shaped pattern" (16) where a single time track splits into two. Gallagher's subject is alternative history narratives, so her article is concerned with plots that "undo" some event in the past to demonstrate what the present might be like if a critical event or choice had gone another way. This same Y-shaped model of time is implicit in scientific jeremiads but to less salutary ends. Whereas the plot of undoing aims to highlight or (in the political arena, remediate) historical injustices, a similar logic when applied to the future reduces a plurality of possible outcomes to two stark alternatives.[21] Science fictions about time travel have sometimes engaged in a similar reduction of temporal alternatives, particularly those that involve the so-called grandmother paradox in

which the protagonist travels back in time and accidentally marries a grandparent. But more commonly, SF stories about time travel, parallel worlds, and multiverses have opened onto an infinity of possible universes – think of classics like Fritz Leiber's *The Big Time* (1958) or more recent stories like Greg Egan's "The Infinite Assassin" (1991), not to mention nongenre works such as Borges's "The Garden of Forking Paths" (1941). Kass's model of the future, by contrast, depends on the same either/or choice that is echoed in his us-against-them rhetoric.

What Bercovitch says about the Puritan jeremiad applies as forcefully to Kass's book: "The rhetoric plainly substitutes symbolic for social analysis" (Bercovitch 177). Here's how Bercovitch explains the problem with this procedure:

> Symbolic analysis . . . confines us to the alternatives generated by the symbol itself. It may suggest unexpected meanings, but only within a fixed, bipolar system . . .. We can understand what is being represented only by measuring it against its opposite, or by placing it within a series of comparable and related oppositions. (177–78)

It is hard to think of a better example of how symbolic analysis confines a person to alternatives generated by the symbol itself than a line such as this one in Kass: "Because to say 'yes' to baby manufacture is to say 'no' to all natural human relations" (*Life* 19). *All* natural human relations?

Fukuyama's *Our Posthuman Future* is the most temperate, thoughtful, and persuasive book of the three, but it is a jeremiad all the same. The core of the book is a carefully argued set of chapters defining and defending what Kass and Sandel leave vague, the concept of human nature. His arguments draw on evolutionary biology and psychology to provide a ground for speaking of human nature without resorting to religious assumptions. I will not debate whether these arguments hold up but will only focus on the rhetorical moments where his quasi-biological defense of the concept of "human nature" slides into generalizations about what it is "natural" to desire, think, and do – moments, that is, where statements about human nature become motives for action.

Students of romanticism have long been aware of what Paul de Man termed the "intentional structure" of the organicist metaphor, which underwrote much literature and philosophy of the period. The characteristic effect of this metaphor was to import a temporal dimension into a substantive quality, giving to a concept such as "nature" the appearance of entailing ("intending") particular ideas, feelings, or modes of being. Something is "natural" because it appears to originate in nature, not

because it differs from the artificial or the unnatural. Clearly, if one thinks about it for a minute, one realizes that artificial things trace their origins back to nature. Everything *originates* in nature, even society (if a religious origin is discounted, as it is by Fukuyama). This is as true of cloning as it is of queer sexuality or anything else that a conservative commentator might want to condemn as "unnatural." You cannot call something "natural" merely because it originates in our shared biological nature – you must find some other way to define the unnatural if that is your agenda.

When Fukuyama claims to have proven that human nature "serves to provide us with guidance as to what political orders won't work" (*Our Posthuman Future* 127) because they are not "natural," we see the organicist metaphor structuring his thought. The "failure of communism" occurred because of the "failure to respect the natural inclination to favor kin and private property" (127). When he says, "Human beings have been wired by evolution to be social creatures" (124), he makes a statement about what human nature *is*, based on claims put forward by evolutionary psychology. When he moves on to say that humans have "natural tendencies" and "natural human desires" (126–27), he makes a different kind of statement about where certain tendencies and desires originate. The intentional structure of the metaphor of organic growth lends the latter statement its only power.

Let me turn to the other side, the proenhancement books that have glutted the market. The same rhetorical elements can be found in these texts too. The group of anticipations concerning developments in genetics are, if anything, more dependent than the jeremiads on the habits and sensibilities cultivated by SF. The language of their titles is rich with tropes that evoke a novum: genetics will enable us to redesign our species, enhance the human, make better people, upgrade the brain, reach our inevitable genetic future, assist in radical evolution, and design our babies.[22] The three strategies of performative speech, symbolic oppositions, and organicist metaphors are deployed just as prominently.

The rhetoric of proenhancement anticipations warrants somewhat less detailed treatment since it lacks the call to action characteristic of jeremiads and dystopias. That is, encomia to genetic engineering generally lack a compelling demand to act in history. Rather, they seemed designed to wow the reader with the present than to shape the future. In the crassest cases, the intent seems to be to make money off of the author's own science by publishing a trade book. The impulse may be venal, but it is relatively harmless.

On the surface, the kinship of the genre of anticipations with SF would appear to be greater than that of jeremiads, but both nonfiction genres are the siblings, as I said earlier, of the SF they scorn. An unmistakable sign of their affiliation lies in their continual invocation of Aldous Huxley's *Brave New World*. Whereas Kass and Fukuyama devote substantial parts of their opening chapters to discussing Huxley's dystopia as a warning about our future, Stock, Garreau, and Green all invoke Huxley's vision to distinguish it from what they claim are more probable futures. The continuity they assume between a renowned *fictional* future and their own nonfiction scenarios makes the point. Science fictional habits of mind are implicit preconditions of all these texts. If Huxley's looming shadow is not enough, there is another piece of SF that is invoked several times, although none of the authors make clear that they are quoting a fiction. Lee Silver frames his anticipation of genetics, *Remaking Eden: How Genetic Engineering and Cloning Will Transform the American Family* (1998), with an amusing fiction in the form of a commission report in the year 2350, detailing worries about the GenRich and the Naturals diverging to form two incompatible species. Silver cribs the idea of an imaginary future lecturer from J. B. S. Haldane's "Daedalus, or, Science and the Future" (1923), and Silver's imaginings are every bit as speculative. Fukuyama, however, references this future vision without letting on that it is a fiction. Ronald Green, at least, follows his discussion of Silver's "troubling prediction" (Green 135) by a discussion of H. G. Wells's vision of the Morlocks and Eloi in *The Time Machine*. But Green never directly states that Silver's worry is a fantasy, not a prediction. Such slippage illustrates the kinship these works bear to our culture's science fiction.

Like jeremiads, positive anticipations of our genetic future aspire to be prophetic, but theirs is a more prosaic form of prophecy, one that cannot trace its lineage from the warnings of Biblical seers and Puritan preachers. Anticipations traffic in scientific razzle dazzle, and their attempts to inspire awe at biotechnology's wonders sometimes result merely in the feeling of gee whiz. Their predictions risk being disproven by the next twist or turn of history; the best they can aim for is the hit-or-miss success rate typical of Wells's prognostications in *Anticipations* (1901), and he was unusually successful. Both jeremiads and encomia are vulnerable to disconfirmation, but the latter especially court the ridicule of time. They are the dreamers who risk waking to laughter. Disconfirmation of a jeremiad grants a feeling of relief. There but by the grace of God, we sigh.

The few worrisome problems that encomia present differ in kind from jeremiads too. They are more immediate and tend to call for practical

solutions. Several commentators are concerned that unduly optimistic expectations can raise false hopes in patients or result in disillusionment when technologies do not fulfill these promises in a timely fashion. As a result, "an emerging technology can be smothered or hampered . . . by the weight of enthusiastic speculative expectations (such as has arguably been the case for genomic medicine)" (King et al. 147). Others have argued that the debate about hypothetical outcomes of technologies still on the horizon "bypasses the present as a site of moral agency," diverting attention away from more urgent current concerns (Schick 226).

Perhaps the most troubling issue with scientific anticipations is that they often fall prey to a temptation embedded in the very structure of genome time. That temptation is the millenarian impulse, the dream of sudden, radical transformation of the human. We saw it on display in the rhetoric of the "new immortals," "fast-forwarding evolution," and taking "the next step up" listed in the quotations at the beginning of this chapter. This dream has given rise to the discourse of transhumanism and talk of the coming singularity. It lies behind the belief that we are "the last humans," now "poised to transcend our current form" (Stock 1). Millenarian thinking is teleological and proceeds in stages with pronounced emphasis on beginnings and ends. John Harris is not shy about proclaiming the teleological goal of "making better people." He writes: "I propose both the wisdom and the necessity of intervening . . . to improve things by taking control of evolution and our future development to the point, and indeed beyond the point, where we humans will have changed, perhaps into a new and certainly into a better species altogether" (4–5). For many, the magnitude of this change can only be grasped by invoking the dawn and the end of life as we know it. Like Kubrick in *2001: A Space Odyssey*, Stock imagines two cataclysmic stages of transformation on our planet:

> A momentous transition took place 700 million years ago when single cells came together to form multicellular life . . .. Today we are in the midst of a second and equally momentous evolutionary transition . . .. Humanity is moving out of its childhood and into a gawky, stumbling adolescence in which it must learn not only to acknowledge its immense new powers, but to figure out how to use them wisely. (Stock 16–17)

Shades of Arthur C. Clarke's *Childhood's End*! Science fiction has given us richer, more fully imagined visions of such change, but there is a difference between fiction and scientific anticipations, or there should be. That difference is one of genre, and understanding the power of genre to shape our response to genome time speaks directly to the value of literary studies

for bioethics and public policy. Literature makes it hard to forget the human component that is the reverse side of genome time: not only the incomprehensible eons Stock evokes, but also the arc of individual lives; not only the birth of multicellular organisms, but also the legacy of our recent historical past, the quotidian circumstances of the present, and the near-term prospect of what lies ahead. In literature, we encounter the full resonance of genome time – both the millenarian or dystopian transformations to come and the incalculably precious lives lived one moment at a time.

PART IV

# *Genome Time*

Back when the direct-to-consumer genetic testing (DTC-GT) company 23andMe was just getting started, my wife's medical school decided it would offer a free DNA test to every entering student. Since practitioners might soon be confronted with patients who had gotten DNA tests and would then want to know what they meant, the school thought it would be a good idea – maybe even a fun icebreaker – to let first-year medical students see for themselves what consumer genetics had to offer.

As a professor of law, medicine, and bioethics who was also directing their required course in genetics, my wife thought it would be the responsible thing to do to take the test herself. But even before she received the results, she began to have second thoughts. How much did she really want to know about whatever 23andMe's (rather limited) panel of results might reveal? What privacy protections did they have in place? Did she really want to know the company's estimate of her risk for future health complications? She already knew she did not want to learn about Alzheimer's and Parkinson's and so opted out of receiving risk scores for those conditions. It didn't help when she began reading studies that showed wide differences in results obtained from the three best-known DTC-GT companies.

The night she found a call on our answering machine from a stranger in another state claiming kin, she grew affirmatively disturbed. Something about the voice on the machine felt a little creepy. She was bothered to realize that she had voluntarily offered up private information about herself to a third party – in fact, like everyone else who uses these services, she had actually *paid* a corporation to take her personal data. And now she was feeling vulnerable.

Over the years, as news has come out about police departments submitting DNA samples under false names to gain information that would allow them to identify suspects in crimes and about 23andMe's contract with the pharmaceutical company Glaxo Smith Kline to share de-identified health information about subjects in 23andMe's database, enthusiasm for DTC-GT services has begun to wane. To be fair,

23andMe offers its customers the option to opt out of having their data used in for-profit drug development, and it has always had one of the better privacy policies in the business, but like almost all End User License Agreements, it reserves the right to change its privacy policy at any time.

Some of the things that go on in the largely unregulated world of DTC-GT might astonish you. Few people are aware that there are some ninety DTC-GT companies operating in the United States alone. Many of them have appallingly bad privacy policies or no policy at all.[1] Still fewer people are aware of the practice of surreptitious genetic testing in which customers take DNA samples from their spouse or children without their knowledge and submit them for analysis in order to help discover potential infidelities or to aid in a divorce or child custody case. Twenty-seven DTC-GT companies allow or explicitly encourage the submission of surreptitious samples – one advertisement helpfully suggests that you send in discarded cigarette butts, chewing gum, used condoms, dirty underwear, or lipstick stains.

Not all apprehensions about these services concern the protection of personal data. Another troublesome aspect of commercial genetic testing is the problem of what consumers will do with their data once it is returned. Even with the aid of glossy explanatory brochures, many people find themselves needing to pay an additional company to interpret their results, racking up further costs for information that rarely is very useful in a clinical setting. Primary care physicians, in turn, report not having the expertise to know how to interpret detailed genetic data and so often end up referring patients to specialists – an economic burden on society even for those patients who have the means or insurance coverage to afford it.

Most of all, there can be unexpected psychic costs. Long before the phrase "trigger warning" had entered the lexicon, I learned from my students that I needed to be careful about how I approached novels that dealt with breast cancer or Alzheimer's disease because those books could be disturbing for students with relatives who were afflicted with these conditions. More than once, a student approached me after class to ask whom they should talk to about their own risks or to explain why they did not want to get tested.

Invariably, the anxiety that students were experiencing had a temporal dimension. Here was a test that could reveal their future – or so they (mistakenly) thought – and it was disconcerting to consider that a sequence of letters could open a vista on a danger that lay decades ahead. What would such knowledge do to them in the interim? How would they be changed? After such knowledge, what . . . relief? despair? This, it seems, was the curse of data in the age of genome time.

CHAPTER 7

# *Time Considered as a Helix of Infinite Possibilities (Samuel R. Delany)*

My first encounter with genome time may have been in a science fiction story I read as a teenager in the *Nebula Award* volume for 1969, Samuel R. Delany's "Time Considered as a Helix of Semi-Precious Stones." The title intrigued me immediately, as it did the American composer Marc Satterwhite twenty-five years later when he tried to capture in music the "images of dazzling, swirling brilliance" that Delany's words evoked. Satterwhite's piece for violin, clarinet, and piano attempts to mimic in its formal construction the symmetry of the helix, which he describes as "ever spiraling outward and changing, yet ever the same" (Satterwhite).

The idea of a spiraling narrative, changing yet formally the same, is at the core of Delany's award-winning short story, a work that was seen at the time as a landmark of the New Wave movement in science fiction, later rechristened by Delany and others as "speculative fiction." Evoking the double helix of genetics, Delany constructs a narrative that is simultaneously linear and recursive. In the story, the advent of something called "holographic information storage" allows officers of the Special Services to discover and predict everything a suspect has done or will be doing at any time in the past, present, or future. Hence, every episode in the story is always known (both before and after the fact); every moment is only the manifestation of a preordained time. Yet the narrative moves forward in a chronological order spanning fifteen months, a linear timeline marked each month among members of the criminal class by a new password, a changing shibboleth of semiprecious stones.

This chapter explores Delany's striking conception of a data structure that enables probable assessments of past and future events as a way of elaborating on the temporal implications of genomics. Juxtaposing Delany's vision of "holographic information storage" with the "information metaphor" (Keller, *Refiguring Life* 18) in genomics reveals new dimensions of the temporal logic at work in the latter and reveals some of the social consequences enabled by this logic.

Delany's helical narrative, like Satterwhite's spiraling musical composition, might be seen as the aesthetic correlative of another helical structure, the double helix of DNA. As I have argued throughout this book, genomics possesses a distinctive time signature, a paradoxical embrace of both linearity and simultaneity. Delany's narrator is a con artist who changes his name as often as Melville's Confidence Man or HCE in Joyce's *Finnegan's Wake* (from whom Delany borrows the initials for each of his aliases). Heretofore, the narrator has survived by his wits on the margins of interplanetary society, but a Special Services' hologram has traced all his past deeds and identities, and at the same time, has discovered that he is about to graduate from petty larceny to burst on the scene as a major criminal. This forecast is as much a revelation to him as it is to the enforcement agencies that now must synchronize their movements to his calendar. Month by bejeweled month, Special Services and HCE (as I will call him) play cat and mouse, their movement through time coordinated by an information system that identifies from nearly infinite possibilities the one that will occur next.

The Special Services agent explains the unique qualities of "hologramic information" this way: "hologramic information storage simply means that each bit of information we have – about you, let us say – relates to your entire career, your overall situation, the complete set of tensions between you and your environment" (224). The parallel with the genetic information contained in each cell of the body is striking. Today, one can read out a person's entire genome from a tiny tissue sample, thereby gaining knowledge of a multitude of physical and behavioral traits.

With the exception of single-gene disorders such as Huntington's disease, however, genomic analysis deals with probabilities, not certainties, and so, it turns out, does Delany's vision of hologramic information. Despite the Special Service agent's claim to know everything about HCE's future actions, he always manages to stay one step ahead of the police. As with genomics, hologramic sequencing does not actually predict (still less, determine) one's life course. Rather, it generates a quantitative distribution of probabilities to forecast future outcomes. A character in the story cautions that people should not take such forecasting at face value. "You must remember ... that if everything, everything were known, statistical estimates would be unnecessary. The science of probability gives mathematical expression to our ignorance, not to our wisdom" (232).

The fantasy of an information system in which "each bit of information we have ... relates to your entire career, your overall situation, the complete set of tensions between you and your environment" (Delany 240) is the

dream behind genome time. It fosters the illusion that data encoded in your DNA relates to your entire life – not only where you came from but what you will become – and that it is knowable from a single test in the present. Instead of Delany's "hologramic information storage," think whole genome sequencing, and you have the idea. Linear as jewels on a string, yet endlessly spiraling, ever the same, genome time claims to consolidate in a moment of revelation all times and places, all nature and nurture, "the complete set of tensions between you and your environment" (Delany 240).

## Double Temporality: Nanoscience, Climate Science, and Queer Time

Genomics is not the only twenty-first century science that exhibits a double temporality, but the powerful symbolism of the double helix may make it the most memorable. Nanoscience is another field that has inspired models of time that combine eventfulness in the present with a synchronic perspective that encompasses past and future. Colin Milburn relates the temporal logic of nanotechnology to the Christian figural interpretation of history. Comparing the time of nanotech to Biblical typology, Milburn quotes Eric Auerbach's famous description of typology's dominant trope, *figura*: "The here and now is no longer a mere link in an earthly chain of events, it is simultaneously something which has always been, and which will be fulfilled in the future." (Milburn 207n38, quoting Auerbach, *Mimesis,* 74).[1] Milburn's insight may be derived from Donna Haraway's extended discussion of technoscience as "a millenarian discourse about beginnings and ends, first and last things, suffering and progress, figure and fulfillment" (Haraway, *Modest Witness* 10). Haraway begins with Auerbach's concept of *figura* as well, noting that "The discourses of genetics and information sciences are especially replete with instances of barely secularized Christian figural realism at work" (10).

The social scientist Cynthia Selin, however, argues that there is not "a temporal logic inherent in nanotechnology" but rather "a temporal dimension coded in the way that nanotechnology is framed and represented" (122). Selin believes that

> the dreamy aspect of nanotechnology . . . makes it an apt case for looking at the role of time and technology. Since the term was coined and the field first began to take shape, nanotechnology has been saturated in futuristic promises and threats. Both the uncertainty and expectancy of nanotechnology lend a certain degree of fantasy or science fiction to most characterizations. (123)

Her conclusion is that "time is embedded in the representations of the technology" (131). Whether one accepts Milburn's account of nanotechnology or prefers Selin's more cautious formulation, the distinction between a temporality inherent in genomics or one only contained within our representations is harder to maintain, even though representations of genomics have proliferated in realist fiction (Roxburgh and Clayton 22) and science fiction since the 1990s (Slonczewski and Levy; Yaszek and Ellis; Schmeink 9–10). The temporal logic of the genome is so deeply imbricated with the science itself that it is hard to distinguish what is inherent in the concept from what is metaphorical. Lily Kay makes this point on the opening page of her influential study, *Who Wrote the Book of Life?*: "the 'language of DNA' is not merely a popularization or rhetoric of persuasion, but rather a representation qua intervention with operational force" (1).[2]

A third scientific project that has led to profound re-theorizations of time is the effort to understand climate change. The historian Dipesh Chakrabarty writes, "The crisis of climate change calls for thinking simultaneously on [two] registers, to mix together the immiscible chronologies of capital and species history" (220). The chronology of capital, for Chakrabarty, is the linear history in which the world is immured, whereas "species history" is a time scale of such magnitude that it requires a different relation to time. A prominent scholar of climate fiction, Ursula Heise, also argues that climate change has engendered "a particular kind of temporality, a dual and seemingly contradictory emphasis on slowness and speed" ("Extinction" 55), with "slow" corresponding to the ungraspable durée of geological time and "speed" gesturing toward the historical onrush of impending climate disaster. The science of climate change is an outlier, however. It appears to have largely purged the millenarian impulse that still haunts other twenty-first century fields such as genomics and nanotechnology. The extinction of all life on earth that shadows climate change seems to have discouraged eschatology.

I will come back to this difference between the sciences of climate change and genomics, but first I want to range even further afield to consider a social and political model of time that is prominent in the humanities, "queer time." The comparison of queer time with Delany's narrative seems relevant, even urgent, because Delany's story emphasizes what the queer theorist José Muñoz has called "queer relationality" (6). Crucial developments in "Time Considered as a Helix of Semi-Precious Stones" depend on queer relations from the narrator's past, which remain unspecified in the present, yet shape future events decisively. Fleeing from

his first encounter with the Special Services, HCE runs across a friend he has not seen for several years, a boy named Hawk. This boy is one of the celebrated Singers of the City, a band of oral storytellers whose gift for singing stories of vital importance to their worlds make them revered throughout the planets. Their power comes from immediacy, an art that stands apart from the avalanche of media, advertisements, and fake news: "it was a spontaneous reaction to the mass media which blanket our lives" (Delany 235). What makes these Singers exceptional is that their songs may be heard only once. They are unique performances, and interplanetary law prohibits recording any of their spontaneous recitals.

The Singers have the kind of aura Walter Benjamin famously attributed to the work of art before the age of mechanical reproduction (Benjamin 217–53). Delany, however, emphasizes the figure of the Singer, not the song. Male or female, old or young, the Singers are auratic figures. Their aura comes from performances that listeners find too compelling to ignore. "What makes them Singers is their ability to make people listen," Delany writes (234). Once identified, a Singer becomes a node in a network of trusted meanings. "Hundreds of people stopped to listen; a hundred more; and another hundred. And they told hundreds more what they had heard" (234). The media theorist Alan Liu relates this capacity of oral storytellers to function as nodes in communities to contemporary information systems that work through "store-and-forward networking" (Liu 13). Delany has something similar in mind, unlikely as a return to oral storytelling might seem in the context of global information networks. Indeed, this idea may be the most improbable conceit in Delany's sweeping science fiction story. But the notion that an interplanetary civilization would grow so weary of untrustworthy media that it would put faith in Singers allows the story to connect Hawk's queer aura to a different order of time.

Liu's account of oral storytelling can help clarify the status of Delany's Singers in an information age. Liu writes: "The time of the voice was simply a different order of time. It was legendary time: *so was the world in the beginning; so it is for us now*" (15, italics in original). With the advent of writing, we lost the ability to understand how storytellers could function as nodes in a network, how their ephemeral performances could persist and spread. With writing, "permanence changed into a new kind of renewable permanence: reproducibility . . . or the reliable reappearance of the same text in multiple copies" (Liu 16). The very facility of this diffusion of information changed our relation to networks. The nodes in contemporary information systems became more functional – not people so much as industries, professions, and technologies – publishers, printers, distributors, book

sellers, news vendors, and ultimately, media channels.[3] Delany wagers that a postmodern, posthuman, post-everything society might just grow so suspicious of the cacophony of disembodied information channels that it would reembrace legendary time, reinvest faith in an embodied performance whose immediacy and power catalyzes oral storytelling as "store-and-forward networking."

This is an outlandish wager – more *outland*ish than interplanetary travel, far more outlandish than the notion of a "hologramic information system." After all, many people believe whole genome sequencing already constitutes such a total information system with all the temporal consequences that entails. But the improbability of a near-future society putting its faith in Singers should not obscure Delany's insight – that to know our past and future all at once, whether in a hologram or a genome, returns us to something like legendary time.

Delany's story underlines the queerness of this conception of time by queering it in explicitly sexual terms. Years ago, our narrator "did something for [his friend]" (240) that left scars on the Singer's body and a debt of love. Everything turns on how the Singer repays that debt – all the foreordained events in the story spiral out from that effaced "something" that happened years before. But the nature of their bond remains too queer to be easily expressed. Hawk's struggle to articulate his feelings is riddled with gaps: "Look . . . you touch a person softly, gently, and maybe you even do it with love. And, well, I guess a piece of information goes on up to the brain where something interprets it as pleasure. Maybe something up there in my head interprets the information in a way you would say is all wrong . . ." (240) [ellipses in original].

The ellipses in the story – both the absence of details about what happened between the two men and Hawk's struggle to find words to explain their bond – accords with the ideas of another queer theorist, Elizabeth Freeman, who notes that queer relationality "fold[s] subjects into structures of belonging and duration that may be invisible to the historicist eye" (xi). Such bonds, according to Freeman, evoke "an affective register irreducible to traditional historical inquiry, what has been forgotten, abandoned, discredited, or otherwise effaced" (3). Freeman's contrast between normative time and the "invisible," "abandoned, discredited, or otherwise effaced" moments of queer time helps us understand why Delany chose to represent the bond between HCE and Hawk through ellipsis.

Not surprisingly, Delany's writing is invoked by some of the most influential theorists of queer time. Both Muñoz and Jack Halberstam adduce Delany's works as important touchstones.[4] Halberstam's *In a*

*Queer Time and Place* (2005) offers one of the most influential definitions of queer time. For Halberstam and many theorists who followed, queer time refers to those "models of temporality that emerge within postmodernism once one leaves the temporal frames of bourgeois reproduction and family, longevity, risk/safety, and inheritance" (6). It offers alternatives to the "time of reproduction [that] is ruled by a biological clock for women and by strict bourgeois rules of respectability and scheduling for married couples" (5). Most queer theorists, including Halberstam, focus on Delany's theoretical writings and autobiography, not his science fiction. Delany's autobiographical *Times Square Red, Times Square Blue* (1999) is crucial for Halberstam in articulating "the relations between sexuality and time and space" (13). Delany's volume dramatizes how "queers use space and time in ways that challenge conventional logics of development, maturity, adulthood, and responsibility" (Halberstam 13). But these words could easily be applied to Delany's earlier story. The unconventional logic of Hawk's development, his boyish maturity, and the iconoclastic way he bears his adult responsibility as a Singer of the City all attest to Halberstam's insight.

With adolescent glee, Hawk revels in using "space and time in ways that challenge conventional logics." To help HCE unload some precious stolen goods, Hawk decides to take him, univited, to an elegant party held in the penthouse of one of the most exclusive buildings on the planet. Here is how Hawk enters the cordoned-off space of the ultra-rich and politically connected: barefoot with black grimy feet, "very dirty black denim jacket, no shirt beneath; very ripe pair of black jeans" (226). He attracts the frowns of guests from clear across the lobby: "A cluster of men and women in evening dress were coming out. Three tiers of doors away they saw us. You could see them frowning at the guttersnipe who'd somehow gotten into the lobby . . . [but] one of the men recognized him, said something to the others. When they passed us, they were smiling" (230). Their entrance to the party creates a similar stir. Hawk refuses to introduce his guest, leaving the host grasping at hints to discover if HCE is "a miscellaneous Nobel laureate . . . or a varlet whose manners and morals were even lower than mine happen to be" (231).

The story's style, in its postmodern dislocations, winking allusions to both high and low culture (Joyce, Henry James, *Just So Stories*), and poetically intensified descriptions violated the expectations of science fiction readers too, who at the time were more accustomed to formulaic plots and conventional character types. The literary critic Tyler Bradway has astutely analyzed Delany's commitment to "queer experimental

writing" as a vehicle for subversive politics (1–50). Here, Delany's experimental style not only violates the genre norms of science fiction but also brands the story as New Wave, a consciously iconoclastic movement of the 1960s that provoked outrage and prizes in equal number.

But the question remains. How do the queer dislocations of plot, character, time, and style in Delany's story relate to the helical time structure of contemporary genomics? My answer requires distinguishing between two broad currents in theories of queer temporality. The first includes the figures from whom I have been quoting, Halberstam, Muñoz, and Freeman. These theorists all speak of queer time in terms of potentiality and possibility, not foreclosed futures. Halberstam writes of the "potentiality of a life unscripted by the conventions of family, inheritance, and child rearing" (2). Muñoz values "queer relationality" because it serves as a form of "encrypted sociality" and promises a "utopian potentiality" (6). Freeman embraces "embarrassing utopias" and other fugitive "forms of being and belonging" (xiii). This emphasis on relationships, sociality, utopian possibilities, and belonging is an affirmative conception of queer time. It is an example of what Eve Sedgwick called the "reparative" impulse in critical thinking, a precedent all three theorists invoke. Like Sedgwick, they celebrate the healing, reparative nature of a queer time that insists on "potentiality or concrete possibility for another world" (Muñoz 1).

Muñoz contrasts his perspective with what he characterizes as "antisocial queer theories," theories he identifies with the work of Leo Bersani and Lee Edelman. Muñoz calls their ideas "antirelational," and he rejects the rhetoric of "no future" that Edelman develops in a book of that name, *No Future: Queer Theory and the Death Drive* (2004).[5] Writing in a polemical vein, Muñoz argues that "antirelational approaches to queer theory are romances of the negative, wishful thinking, and investments in deferring various dreams of difference" (11). Instead, he insists "on the essential need for an understanding of queerness as collectivity" (11). It is this vein of queer relationality, I maintain, that is cherished in Delany's story and modeled in his helical narrative.

The contrast between these two models of queer temporality can help us contextualize the difference mentioned previously between genome time and the temporality of much thinking about climate change. In the writing of Chakrabarty and others, the time of climate science chimes perfectly with Edelman's rhetoric of "no future." The "current crisis," Chakrabarty writes, "disconnects the future from the past by putting such a future beyond the grasp of historical sensibility" (197). Faced with the prospect of human extinction, the queer objection to conceptualizing our future

largely in terms of a reproductive logic makes a new type of sense. Edelman and Bersani developed their ideas in the shadow of the AIDS epidemic. Writing for and about a queer community under threat of extinction, they paired their rejection of reproductive futurity with a celebration of erotic self-shattering. They answered the prospect of "no future" by reveling in ecstatic moments that disconnect the present from any thought of futurity. Outside a queer context, in countless apocalyptic movies, we have seen a hackneyed version of this response – the scenes of rioting and sexual abandon that Hollywood seems to think would be the inevitable outcome of learning the world was coming to an end. But Edelman and Bersani reframe the erotics of "no future" in terms of its effect on the subject, a *self*-shattering, not an indiscriminate riot, that represents a viable mode of living in the absence of reproductive futurity.

Delany signals his affinity with a reparative vision of queer time by the story's invocation of an open future, full of possibility, and its explicit rejection of paranoia as an "occupational disease," a "dilly of a delusional system" (257–58).[6] Near the end of "Time Considered as a Helix of Semi-Precious Stones," HCE shares a moment with a major rival, someone he anticipates having to fight against for survival in the high-status criminal circles he now occupies. The two rivals muse over their interlaced futures, speaking philosophically of their inevitable conflict. The conclusion of their conversation is not angry or fearful, but hopeful: "'If you can fight me off long enough . . . we'll get to the point where it'll be worth both our whiles to work together again. If you can just hold out, we'll be friends again. Someday. You just watch. Just wait'" (257). The ending, like the story as a whole, describes queer ways of inhabiting time in spite of probabilities that would seem to foreclose possibilities. "We'll be friends again. Someday."

## Double Temporality in Other Contemporary Fiction

Other novelists have aligned genome time with queer relationality. In an earlier chapter, I explored David Mitchell's image of time in *Cloud Atlas* as nested Matryoshka dolls, each present moment "encased inside a nest of . . . previous presents" (393). But Matryoshka dolls are only one of Mitchell's many images for genome time. Others spill out in a love letter that a young composer, preparing for suicide, writes to another man. The composer has just finished his masterpiece, "Cloud Atlas Sextet," a work for six musicians that spirals circularly around six repeated motifs. Like Satterwhite's composition, "Cloud Atlas Sextet" aspires to capture both

linear and cyclical conceptions of time. As experienced by the characters, the events of their lives are unique, charting a linear course through history, but history itself, Mitchell proposes, operates according to a principle of "Eternal Return" played on "Nietzsche's gramophone." "Rome'll decline and fall again, Cortés'll lay Tenochtitlán to waste again, and later . . . you and I'll sleep under Corsican stars again, I'll come to Bruges again, fall in and out of love with Eva again, you'll read this letter again, the sun'll grow cold again" (471). The sextet, with its melancholy echoes of other artists but also its startling originality, mirrors the structure of the novel in which it appears, and it links *Cloud Atlas* to a beautifully reparative vision of queer time.

The queerness of genome time is not always aligned with queer sexuality, however. In fact, there are some accounts of genome time that are heteronormative in orientation, such as Ian McEwan's *Saturday* (2005) with its tender evocation of married, heterosexual lovemaking. But sexuality – whether normative or non-normative – is not essential to the representation of genome time as paradoxical. Novels do not have to talk about sexuality at all to provide powerful musings on the queerness of genome time.[7] Hence, there are novels that multiply other analogies for its dual temporality. One of the earliest novels about genomics, Richard Powers's magisterial *The Gold Bug Variations* (1991), found musical, seasonal, and spatial analogues for genome time's paradoxical structure: the fourfold patterns in Bach's *Goldberg Variations*, the four seasons of the year, the four-letter code of DNA, and the four-part poem, composed in quatrains, which serves as the novel's epigraph. The most memorable analogy for genome time in Powers' work is that of the fractal. In fractals, self-organizing forms reveal similar patterns of organization at every level of scale. Snowflakes are the classic example – each crystalline shape replicates the same pattern at every power of magnification. Powers's articulation of this principle comes late in his novel:

> The double helix is a fractal curve . . . . [E]very part – regardless of the magnification, however large the assembled spin-off or small the enzymatic trigger – carries in it some terraced, infinitely dense ecosystem, an inherited hint of the whole. . . . The code is universal. Here, this city, me, the forest of infection on my hands, the sea of silver cells scraped from the inside of my mouth. Every word I have, . . . every predication, every sculpted metaphor. (627)

"An inherited hint of the whole" – the phrase connects the scalar thinking of fractals to the concept of genome time. Inheritance is set free from exclusively linear conceptions of historical time. Now an alternative

presents itself: recurrence can be thought of intrinsic to life cycles not just different members of a series. Delany's "holographic information storage" worked this way too. An operative of the Special Services explained: "even if you have a square centimeter of the original hologram, you will have the whole image – unrecognizable but complete" (115). This enables the Special Services Department to translate a tiny data point from an individual – a sample as small as a cheek swab – into a model of the whole. And not just the whole in the present moment but its past and future as well. Forensic geneticists possess this capability already. They can use it to reconstruct the likely appearance of an extinct species from fragments of ancient DNA or to build models of the (probable) appearance of suspects or missing children from decades old genetic material (Aldhous; Evans, Skrzynia, and Burke).

We find this scalar thinking elsewhere in contemporary responses to genomics. As we saw in Chapter 1, McEwan's narrator analogizes the scalability of genomic information to the city of London. The city is "a biological masterpiece – millions teeming around the accumulated and layered achievements of the centuries, as though around a coral reef" (McEwan 3). The analogy spirals out from the protagonist's city square to encompass the largest historical event of the day, the impending invasion of Iraq. The leap from DNA to cell to organism, and from there, to consciousness, literature, London, the war with Iraq, and beyond is breathtaking. Yet this scalar movement recurs frequently when one turns to twenty-first century novelists who care about science.

The common thread that unites these images and distinguishes them from nineteenth-century attempts to come to terms with deep time is the concept of scalability. Chakrabarty sees the two perspectives on time of climate change as "immiscible," but genomics, like the queer temporality of Delany's story, sees the two ways of perceiving time as a matter of scale. Up close, one sees only contingency, but zoom out to a level where one can see the entire hologram or whole genome, and the pattern becomes clear. Providing a DNA sample or outwitting an agent of the Special Services are punctual moments in a linear sequence, but each moment yields data that, seen in its entirety, becomes a microcosm of the whole.

Mark McGurl shares my sense that scalability is one of the keys to recent literature's interest in science.[8] Writing about "the turn toward science" in literary studies, he comments: "The appeal of fractal geometry ... would appear to be what Albert-László Barabási called its 'scale-free' nature – the same lovely (and appealingly organic-looking) patterns repeating themselves at all levels of observation" (535–36). Later

in the same article, McGurl expands this generalization to apply not just to current trends in the humanities but to "all literature," which tends "to facilitate this recursive sequence of scaling up and scaling down" (541). That is what we see in Delany's hologram, McEwan's London, Mitchell's love letter, and Powers's fractal curve – genomic fictions that trace the dynamics of genome time at every level of magnification.

## The Temporality of Ancestry Tests

Lest this discussion leave readers with the impression that the temporality of genomics is only a theoretical question of little practical importance to our lives, I want to conclude with an example of its impact on public policy, for the temporal assumptions embedded in genomics have consequences of importance to society. Haraway attributes problems like "genetic fetishism" and genetic determinism, in part, to taking the temporality of genetics too literally: "The fetishist ends up believing in the code of codes, the book of life, and even the search for the grail" (*Modest_Witness* 146). The prominence of Christian imagery and figural structures by commentators on genomics reflects the continuing force of religious paradigms even in secular, scientific contexts. The fictions we have examined in this chapter dismantle these religious paradigms, acknowledging the power of genome time but reframing that power in demystified terms.

Literature, music, and the arts were among the first to perceive the social implications of the temporality of genomics, insistently reflecting on the paradoxes at the heart of our identities as biological beings. Mortality and continuity, the individual and the species – art personalizes these dual temporal frames, giving us intimate glimpses of how we live on both planes at once. Art speaks to our most profound intuitions of why our lives matter, transient though they may be in the shadow of infinitely longer cycles of flourishing and extinction.

Throughout the last two centuries of western civilization, art has had only one real competitor for addressing these mysteries, and that is religion. That competition represents one of the reasons for the emergence of art, in an age of growing skepticism in the nineteenth century, as a substitute for religion – a displacement we saw in the work of Matthew Arnold and many others. But today, a strange reversal has occurred. Politicians and policy makers who address fundamental questions about life and death do so almost exclusively in religious terms.

One immensely consequential example of the reach of religion in setting genetic policy comes from George W. Bush's President's Council on Bioethics (now replaced by the President's Commission for the Study of Bioethical Issues). The numerous and vocal religious conservatives on the panel successfully framed the debate on stem cell research in moral terms drawn from the Judeo-Christian tradition. The only counterarguments that garnered much attention were those made by devoted secularists – most notably, Steven Pinker and Richard Dawkins – who were not on the Council.[9] Secularist arguments such as theirs, which foregrounded their commitment to atheism, have rarely gained much traction in US public policy. Purely materialist arguments seem to have been too stark to persuade those who create the policies that regulate crucial scientific endeavors. The secular resources of art and culture – great wellsprings of symbols and meanings, which provide a different mode of access to what often seem imponderable mysteries – have scarcely been tapped by bioethicists who oppose religious restrictions on science. We should remember the example of Thomas H. Huxley, who in an age of fierce debate between religion and science, did not rely on brute materialism to convince a public worried about the implications of evolution but instead drew upon a panoply of cultural resources – Greek myth, Eastern religions, ancient philosophy, art, and poetry.

Today, policy analysts or policy makers rarely invoke the resources of literature and the arts when they struggle to address moral and religious arguments against genetics. When issues are framed in moral terms, as they often have been in this arena, the neglect of literature and the arts has impoverished the debate, reducing the public responses to a stark choice between secular science and religious dogma – with the latter increasingly carrying the day. By contrast with fundamentalist movements, literature and the arts are more likely to prize human aspirations than to proscribe behaviors. This difference is on display in a reparative work like Delany's "Time Considered as a Helix of Semi-Precious Stones" – or, indeed, in the other affirmative visions we have glanced at in this chapter, *Saturday, Cloud Atlas,* and *The Gold Bug Variations*. Imagine how Delany's vision of queer relationality, for example, speaks of the deep rhythms of time to an audience unwilling to endorse more restrictive understandings of human relationships. It could – and should – speak to policy makers too.

With much religious thought about genomics preoccupied by opposition to specific forms of genetic research, the absence of cogent guidance in this sphere has had unfortunate social consequences. One striking example of these consequences is the unthinking use of direct-to-consumer genetic

testing (DTC-GT) services, which I mentioned in the introduction to Part IV of this book. At first, it may seem unclear what genome time has to do with the trend toward sending your DNA off to companies which, for a price, claim to be able to disclose all the mysteries of your ancestry, your race, and your geographical origins, as well as your future risk of developing a growing number of health conditions. But companies like 23andMe and Ancestry.com rely on genome time for their very existence. They have built their business models on the promise of genomics to reveal the mysteries of a customer's past and future, ready to hand via a simple spit test. If these companies needed marketing help, they could sell their wares as real-life time travel. Some perhaps would were it not for another sleight of hand that hides the temporal nature of their product – the spatial and alpha-numerical nature of genomic data, a visual display that condenses diachronic movement down to the synchrony of the code. DTC-GT companies hardly need further marketing assistance. According to the *MIT Technology Review*, by the end of 2019, more than 26 million people had paid to have their DNA sequenced by a commercial entity (Regaldo).

The innocent act of using a DTC-GT company to sequence your genetic information can have far-reaching social consequences. Sometimes these consequences can be gratifying – uniting adopted children with their biological parents, finding unknown relatives, revealing treasured details about one's cultural heritage. Alondra Nelson highlights African Americans who "use genetic ancestry testing with the hopes of shedding light" on ancestral ties that were obliterated by "the Middle Passage and racial slavery" (5). For this group, genetic analysis has the potential to "contribute to community cohesion, collective memory, or social transformation" (8). For others, particularly those in LGBTQIA+ relationships, locating genetic strangers can aid in establishing alternative kinship networks more accommodating of difference, the process Donna Haraway calls "making kin" (*Staying* 99–103; see also Casey and Clayton). But often the social consequences can be destructive. As a growing number of people are discovering, genetic information has the potential to reveal private details not only about the customer who submitted a DNA sample but that of family members, more distant relatives, and even total strangers. A disturbing but little-known consequence of seeking information about one's ancestry is that this act may disclose to an ever-widening circle of people private details that one might never have imagined making public – children born out of wedlock, the infidelity of partners, a criminal past, unwanted kin, and more. The fact is that revealing data about one person's genome unavoidably reveals information about the DNA of their

parents and children, their cousins, and their cousins' cousins, extending outward to hundreds of people, many of whom might be total strangers. A single disturbing revelation can have rippling consequences for others who never agreed to have their DNA sequenced or dreamed that someone else's decision might have an impact on their lives. And these are merely the personal risks that one runs by taking a simple genetic test. Most people have by now heard of the risks of surveillance by government agencies, ranging from law enforcement to immigration control, that come with depositories of genetic data, whether collected by the government or uploaded by well-meaning relatives to open-access databases.[10] In 2018, it was estimated that 60 percent of white Americans could be identified by existing ancestry databases and that within three years, that number will have risen to 90 percent (H. Murphy).

Public trust in the revelations of genomics is truly astounding. Travel to the past via genetic ancestry research carries enormous credibility for many people and institutions. Newspapers have reported cases of adoptees and donor-conceived children jettisoning life-long relationships in favor of their newly revealed biological "family." In their book *Random Families*: *Genetic Strangers*, *Sperm Donor Siblings, and the Creation of New Kin* (2018), Rosanna Hertz and Margaret K. Nelson document numerous examples of "genetic strangers" bonding on the basis of nothing more than data about their biological kinship, sometimes at the expense of the families that have raised them. The nation's courts have also been open to the revelations of genetic sequencing. Despite some studies that show that DNA evidence is not always reliable, courts often accept its testimony about the past – sometime to exonerate, more often to condemn (Hoeffel).

Travel to the future is equally widespread. Consider the faith that consumers place in genetic tests to reveal their risk of acquiring future medical conditions. Since 2017, 23andMe has received FDA approval to market genetic health risk reports for an ever-growing list of conditions: late-onset Alzheimer's disease, Parkinson's disease, hereditary thrombophilia, and several types of cancer, including those associated with the BRCA1 and BRCA2 genes ("FDA allows marketing"). Despite the high percentage of false positives in direct-to-consumer genetic tests (Tandy-Connor et al.), the varying results from one company to another (Huml et al.), and the protests of clinicians who are confronted with data about genetic probabilities that they are unprepared to interpret (E. Clayton, "Be Ready"), consumers still flock to DTC-GT companies for what they regard as information about their future. Our nation's courts, too, have flirted from time to time with considering genetic evidence concerning a suspect's

propensity to commit future crimes, a topic that I discuss in detail in the next chapter (Greely and Farahany). The prophetic power of DNA continues to be trumpeted as if genome sequencing were one of the golden horns of Revelations blowing on judgment day.

We should not blame a gullible public for believing in the power of genomics to reveal our past and future. Such assumptions are deeply embedded in the temporality of genomics itself. Some of the most astute critical minds to take up problems such as genetic essentialism and genetic determinism – Richard Lewontin, Evelyn Fox Keller, and Lily Kay, among others – have made little headway against these assumptions. Perhaps the resources of secular scientific reason are not sufficient to overcome such wellsprings of belief. Speaking logically against temporal belief structures that have persisted through millennia of myths, ritual practices, and religious traditions may not suffice. Literature and the arts take up the burden of these belief structures, usually in secular terms, but they do not dismiss the enormous power of such temporal structures to give meaning to lives. Knowledge of the presence of our past and the promise of a future – whether for ourselves, our descendants, or even our species – has been an inexhaustible resource for as long as there has been literature.

CHAPTER 8

# *Biodystopia*
## *(Gary Shteyngart, Philip Kerr, Margaret Atwood)*

The opening line of Gary Shteyngart's 2010 novel *Super Sad True Love Story* satirizes one of the central concerns of a genre we might name *biodystopia*: longevity research. "Today I've made a major decision: *I am never going to die*" (Shteyngart 3, italics in original). With this bravado gesture, Lenny Abramov commits himself to a lifetime of expensive "dechronification treatments" (181) provided by the company for which he works, Post-Human Services. He will re-grow his liver, replace his circulatory system with smart blood full of nanobots, halt the loss of telomeres in his DNA, and stick with a low-cholesterol diet and massive supplement regimen for the rest of life, which he rashly expects to be eternal. Composed in alternating chapters of Lenny's self-pitying diary and his girlfriend's obscene text messages, the novel brilliantly satirizes the top agenda of the transhumanist movement – live forever through biotechnology and a heart-healthy lifestyle.

Shteyngart's novel is a recent entry in a long line of biodystopias, descended as we saw in Chapter 5, from a group of British writers who surrounded J. B. S. Haldane, Julian Huxley, and most notably, Julian's brother, Aldous Huxley. The legacy of Huxley's *Brave New World* (1932) has been taken up in the last few decades by a powerful group of biodystopias, beginning with the influential film *Blade Runner* (1982) with its genetically engineered replicants stalking a dystopian Los Angeles. Another milestone of the genre is the 1997 film, *Gattaca*. I have written about both of these films elsewhere, but it is worth noting the impact of their visions on the biodystopias that followed. In both cases, dystopian societies are seen as stemming directly from inappropriate uses of genetic technologies. The echoes of Nazi Germany in *Gattaca*'s genetic discrimination, eugenic policies, identity cards, secret police, Fascist architecture, and WW II-era fashions powerfully associate genetic engineering with the atrocities of National Socialism.

Biodystopian novels similarly construct nightmare societies shaped by the consequences of unethical uses of genetics. A list of just the most memorable of these books is impressive: *Brave New World* (1932), of course, Philip Kerr's *A Philosophical Investigation* (1992), P. D. James's *Children of Men* (1992), Walter Mosley's *Futureland* (2001), Margaret Atwood's *MaddAddam* trilogy (2003, 2009, and 2013), the near future chapters of David Mitchell's *Cloud Atlas* (2004), Kazuo Ishiguro's *Never Let Me Go* (2005), Paolo Bacigalupi's *The Windup Girl* (2009), Shteyngart's *Super Sad True Love Story* (2010), Naomi Alderman's *The Power* (2017), Louise Erdrich's *Future Home of the Living God* (2017), and Nana Kwame Adjei-Brenyah's *Friday Black* (2018).

The conventions of biodystopia differ little from the dystopian novel generally. An isolated hero struggles against an oppressive social order whose restrictions reach into all corners of life. The "bio" prefix simply marks the internalization of dystopia in every cell of the subject's body. It registers the penetration of what Foucault termed "biopower" throughout every institution of the state and civil society, every familial and personal relationship, every aspect of work and play. The setting is the near future with recognizable roots in present-day social problems, and the forces arrayed against the protagonist are overwhelming. The plot generally ends in defeat or death except in the recent craze for Young Adult versions, where the youthful protagonist prevails at the end of a best-selling trilogy.

Unlike classic dystopias, however, the most daunting opposition comes not from the state but from within the protagonist. Shteyngart's Lenny Abramov, for example, has so internalized society's technoconsumer longings that he courts his own oppression. The incentive structures for obtaining genetic enhancements from Post-Human Services, nicely captured by a public ladder board of employee health rankings, shackle Lenny to the corporate goals of his employer, a supposed friend who turns out to be his nemesis. Lenny's convoluted desire for the very commodities that nearly destroy him results in a manic satire, more akin to Black Comedies like *Catch-22* (1961) than the somber vision of a work like *Nineteen Eighty-Four*. As literature, Shteyngart's novel is a hilarious achievement, but it also serves as a thought experiment, extrapolating a dire scenario from looming bioethical questions. The near future it imagines stands as a powerful indictment of the present.

Biodytopia should be distinguished from a closely aligned genre, which is also enjoying a vogue (Alter) and often features genetic disasters: postapocalyptic fiction. The boundaries are sometimes hard to distinguish, but postapocalyptic novels take place *after* society has been destroyed by

genetic plague, nuclear holocaust, climate change, alien invasion, terminators, or zombie attack. David Mitchell highlights the distinction by bracketing the postapocalyptic far future in the central section of *Cloud Atlas* with two chapters set in a near future biodystopian society. In Chapter 4, I characterized the postapocalyptic heart of Mitchell's novel in which the planet has been ravaged by nuclear disaster, and the last remnants of humanity, except for a handful of Prescients, have regressed to primitive tribal existence. The near future chapters, by contrast, depict a thriving but horrific society exploiting a slave labor force of clones whose organs are harvested as needed by citizens, and at the end of their useful lifespan, are decapitated and recycled like Soylent Green as food for the still-living clones.

The most significant differences between dystopia, biodystopia, and postapocalyptic fiction are the protagonists' relation to society. In dystopia, the protagonist is defined by resistance to the social order and is often overwhelmed by the crushing isolation of this predicament. To find a kindred spirit is an ever-present temptation, one that may guide the plot and endanger the protagonist – think of *Nineteen Eighty-Four*, *Fahrenheit 451,* or *The Handmaid's Tale*. In biodystopia, by contrast, the protagonist may have little awareness of oppression. Shteyngart's hapless Lenny Abramov fills his days with frenzied sexual pursuit of a teenage girl, decades younger, which partially motivates his hunger to turn back the biological clock. Until almost the end, Lenny has little thought of resistance, and only when his world is collapsing around him does he begin to free himself from his former desires, including the desire to live forever.

Postapocalyptic fiction, however, differs in significant ways from both dystopia and more recent biodystopia. In postapocalyptic works, reconstituting a social order is almost always a central motivating force. If the protagonist is isolated at the outset of the narrative, this solitude is often only a preliminary condition. The goal of building a new community is paramount, frequently literalized by creating a physical sanctuary, as in John Wyndham's *The Day of the Triffids* (1951) or David Brin's *The Postman* (1985). Postapocalyptic novels are more often about recovery than despair.[1] Hence, their plot structure owes less to naturalism with its deterministic narrative arc than most dystopian tales.[2] Oddly enough, postapocalyptic fiction is generally more optimistic than dystopia. Readers gasp at catastrophe and are comforted by hope at the end.

Having said this much, let me add a caveat: genres can shift their boundaries like a river carving a course through alluvial plains. Great literature often views conventions as limits to be transcended, and

genre-mixing is a powerful source of literary innovation. Thus, it would be wrongheaded to view genre categories as pigeonholes or straightjackets. Instead, I think of them as heuristic constructs, useful for posing the kind of questions I want answered. Sometimes it makes no difference at all whether one thinks of a novel as dystopian or postapocalyptic – or science fiction or utopian, for that matter. But if one is interested in literature and public policy, genre categories make a great deal of difference, for the implicit message sent by a novel's conventions has as much impact on society as its explicit themes.

*Super Sad True Love Story* communicates its irreverence toward genre in its very title. The mocking tone of "true love story" takes an ironic stance toward genre conventions while the novel itself dazzles with its command of multiple genres: biodystopia, satire, diary, and emails, a twenty-first century mode of epistolary fiction. In what follows, I turn to two further biodystopias that mix and match genres with élan. One has not received the attention it deserves, Philip Kerr's *A Philosophical Investigation*; the other, Margaret Atwood's *MaddAddam* trilogy, has been hugely influential. But both turn to recent discoveries in genomics to create chilling biodystopias.

## Philip Kerr, *A Philosophical Investigation*

Philip Kerr's *A Philosophical Investigation* (1992) mixes detective fiction with biodystopia in a near future London that has been shaped by the misuse of pervasive genetic screening. Citizens have their genome embossed as a bar code on their driver's license. Elaborate databases are compiled on every man, woman, and child, including medical information, criminal record, employment history, credit rating, address, phone number, photograph, and other personal data in a central repository accessible to authorized users throughout the European Community.[3] Hence, "for the first time ever," a police memo triumphantly reports, "the machinery was now in place which enabled Government to track the individual before he offended at all" (44). Years before Tom Cruise starred in *Minority Report* (2002), Kerr imagined the consequences of believing that biological markers could identify violent criminals before they committed a crime.

In *A Philosophical Investigation*, the British government has legislated strict safeguards for the protection of privacy and has made their genetic screening program entirely voluntary. The protections in place in this imaginary future are far more rigorous than those in the Genetic

Information Nondiscrimination Act (GINA), which the United States Congress finally passed in 2008 after nearly a decade of debate. But these safeguards turn out to be largely ineffective. Hacking into the most secure databases is a common occurrence in the novel because the huge number of access terminals required by such a national, all-purpose databank makes carelessness, human error, blackmail, bribery, and deceit almost inevitable. This vulnerability is one that biobanks today have to confront, but the problem is made worse in our world by the rise of commercial repositories outside of heavily regulated government, hospital, and university settings. Today, biobanks are being set up by pharmaceutical corporations, patient groups, and others. Even in medical centers, the ubiquitous availability of computer terminals with access to patient records makes private medical information vulnerable to hacking.[4] Security experts are aware of the challenge to protecting the privacy of medical data and are working hard to design greater safeguards, but the expectation that disclosure of these data can be completely prevented is increasingly understood to be unrealistic (Yan et al.).

In the novel, a serial killer gains access to information about his future victims by logging onto a hospital computer. More disturbing, the police and members of the medical profession in the novel are repeatedly shown violating their own regulations. In the course of an investigation, Jake, the female chief inspector who is the protagonist of the novel, feels no qualms about having software developed that would circumvent the privacy rules governing an ultra-secret database, which even she is forbidden to access. When she seeks permission from her superior to undertake this illegal search, her boss interrupts her by saying "Spare me the technical explanations" (109), a comment that reflects the way in which our reluctance to learn about the inner workings of technology makes us vulnerable to its abuse.

The most interesting feature of Kerr's novel is its conception of an international project called the Lombroso Program. This initiative is named after Cesare Lombroso, the nineteenth-century criminologist and social Darwinist, who believed that it was possible to detect criminality on the basis of physical characteristics and who theorized that the so-called criminal personality was an atavistic throwback to primitive racial types. The program's name underlines the danger of reviving nineteenth-century scientific racism for the genome age. The Lombroso Program involves screening males for a biological condition that increases a tendency toward aggression. The novel imagines that by 2010, the neurological determinants of violence will have been isolated in the brain. The ventro medial

nucleus (VMN) has been found to inhibit aggressiveness in males, but a tiny percentage of men (0.003) turn out to lack this center. Men without this center are labeled by the novel VMN negative.

The possible role of the VMN in aggression has a scientific basis. According to the *Dictionary of Psychology*, there is a possible relationship between lesions in the VMN and "aggression or rage," resulting in a condition called "ventromedial hypothalamic syndrome" (Colman). The existence of a syndrome, however, does not imply a causal relationship – it merely indicates that there is a *correlation* between VMN lesions and increased aggressive tendencies. In the years leading up to the publication of *A Philosophical Investigation*, research on the genetic factors involved in this syndrome culminated in plans for a conference on Genetic Factors in Crime at the University of Maryland. When word of this conference got out to the news media, the idea that scientists were investigating a genetic predisposition to criminal behavior provoked widespread criticism, and the National Institutes of Health (NIH) ultimately withdrew funding for the meeting (Goleman). Although organizers later explained that the conference would have included discussion of the bioethical issues raised by the topic, some critics accused Health and Human Services of trying to launch a "violence initiative," which would include testing of inner-city school children – most of them African Americans – for genetic markers associated with a higher propensity for violence (Stone 212–13). A study led by Avshalom Caspi at King's College, London in 2002 took another step toward uncovering a gene associated with aggression. Caspi and his colleagues identified a particular version of a gene linked to low levels of the enzyme MAOA. They found that boys with a deficiency of this enzyme were more likely to respond to childhood abuse with antisocial behavior than those with a high level.

The paper by Caspi and his colleagues was heralded by the media as a discovery of the "gene for violence." Caspi immediately responded that there was no such thing as a gene for violence and that speaking of genes "for" any behavioral condition betrayed a profound misunderstanding of the nature of scientific correlation, which only suggests an association between a gene and a given trait, not a causal relationship. In this effort, Caspi joined a long line of scientists and bioethicists who have tried to drive home a similar message. Richard Lewontin is perhaps the most prominent geneticist to protest against the mistaken notion that genes "cause" anything ("In the Beginning" 1264). Horace Judson, author of a valuable history of genetics, has put the point forcefully: "The phrases current in genetics that most plainly do violence to understanding begin 'the gene for': the gene for breast cancer, . . . the gene for schizophrenia,

the gene for homosexuality, and so on" (769). Robert Plomin, one of the most eminent figures in the field of behavioral genomics, has stressed for a number of years that no interesting behavioral condition can be explained by pointing to a single gene – that all complex behaviors in humans depend upon the interplay of environmental factors and multiple genes. Drawing on his studies of identical twins, Plomin and his coresearchers have discredited the notion that one can locate a "gene for" such traits as "aggression, intelligence, criminality, homosexuality, [or] feminine intuition" (McGuffin, Riley, and Plomin, 1232). But the belief that personality traits are caused by individual genes continues to be spread by sensational newspaper accounts of recent genetic discoveries as well as by some geneticists themselves.

A dramatic example of geneticists proclaiming the existence of genes for behavioral conditions accompanied the landmark issues of *Nature* and *Science* that published the draft sequence of the human genome back in 2001. David Baltimore, then president of Cal Tech and a Nobel Prize winner in the field of genomics, was perhaps the most unrestrained in his visionary prognostications. Writing in *Nature*, he promised, with scarcely any qualification, that the "analysis of [the genome] will provide us with the power to uncover the genetic basis of our individual capabilities such as mathematical ability, memory, physical coordination, and even, perhaps, creativity" (816). Svante Pääbo, writing in *Science* that same week, suggested that racism would disappear when society came to understand that humans shared 99.9 percent of their genome with one another. Pääbo emphasized that individuals from the same region, who share superficial traits such as skin coloring, hair type, and facial features, may be less closely related to one another genetically than they are to people from distant regions who look very different. Thus, Pääbo wrote, "genome-wide studies of genetic variation among human populations may not be so easy to abuse – in terms of using data as 'scientific support' for racism or other forms of bigotry – as is currently feared" (1220).

Although such sweeping claims are less common now among scientists, even the most responsible voices in the scientific community occasionally fall into their own hopeful speculations. Plomin and his colleagues predicted that "advances in genetics" will reduce the stigma associated with mental disorders because "identifying genes involved" with mental illnesses "will do much to improve public perception and tolerance" of these disorders. Thus, he thinks that "some of the ethical specters raised by the advent of behavioral genomics probably have little substance" (McGuffin, Riley, and Plomin 1249).

Kerr's novel imagines a very different outcome from future advances in identifying mental predispositions toward undesirable traits. But why should we care about what a novel suggests might happen? Because the optimistic prophecies of Baltimore, Pääbo, and Plomin are no less imaginative acts than Kerr's fiction. Despite appearing in scientific journals, the predictions of these geneticists are not based on evidence. Researchers have conducted studies of how public attitudes are affected by genetic information, but the editorializing of these genomic scientists does not refer to this research – and it could not, because the results of empirical studies actually give reasons for concern, not optimism. In truth, the prophecies in *Nature* and *Science* that accompanied the draft sequence of the human genome cannot lay any more claim to authority than fiction. And, in a novel, readers can at least assess the caliber of the author's worldview, judge the logic of extrapolation, and weigh the motivations that drive behavior. The scientists' predictions are efforts at world building, attempts to envision a future that we might soon inhabit, and as such, less substantial than the worlds imagined by accomplished novelists. As world building, the real aim of such pronouncements is to bring about the state of affairs they confidently predict. This aim is noble, although it sometimes is little more than wishful thinking. Hence, it is important to understand when the impulse toward world building is shaping one's ideas. Sketching a desired future as though it were implicit in one's experimental results may hide potential dangers from view.

If scientists find it hard to resist speculating beyond what their results show, how much harder is it for the media? Despite all the denials that Caspi's research did not reveal the existence of a gene for violence, none of that prevented the press from spreading the word. And such misunderstandings have real-world consequences for race relations and criminal justice. My colleagues at Vanderbilt University have documented that research on the MAOA gene's link to aggression has already moved from the news media to the courtroom, where defense lawyers have invoked this research in criminal cases (Bernet et al.). Apparently, no matter how many times one repeats that there is no gene for violence, people will believe there is. Hence, the warning in Kerr's novel about the possible consequences of a society that thinks it has uncovered the biological bases of violence becomes relevant, as pertinent for our moment as *Brave New World* was for the 1930s.

In Kerr's novel, a government-sponsored screening program has been initiated to identify members of the population who are VMN negative. Everything has been done to protect the civil liberties of the subjects of this

screening program. Socially conscious scientists and bioethicists could not ask for more scrupulous policies governing the use of the information than those in the novel. The test is (supposedly) voluntary, and the subjects are guaranteed anonymity. Those who test positive are offered the option of psychological counseling and drug therapy but are not compelled to take either, and the counselors are governed by principles of medical confidentiality. Further, the results of the test cannot be used as evidence in a criminal case. Police will be notified if a suspect in an investigation is VMN negative, but the test itself is not admissible in court. Most important, the medical authorities repeatedly counsel the public that the condition establishes only an increased risk of violence; it does not determine or cause anyone to commit a crime**.** That is, they assert exactly what Robert Plomin and Avshalom Caspi's research shows to be the case with all complex behaviors, which is that multiple gene systems, interacting with environmental factors, result in a quantitative distribution of probabilities for a given trait. There is no "gene for" violent crime, not in Plomin or Caspi's research, nor in the imagined world of *A Philosophical Investigation*.

Despite all these safeguards, the Lombroso Program proves to be an ethical disaster. The notion that the test is voluntary quickly becomes a sham, because a daunting array of social and economic pressures are brought to bear, making it difficult for citizens to exercise their right not to be tested. The novel's depiction of these pressures amounts to an incisive critique of similar forces today, which could transform voluntary screening programs into mandatory gateways. In the early years of the Lombroso Program, advertising campaigns and cash incentives combined to make taking the test seem attractive. "It wasn't long," the novel observes, "before employers in the public sector began to insist on tests for all their employees. And these were swiftly followed by health and insurance companies" (46). The inability to find employment or obtain health insurance without these "voluntary" tests would make life very difficult.

Ethical, legal, and social problems proliferate in *A Philosophical Investigation*. For example, there is the disturbing way in which the society uses statistical profiling. On the trail of a suspect, the chief inspector is free to use a technique called "systematic composite profiling" to identify "the type of man responsible, as distinct from the individual" (111). Although the courts in the novel have ruled that "genetic population tests are inadmissible as evidence on the ground of their obvious racism" (193), they have allowed composite profiling as part of police investigations. Hence, the detective is permitted to search the central database using

filters for the probable race, sex, age, and religion of a "typical" serial killer to narrow the range of suspects. Statistical profiling using categories that US courts have designated as "protected classes" raises a strong suspicion of structural bias. There have been disturbing reports of a widely used algorithm that mistakenly flags African American criminal defendants as twice as likely to commit future crimes as white defendants (Crawford).

The most distressing effect of the "geneticization" of this future society is the rampant stigmatizing of people with a genetic predisposition toward any conditions that have become socially undesirable. Men identified by the Lombroso Program rightly fear that they will suffer discrimination of the sort that initially affected people who were found to be HIV positive. In the novel, one character opines that "at some stage we're going to round them all up and put them in a special prison hospital" (109); another worries about "some sort of deportation order – maybe even to quarantine people like me" (239). The serial killer, who has himself been identified as VMN negative, argues that the underlying logic of the screening program is itself eugenic. Why else identify this dangerous population if the ultimate goal is not to eliminate the group? He defends his killing spree, which targets other VMN-negative subjects, as merely fulfilling the eugenic implications of the state's own screening policy.

Plomin's wishful belief that advances in genetics will improve public tolerance of individuals with behavior disorders contrasts vividly with Kerr's biodystopian fear that exactly the reverse will occur. In Kerr's novel, the world has become so accustomed to the statistical generalizations of genetic research about populations that characters feel free to engage in wholesale racial, ethnic, and sexual stereotyping. The novel is full of racial epithets, sexism, and homophobia, which sometimes make for uncomfortable reading.[5] Although it is a mistake to equate quantitative distributions of traits across populations with racial categories, that is exactly what the public does – in the novel and in our world today. Population geneticists insist that populations that share traits are not the same as races, but doctors continue to use race as a proxy for determining at-risk patients. The point Kerr seems to be trying to make by depicting a hyper-racialized culture is that "geneticization" may actually desensitize society. The very kind of probabilistic distributions that Plomin hopes will prevent us from misusing research about the influence of genes on behavior is seen by Kerr to be a potential cause of racial intolerance and open discrimination.

I have barely begun to scratch the surface of this intriguing novel, which maintains a running intertextual play with the details of Ludwig Wittgenstein's biography and philosophy; the tradition of the detective

genre, including works by Conan Doyle, Raymond Chandler, and Sara Paretsky, as well as such classic essays on English murder as Thomas de Quincey's "On Murder Considered as One of the Fine Arts" and George Orwell's "The Decline of the English Murder"; other dystopias, including *A Clockwork Orange, Brave New World*, and *Nineteen Eighty-Four*; classical literature, particularly the *Aeneid*; and the Frankfurt School of criticism. I will end, however, by noting the novel's self-reflexive dimension, which turns a detective inquiry into a *philosophic* inquiry of the nature of knowledge. Against the certitude that is the goal of detectives – and of all-too-many readers of the human genome – the novel poses its "atmosphere of absolute uncertainty, of continuous change" (Kerr 247). The novel's ironic, self-reflexive structure opposes the deterministic thinking that believes there is a "gene for violence." Instead, it proposes "that all knowledge is merely provisional" (247) and that there are no easy answers to be found in the genome.

## Margaret Atwood, *MaddAddam* Trilogy

Margaret Atwood's *MaddAddam* trilogy – *Oryx and Crake* (2003), *The Year of the Flood* (2009), and *MaddAddam* (2013) – fuses elements of biodystopia with postapocalyptic motifs familiar from numerous novels and films. The dystopian sections exhibit a full array of the biomedical horrors that haunt society in the age of genomics: illegal experimentation with human subjects, designer babies, direct-to-consumer genetic modifications, a genetically engineered pandemic, the cloning of a posthuman species, and a world overrun with transgenic animals like the pigoon, rakunk, and wolvog. Further, the catastrophe that brings down civilization is caused by bioterrorism. The blend of biodystopia and postapocalypse works well to dramatize current biomedical fears and to portray a world in which corporate Compounds have replaced the state, society is divided between privileged enclaves and lawless Pleeblands, and violent internet porn, sexual exploitation, and class oppression exceed all bounds.

*Oryx and Crake* tells story of Jimmy (aka Snowman), an isolated survivor of the pandemic, and a collection of posthuman creatures – called "Crakers" – left under Jimmy's care. Crake, who designed this new species, wanted to free them from all the woes that humanity is heir to, from violence and racism to sexual competition and greed. They are vegetarians who live on grass and leaves. The females mate every three years when they go into heat, choosing four males with whom to copulate so that the offspring belong to the group rather than an individual father. Children

mature in just four years because of accelerated growth factors in their DNA. They have no body hair, ultraviolet resistant skin of all shades, and a citrus odor that repels insects. The males' urine is chemically programmed to ward off predators so that their daily ritual of territory marking keeps them safe from wild animals and gives the males a valuable role in the tribe. The females can purr at a frequency that heals wounds. After an illness-free life, all the Crakers die painlessly at age thirty.

*The Year of the Flood*, the second volume of the trilogy, focuses on other survivors of the plague, particularly two women, Toby and Ren, who had known Jimmy and Crake at different periods in their lives. The women are members of an ecoreligion called God's Gardeners, who are preparing for the end of the world in what their leader prophesizes will be a second flood, but without water this time. The stories from the two novels come together near the end of *Year of the Flood* when Toby and Ren stumble upon Jimmy during the events that had climaxed *Oryx and Crake*. The final book of the trilogy, *MaddAddam*, follows all the characters from the earlier books – Jimmy, the Crakers, Toby, Ren, and other surviving members of God's Gardeners – as they make war against a pair of brutal criminals and make peace with the pigoons, transgenic pigs made with human DNA to serve as a source for organ transplants. Together with the Crakers, pigoons appear destined to inherit an earth largely cleansed of humanity.

Atwood's allusive texts invoke the tradition of biodystopia and post-apocalypse repeatedly. What Fredric Jameson says of utopias is equally true of these genres: they are marked by their "explicit intertextuality . . . the individual text carries with it a whole tradition, reconstructed and modified with each new addition" (*Archaeologies* 2). The two most sustained intertexts for Atwood are H. G. Wells's *The Island of Doctor Moreau* (1896) and John Wyndham's *The Day of the Triffids* (1951), both of which feature biomedical creations that have run out of control.[6] Wells's novel about chimeras anticipates Atwood's pigoons and other transgenic animals. Like Wells's Beast People, the Crakers also are chimeras whose genome has been modified with nonhuman DNA. The Crakers' mating signals come from the monkey family ("a trick of variable pigmentation filched from the baboons, with a contribution from the expandable chromosphores of the octopus" [*Oryx* 164]), the ability to digest grass and leaves "from the Leporidae, the hares and rabbits" (*Oryx* 159), and their therapeutic purring from cats ("Once he discovered that the cat family purred at the same frequency as the ultrasound used on bone fractures and skin lesions . . . he'd turned himself inside out in the attempt to install that feature" [*Oryx* 156]).

Atwood notes that all of the biotechnologies in her text were possible at the time or could be developed in the near future, and as far as transgenic animals are concerned, she has a good case. As we saw in Chapter 2, pig-human, monkey-human, and mouse-human chimeras have been created in laboratories since the mid-1980s. But the pigoons' legacy from Wells's Swine Men is unmistakable. The most significant resemblance is the use of religion to control the creatures. In Wells's novel, Dr. Moreau invents a religion with laws forbidding the eating of meat to suppress his Beast People's carnivorous instincts, but Moreau is unable to prevent them from reverting to savagery. Crake tries the opposite course, attempting to eliminate the God-gene from his new species. Almost immediately, however, they revert but in the opposite direction. They spontaneously reinvent religion for themselves with Crake as a sky deity who controls the thunder and lightning, and Crake's girlfriend Oryx as a protective earth deity.

John Wyndham's cold war-era science fiction classic, *The Day of the Triffids*, shares even more motifs with Atwood. Both authors portray people who erroneously think they are the only survivors of the catastrophe; both emphasize the role of unintended consequences of scientific developments in bringing on ecological disaster; both follow the fortunes of a remnant of survivors who band together to form intentional communities in the hope of reconstructing civilization on a better footing; and both dramatize religious orders that strive to hold back the tide of destruction. Still other motifs reflect their shared interests in bioengineering. Wyndham does not use the vocabulary of genetics (Watson and Crick's discovery of the double helix was still two years in the future), but his prescient concerns with mono-crop agriculture, biofuels, the escape of artificially created species into the environment, and biological warfare have been transposed to the genomic world and thoroughly reimagined in Atwood's trilogy.[7] Wyndham even has characters discuss whether they should fabricate a myth of how the world ended, "Something like the Flood, again" (Wyndham 204), looking forward to the "Waterless Flood" (*Year* 312) of Atwood's second volume.

The fusion of biodystopia and postapocalypse is facilitated by the innovative temporal structure of the three novels, particularly the first. *Oryx and Crake* is structured by alternating chapters that deploy cyclical and linear time structures simultaneously. For the first half of the novel, the odd-numbered chapters narrate the events of a single day in Jimmy's life after the Fall. Written in the present tense, they record the painful tedium of survival as Jimmy scavenges for provisions and watches over the Crakers. The diurnal rhythm of morning (Chapter 1), noon (Chapter 3),

and night (Chapter 5) emphasizes the universal cycle of nature that persists even after apocalypse, and at the same time, the fear, boredom, and encroaching madness of an individual as the hours drag along. For the remainder of the book, the odd-numbered chapters continue to evoke a cyclical perception of time by narrating the remaining days of a week, one day per chapter up until the sixth day, after which the story breaks off. It makes sense that there are only six days in *Oryx and Crake* because this Creator is anything but divine. A terrible boy-genius, this avenging figure unleashes a plague on humanity and fashions a new species with the aid of imprisoned fellow scientists. Hence, Crake seeks death, not a day of rest, when his labor of creation is complete.[8]

The even-numbered chapters follow a very different time scheme. Narrated in the past tense, they consist of Jimmy's memories of growing up. Wholly linear in structure, they form a twisted bildungsroman for the appointed guardian of the Crakers. Chapter 2 begins with Jimmy at age five; Chapter 4 covers his preteen years, and Chapters 6, his high school infatuation with Oryx. The remainder of the even-numbered chapters continue Jimmy's history until their narrative line catches up to the sixth day in the present. In the final two chapters of the book, the separate timelines come together, merging in the novel's provocative, if open-ended, climax.

Intertwining both cyclical and linear conceptions of time, I have argued, is the signature of "genome time." Of course, novelists hardly need to be thinking of genomes to grasp for themselves the power of braiding universal and particular storylines into a single strand, a narrative helix if you will. But everything about Atwood's trilogy indicates that she had genomics in mind. The time schemes of *Year of the Flood* and *MaddAddam* are not so intricate as that of *Oryx*, but they both manage to evoke this braided temporality in their alternating structures. *The Year of the Flood* captures the cyclical dimension by beginning each chapter with a sermon by Adam One delivered in the past before the flood. Each sermon is keyed to a day in the Gardeners' liturgical year, a cyclical structure common to many religious traditions. The body of the chapter then shifts to the same day of the liturgical calendar in the postapocalyptic present. As in *Oryx*, the timeline of the sermons eventually catches up with the main story. In *MaddAddam*, the cyclical dimension is encoded in the ritual stories Toby tells the Crakers about what their human predecessors had been like, a ritual continued by a Craker child named Blackbeard after Toby's death.

Both the dystopian society and the apocalypse that destroys it are seen as stemming directly from unethical exploitation of genetics research. Corporations creating genetically modified organisms (GMOs) largely rule

society. GM varietals have replaced conventional species in agriculture. Jimmy's father works at OrganInc Farms, which modifies organisms for medical purposes. Jimmy and Crake go to high school in the HelthWyzer Compound, a corporation that markets cosmetic genomics through its NooSkins subsidiary as well as pursues more nefarious activities such as intentionally unleashing genetically modified viruses in its health supplements for which only HelthWyzer possesses the pharmacogenomic cure. As an adult, Jimmy works first at AnooYoo Spa, and later, with Crake in RejoovenEsense, responsible for the BlyssPluss pill. (The emphasis on life and beauty-prolonging treatments brings to mind Shteyngart's satire of the rejuvenation treatments marketed by Post-Human Services.) BlyssPluss is advertised as protecting against all known STDs, working as a super-Viagra for both men and women, and prolonging youth; its less publicized properties include sterilization and serving as the vector for the pandemic disease that annihilates nearly all of the human species. In the Pleeblands, an even more free-wheeling market for illicit human gene mods thrives.

One of the most frequently voiced concerns of contemporary critics of GMOs is the danger of modified genes escaping into the wild. Atwood's novels dramatize this danger with startling power. Escaped pigoons represent continual threats to the characters not only because of their enlarged size and strength but because the human genetic material mixed in their DNA has enhanced their intelligence. They hunt in packs, learn to set ambushes for the unwary, engage in sabotage, and develop sophisticated strategies to aid them in their conflict with the armed humans. In Chapter 2, we looked at some of the ethical questions raised by creating human/nonhuman chimeras, paying especial attention to the problems with splicing human neuronal cells into nonhuman animals. One of the principal dangers, according to several bioethics committees and Wells's *Doctor Moreau*, was that enhancing the cognitive abilities of a nonhuman animal would raise its ethical status. The conclusion of one bioethics group was that "more humanlike capacities" would give an animal a "greater capacity for suffering" (Greene et al. 385). This is exactly what happens to Atwood's pigoons, a realization that is brought home to the human survivors when they observe the transgenic animals developing mourning rituals for their dead (*MaddAddam* 326). At the conclusion of the trilogy, the human community comes to terms with the new moral stature of this companion species, which had been so recklessly created by the huge "BioCorps" (*MaddAddam* 56). Ultimately, the surviving humans realize that they must collaborate in building a new civilization not only with the Crakers – with whom they have already begun to interbreed – but with chimerical pigs.

Atwood's novels have had a strong impact on public fears about genetics. Some of this impact might be seen as merely alarmist, akin to the conspiracy theories common in thrillers at the multiplex. Here is an exchange from *The Year of the Flood*, alleging that Toby's mother had been experimented on by HelthWyzer, the pharmaceutical company for which she worked, possibly as a reprisal against her husband for refusing to sell his house to the corporation:

> "Did it ever occur to you, my dear," said Pilar, "that your mother may have been a guinea pig?"
>
> It hadn't occurred to Toby, but it occurred to her now.
>
> "Now, promise me that you will never take any pill made by a Corporation," said Pilar. "Never buy such a pill, and never accept any such pill if offered, no matter what they say. They'll produce data and scientists; they'll produce doctors – worthless, they've all been bought."
>
> "Surely not all of them!" said Toby.
>
> "No," said Pilar. "Not all. But all who are still working with any of the pharmaceutical corporations. The others – some have died unexpectedly."
>
> *The Year* 104–5

While the dystopian world of Atwood's novels justifies such a passage as part of the social fabric, it is not the sort of insight that would lead to thoughtful reflection on bioethical issues in our own world. Other aspects of the novels, however, have articulated important concerns, which have played a role in public policy debates. Where bioterrorism is concerned, we have unusually direct evidence of the kind of influence Atwood's fiction has exerted. The prominent jurist and legal theorist Richard Posner cites *Oryx and Crake* as the origin of his study of how our society should prepare for future disasters, especially those that could be caused by bioterrorism. (Posner's invocation of Atwood is ironic since he is a vocal critic of the law and literature movement.) In *Catastrophe: Risk and Response*, Posner writes:

> The germ of the book is a review I did of Margaret Atwood's 2003 novel *Oryx and Crake* . . .. I was curious whether there was any scientific basis for her dark vision – and discovered that there was and that the social sciences were not taking it as seriously as it deserved. The law was paying no attention at all, because law is court-centric and there have been no cases involving catastrophic risks in the sense in which I am using the term, and because a cultural gulf separates lawyers from scientists. (vi)

Posner sets out to correct an inadequacy in two fields far removed from the literary – economics and the law – because of his alarm at the scenarios

that Atwood portrays. Posner's extensive research convinces him that "the law's conventional methods for resolving science-laden legal disputes" are inadequate and that the "law is indeed lagging dangerously behind an accelerating scientific revolution" in biotechnology (vi–vii).

The catastrophes caused by bioterrorism in Atwood's novels range from anarchistic acts of sabotage by the MaddAddam group, which releases genetically engineered mice that eat the insulation on electric wiring, weevils that attack only GM coffee beans, microbes that eat the tar in asphalt, wasps with a modified form of chicken pox specific to ChickieNobs, to Crake's apocalyptic plot to eradicate the human species.

Perhaps the most influential aspect of the trilogy has been its vision of genetically modified organisms. Worries about GMOs loomed large in the public's mind during the decade Atwood was publishing her trilogy (2003–13) and are still widespread.[9] Government agencies and bioethical groups have studied the issue extensively, and news coverage, social media, and protests (especially in Europe) are prominent. There is evidence that Atwood's fiction is doing its part to shape these attitudes. An internet search for "Margaret Atwood" and such topics as "environmentalism," "genetics," and "GM foods" yields hundreds of thousands of hits, many of them pointing to environmental organizations advocating public policy in the United States, Europe, Asia, and the Middle East.

According to a 2010 Congressional report on "Biotechnology in Animal Agriculture," about half of US citizens surveyed oppose the use of biotechnology in the food supply. Two-thirds express discomfort with cloning animals for food, "more of them out of religious or ethical concerns than food safety concerns" (Cowan and Becker 16). Finally, "A majority of respondents to [a] Pew survey believe that regulators should take into account ethical and moral considerations" (16). But there is broad disagreement about whether federal regulations should be based solely on scientific findings about safety and environmental harms or whether they should take into account public opinion, ethical issues, and cultural attitudes. European agencies have tended to weigh the negative views of the public toward GM foods while also arguing that the science is not settled in this area, whereas US regulatory agencies have largely taken the position that the science is what matters. For example, the FDA's risk assessment of the safety of meat and milk from cloned pigs, cattle, and goats, issued in 2008, concluded that these products were as safe for human consumption as food from conventionally bred animals and that the risk to the environment or the animals themselves from this procedure was no greater than other methods of food production. The FDA

emphasized, however, that it did not consider "the social and ethical aspects of cloning or consumer acceptance of cloned animal products" in arriving at its conclusion (FDA, *Guidance* 10).

Numerous commentators on the topic have argued that the United States too should assess ethical and cultural values in the area of GMOs, especially when the science is unsettled. For example, Winickoff and his collaborators, writing in the *Yale Journal of International Law*, maintain that "GMOs fall into the class of risk situations characterized by both low certainty and low consensus" (Winickoff et al. 83) and thus that "value judgments and public participation" should play an important role in regulating them. "In practice, effective and reliable risk assessment diverges from the simple science-based models promoted by the United States" (Winickoff et al. 84). A 2007 article called "Dolly for Dinner?" in *Nature Biotechnology* reaches the same conclusion, stressing the "need to develop frameworks for considering the ethical aspects of animal biotech as well as the importance of participatory deliberation with the public" (Suk et al. 53), not just rely on the science.

I agree with Winickoff and Suk in principle, but assessing the desires of the public may not be enough to prevent misuses of biotechnology. Opinion surveys and "participatory deliberation" may be insufficient tools for forging policy in this context. Atwood underscores the difficulty of relying on cultural values to determine regulations in an area where false beliefs and overwhelming desires are already sedimented in the practice itself. What makes Atwood's biodystopia so unsettling is the eagerness with which consumers seek the modifications that are bringing on ecological disaster. As in Shteyngart's *Super Sad True Love Story*, the majority of the world's population in Atwood's trilogy have internalized the values that give power to the corporations. The BlyssPluss pill is a perfect example. The pill is an ideal vector for Crake's virus because of consumers' overwhelming desire for its benefits – great sex and a long life.

GM foods, of course, are far more ambivalently coded than the BlyssPluss pill. GMOs are vectors for fears and religious beliefs, for corporate profits and consumer convenience, but also for potential research breakthroughs, health benefits, and hunger relief. As passionate as Atwood is for ecological justice, her novels make it clear that simply relying on current values and public opinion will not resolve such vexed questions.

If assessing public attitudes is not sufficient to ensure sound regulation of biotechnology, what is? In my view, the conclusion of Atwood's trilogy shows us at least part of what is needed. The vision of a future shared by humans, pigoons, and posthuman Crakers is a parable, extreme perhaps, but instructive. The survivors realize that a viable future for the planet

depends on reconceptualizing humanity's place among the other species. The parable speaks of reconciliation with the Other, interspecies harmony, and respect for the environment. It speaks of modesty in a universe where the human may not be the sole arbiter of value. Such attitudes do not come easily, but they are essential for survival in the era of climate change.

Literature gives us a space in which to cultivate this kind of understanding. Rather than an answer, it provides a stimulus to reflection. It challenges us to think and to imagine rather than simply react. Literature can assist us to a more thoughtful conversation about biotechnology – or indeed, about most important topics, whether public or private. Although it may exaggerate in the interest of a good story, it also enables us to judge for ourselves the kind of world we would like to inhabit. In the end – at the end – Atwood's trilogy does more than dramatize the potential dangers of genomics. It shows us the importance of working thoughtfully in the present to create a shared future for our planet.

CHAPTER 9

# *Clones and Other Sorrows*
## *(Kazuo Ishiguro)*

> What if I were to tell you that I could take a scraping of skin from your finger and create another Ezra Lieberman?
>
> *The Boys from Brazil* (1978)

> Doug Kinney is about to get the one thing he needs more of – himself!"
>
> *Multiplicity* (theatrical trailer, 1996)

> A human was cloned. That human was you. Kind of takes the fun out of being alive, doesn't it?
>
> *The 6th Day* (2000)

> It made another me! How cool is that?
>
> "Send in the Clones," *The Simpsons* (2002)

Of the several dozen movies and television series featuring clones that I have watched over the years, one of the most accurate is the earliest – a star-studded film made in 1978 from Ira Levin's novel, *The Boys from Brazil*. In seven minutes of surprisingly effective exposition, a scientist explains to Ezra Lieberman, a Nazi hunter played by Sir Laurence Olivier, the procedures involved in "mononuclear reproduction" or "cloning." Strikingly, the scientist also explains the necessity of reproducing the environment of the original if one hopes to duplicate its character, something missing from the overwhelming majority of films about clones. When Lieberman exclaims, "It's monstrous, doctor!" the scientist replies, "Why? Wouldn't you want to live in a world full of Mozarts and Picassos?" The exposition reaches a climax as Lieberman reiterates what they have learned about the cloned boy's background: "Not Mozart, not Picasso, not a genius who will enrich the world, but a lonely little boy with a domineering father . . . Adolf Hitler."

The emphasis on environmental factors in the development of an individual is a step in the right direction, but the film still misses a fundamental truth about human cloning – that everything the clone encounters, from its epigenetic programming to the household and society

in which it is raised to the very air it breathes, would be different from those of the original. In an amusing essay occasioned by the cloning of Dolly the sheep, Stephen Jay Gould points out that identical twins "are far better clones than Dolly and her mother" because twins share the same mitochondrial genes, maternal proteins, womb, and historical time period ("Dolly's Fashion" 46–47). If someday a human clone is created, it will be a unique individual with its own personality, not a carbon copy or automaton.

Few films even gesture toward environmental influences on the developing child. On the contrary, most present audiences with fully grown adults, the actor doubled before our eyes through the magic of a green screen. Newly minted copies of Arnold Schwarzenegger, Michael Keaton, and the cartoon figure Bart Simpson pop up whenever the action – or comedy – demands.[1] What should we expect, though? Science in popular cinema is usually little more than a transparent excuse for the action. We are so inured to scientific gobbledygook in films and television that it makes us wonder if anyone takes such nonsense seriously. Yet research shows that some people do.[2] The worry that movies about cloning will spread misconceptions about genetic engineering and stem cell research is a valid concern. Unsurprisingly, the most pervasive misconception about clones is the belief that cloning would produce a soulless version of the original, a grown-up automaton equipped with the same personality, desires, opinions, and even memories.[3] The persistence of memory is occasionally justified in movies (as it is in *The 6th Day*) by some form of technology for uploading a person's consciousness intact, but more often, memories come in flashbacks, dreams, or feelings of déjà vu, episodes that call to mind Samuel Butler's conviction back in the 1870s that unconscious memories were passed down from one generation to the next.[4]

In the first chapter of this book, I noted that studying such misrepresentations is a common approach used by social scientists to measure the effects of popular culture on public attitudes toward science. Using discourse analysis, surveys, focus groups, and semistructured interviews, social scientists have examined the impact of everything from films and television to online advertising and social media networks. This kind of research is regularly funded by the ethical, legal, and social implications (ELSI) program of the NIH and cited in policy reports. But the methods of social scientists are not a viable option for literary scholars, for they make little use of our particular set of skills. One does not need graduate training in literary studies to expose the distorted science that appears in the thrillers, superhero pics, and horror movies that make up the majority of the nearly

150 films and TV shows that involve cloning.[5] Moreover, the very idea of looking for factual distortions is problematic in literary criticism because the object under investigation – fiction – complicates any simple relationship between representation and reality.

I am beginning this chapter with films about cloning to highlight an interesting contrast. It turns out that many of the most prominent literary works involving clones view them more sympathetically than most movies. Whereas films usually "send in the clones" to provoke horror, dramatic action, or laughter, a number of prominent novels and short stories use the idea of human cloning to challenge readers to think about what makes us human.[6] The works I have in mind include titles that have come up repeatedly in this study – *Cloud Atlas*, the *MaddAddam* trilogy, *Never Let Me Go* – as well as other interesting texts, all published since the landmark 1975 Asilomar Conference on recombinant DNA: Octavia Butler's *Xenogenesis* (1987–1989), Fay Weldon's *The Cloning of Joanna May* (1989), Eva Hoffman's *The Secret* (2002), Nancy Kress's "Sex Education" (1996), Martha Nussbaum's "Little C" (1998), Jenny Davidson's *Heredity* (2003), Jodi Picoult's *My Sister's Keeper* (2004), and Paolo Bacigalupi's *The Windup Girl* (2009). In most cases, the stories reflect real-life problems with an immediacy that reinforces a sense of realism rather than science fictionality.[7] As a result, the clones are easily read as analogues for marginalized groups in current society – racial or sexual minorities, women, people with disabilities, the poor, the homeless, the displaced and stateless. They excite empathy and political awareness. Sorrow, not terror, is a dominant emotion.

Of these texts, one stands out for the amount of critical attention it has attracted in the relatively brief time since its publication, Kazuo Ishiguro's 2005 novel *Never Let Me Go*. A survey of the relevant bibliography yields more than seventy-five full-length articles in English (there are a dozen or so more in other languages) that discuss the novel, not to mention reviews, interviews, and feature pieces. As one would expect, much of this attention is due to the merit of the novel. But much also stems from the work's bearing on four topics that have been central to this study: dystopia, posthumanism, temporality, and bioethics. I touch on these topics again in the four sections that follow. But I have additional reasons for devoting my final chapter to Ishiguro's novel.

First, Ishiguro's nightmare vision of clones created as sources for human organs can illuminate the principles often used to set organ donation priorities, enriching public discourse on this topic. Second, the novel's self-conscious relation to nineteenth-century realism rounds off this study

by returning us to some of the questions we explored in Chapter 1. Like McEwan's *Saturday*, Ishiguro's novel invokes canonical nineteenth-century literature to deepen our understanding of the social implications of genetics. Highlighting the arc that leads from Darwin's theory of evolution to twenty-first-century genomics, both *Saturday* and *Never Let Me Go* explore the value of literature to guide us as we think about the urgent questions that arise in a scientific age.

## *Bildung* in Dystopia

The science of cloning a human never appears in *Never Let Me Go*. Instead, the novel exploits a variant of the *Bildungsroman* – the boarding-school novel – to focus attention on the environment in which three friends, all clones, are raised. As the novel opens, our narrator, Kathy H., is talking to a patient, a fellow clone, who is recovering from surgery. Kathy is a "carer," a companion who assists organ donors before and after their operations. The occupation is one that all clones pass through before beginning their own career as organ donors. She has been a carer for eleven years, an unusually long period, and feels proud of her skill at calming those under her charge. In January, she will begin the final stage of her life, giving up her organs for others. She is thirty-one years old but knows she has only a year or two of life ahead of her. Some donors do not make it past their second operation, and none are expected to survive their fourth. They call this final donation "completing," as in fulfilling one's purpose on earth.

Kathy grew up as one of the privileged children raised at Hailsham, a boarding school dedicated to giving its students a full, humanistic education in a nurturing environment. They were watched over by a staff of teachers called "guardians," told they were "special" (43), and sheltered from understanding what their future as organ donors entailed. At first, readers are sheltered too. In the early chapters, most readers do not even realize the children are clones unless they have been told ahead of time. The realization dawns slowly, as if we are groping toward some facet of adult knowledge, some recognition essential to mature acceptance of the world, just as are the children themselves. How does the novel pull off this feat?

By beautifully marshaling the elementary literary techniques that E. M. Forster years ago named "aspects of the novel." The point of view is handled deftly by a speaking voice addressing an unidentified "you"; temporal shifts are managed with colloquial ease, sentence by sentence in the cadence of a conversation; the familiar genre of boarding-school novel

slides easily into its accustomed grooves as memoir and *Bildungsroman*, its melancholy tone a natural outgrowth of growing up, the small losses, childhood grievances, schoolyard cliques, and crushes on teachers developing into lifelong bonds among friends; and the main characters, our narrator Kathy, and her childhood companions, Ruth and Tommy, deepen into psychologically complex adults, rounded individuals possessing that half-glimpsed, mysterious realm we call "interiority" – all these deeply recognizable "aspects" of the novel are arranged with such skill that at first one hardly notices that the alternative England in the novel is a biodystopia in which cloned children are raised to have their organs harvested for strangers.

The word "clone" is virtually taboo in the novel. It appears only twice, both times to register the stigma associated with the term. The guardians at Hailsham always preferred the word "students" (261) as a way of glossing over the reality of what lay before their charges. Society as a whole does not want to be reminded of that reality either – hence, the near invisibility of science. Genetics only crops up once in the novel, in a conversation near the end of the book, when something called the "Morningdale scandal" (258) is mentioned. Kathy and her lover, Tommy, have tracked down the head guardian from Hailsham, Miss Emily, and are entreating her to explain some of the things they found puzzling about their upbringing. They have heard rumors that Hailsham students who are truly in love can obtain "deferrals" of their surgeries for a few years (258). Miss Emily, however, crushes those hopes, telling them that the rumor is false. Worse still, Hailsham has been shut down, and the situation of cloned children is even more deplorable than it was before. The end for Hailsham came when a scientist named Morningdale was discovered in a remote region of Scotland conducting illegal experiments involving genetically enhancing clones.[8] "What he wanted was to offer people the possibility of having children with enhanced characteristics. Superior intelligence, superior athleticism" (263–64). But his plan blew up, causing untold damage. Miss Emily explains: "It reminded people, reminded them of a fear they'd always had. It's one thing to create students, such as yourselves, for the donation programme. But a generation of created children . . . demonstrably *superior* to the rest of us? Oh no. That frightened people" (264).

The outcry brought unwanted attention to something the public had been successfully repressing for decades – that their health system depended on heartless procedures that created an exploited underclass. Before the Morningdale scandal broke, "people did their best not to think about you. And if they did, they tried to convince themselves you weren't

really like us. That you were less than human, so it didn't matter" (263). The parallel with apologists for slavery in the nineteenth century is inescapable, as it is with doctors who performed medical atrocities in Nazi concentration camps and the Tuskegee syphilis study.

> But you must try and see it historically. After the war, in the early fifties, when the great breakthroughs in science followed one after the other so rapidly, there wasn't time to take stock, to ask the sensible questions. Suddenly there were all these new possibilities laid before us, all these ways to cure so many previously incurable conditions . . .. And for a long time, people preferred to believe these organs appeared from nowhere, or at most that they grew in a kind of vacuum. (262)

The brevity of this explanation is revealing – WW II, the early 1950s, a vaguely "long time," and suddenly the characters are in the present, inhabiting a society dependent on unspeakable barbarities perpetrated on a class of "untouchables" for the sake of nearly miraculous cures for fully entitled members of society.[9] To grasp how completely Ishiguro's novel buries the science of cloning, contrast the preceding passage with Atwood's depiction of genetic engineering. Atwood's *MaddAddam* trilogy dramatizes the growth of entire industries devoted to producing genetically modified (GM) animals, diagnoses the forces that gave the giant Biocorps power, depicts a character genetically engineering an extinction-level pandemic, details the diverse genetic sources of her chimeras, describes the method of distribution for the pandemic's vectors, and enumerates the nonhuman traits Crake splices into the DNA of a cloned species designed to replace humanity. By contrast, Ishiguro's story is not about astounding scientific advances but about the *normalization* of science, about how biodystopia becomes accepted as the price of medical marvels. Even the victims of this system, the clones, accept this state of affairs as the norm. They never think of rebelling. Once they become adults and leave Hailsham, they encounter no restraints on their free movement, no covert surveillance. "Why don't they just run away?" my students invariably ask. The answer comes readily to hand: because they have completely internalized the conditions of their oppression.

Their failure to lash out at an unjust social order departs from a standard plot convention of dystopia but is unsurprising in biodystopia, which is distinguished from the former by this very process of internalization.[10] As we saw in the prior chapter, biodystopia transposes the structures of domination into the self. The focus of the novel's early chapters on the children's education gives us a step-by-step illustration of how such internalization occurs. At Hailsham, the cultivation of self, or *Bildung*, cannot be disentangled from the socialization of the children for their

destined fate. Both at the institutional level, in their classes, counseling sessions, sports events, and facilities, and on the personal level, as they respond to peer pressure, vague fears, and emerging desires, an education designed to foster humanistic values simultaneously prepares them to accept their future as organ donors. Sadly, this is no paradox.

The classical *Bildungsroman*, or novel of education, narrates the story of how a young person develops into maturity by navigating a series of adolescent crises to find, at last, his or her true calling as an adult. The telos of this process is a mature acceptance of one's destiny and place in society, even when this role represents a diminishment of one's youthful dreams. Franco Moretti has pointed out that for the last two centuries, this destiny has coincided with finding a professional vocation, an occupation that fulfills a place within the social order. That this occupation in the clones' case means sacrificing their lives for the good of others does not prevent them from accepting their fate, any more than it might a well-trained soldier. But their very lack of dissent forces the reader to think again about the project of *Bildung*. Is cultivation of selfhood in service of vocation always praiseworthy? The answer depends on two crucial factors: the roles a society affords its citizens, and even more important, who counts as a citizen.

Matthew Eatough explores the challenge *Never Let Me Go* offers to *Bildung* as a way of raising policy concerns about a current strategy for assessing patients' suitability for organ transplants. Eatough demonstrates that the understanding of *Bildung*, or character development, governing the treatment of the clones in Ishiguro's novel is similar to that used in quality-of-life studies, which are often a factor in decisions about who receives organ transplants. Quality-of-life studies attempt to shift the debate over expensive surgeries and the allocation of scarce organs away from cost-benefit calculations focused exclusively on survival rates and toward measures that weigh participants' affective responses to their condition. The goal is to use affective preferences to "establish an objectively measurable scale . . . that can translate subjective states into a calculable, comparative metric" (Eatough 145). Patients are asked to say whether they would prefer a longer life in reduced health or a shorter life in better health. Using preference-based psychometrics, researchers then "quantify the difference between certain medical conditions *on the basis of participants' affective responses to those states*. This procedure yields what is called a 'quality-adjusted life year' (QALY), a number . . . that designates the difference between an individual's reduced quality of life and that of a fully functional individual" (Eatough 140, italics in original).

Eatough asks several questions about this number. First, what defines a "fully functional individual"? The answer turns out to be the same one offered in *Never Let Me Go* and in the *Bildungsroman* generally: a "fully functioning individual" is defined as someone with the ability to pursue a chosen vocation. The unintended result of this definition is that patients' affective investments in their vocation play a role in the calculation used to determine their eligibility for organ transplantation. For the clones, the reverse is also true. Trained at Hailsham to value the cultivation of the self above all else, they have no difficulty choosing their "professional oriented *Bildung* . . . as organ donors" (Eatough 142) over the continued healthy functioning of their bodies. Second, what are the consequences of considering "the body's physical well-being . . . only to the extent that it impacts the patient's affective experience of the time period under consideration" (Eatough 143)? One is that patients and medical personnel alike are prompted to become less responsive to the body, to discount its suffering as an adequate measure of well-being. This lessening of regard for the body can have distinct drawbacks. For medical professionals, the admirable effort to attend to quality-of-life measures paradoxically results in devaluing of bodily trauma. For patients, the effort requires one to choose between the time of the body and the time of *Bildung* – that is, between the time one has to live and the life one wants to live in time.

As a literary form, the novel has traditionally excelled at registering the variable meanings to individuals of different temporalities. A work of fiction like *Never Let Me Go* can bring home to readers the intensity of felt time, the dilation of what Virginia Woolf called "moments of being," the remembrance of *temps perdu*. In this respect, the form simultaneously honors the transient personal apprehension of time and the shared cultural meanings of a longer durée. This is one of the great achievements of *Never Let Me Go* – its power to imbue both temporalities with a full measure of meaning, our fleeting time on earth and our intimation of times that extend beyond the self.

Eatough's article shows how the study of an individual novel can bring added value to the conversation about an important policy issue. As an example of a literary study that holds as much interest for public policy makers as for readers of fiction, Eatough's work is unusual but not unique. In Chapter 1, I listed some of the other pioneers in this effort. Another literary scholar claims our attention here because his work has also focused on organ donation. Robert Mitchell is a literary critic of Romanticism who has coauthored with Catherine Waldby a book-length study of organ transplantation policy, *Tissue Economies: Blood, Organs, and Cell Lines in*

*Late Capitalism*. Waldby and Mitchell's book highlights contradictions within the gift-giving economy that governs organ donation policy in the United States. Their work, like Eatough's, deserves to figure into conversations about how we make decisions in an exchange fraught with conflicting needs, values, and emotions – an exchange that involves deeply held cultural beliefs about the value of human life.

## Humanism and the Human

Perhaps the most common function of clones in literature has been to challenge traditional definitions of the human. Are artificially created beings individuals; if so, do they have souls; do they have rights that must be respected by the state? The clones' experience at Hailsham is premised on demonstrating their essential humanity. Yet the instinctive revulsion that even some of their committed advocates feel in their presence shows the tenuousness of this conviction. Moreover, the emphasis on artistic expression in the novel asks us to reconsider the traditional link between art and humanity. From earliest childhood, the clones are encouraged to treasure artistic expression and to cultivate their imaginations by creating poetry and drawings for a gallery that, we discover, is intended to prove that clones have souls. But the failure of the gallery after the Morningdale scandal and the collapse of the nascent abolitionist movement on behalf of the clones cast doubt on the persuasive power of art.

Interwoven with these reflections on the human are scenes that provoke one to reflect on humanism as well.[11] Respect for education and faith in the creative imagination as a sign of human worth are only two of many humanistic values that the guardians of Hailsham endorse. In search of a more just polity, the guardians denounce prejudice and inculcate principles of tolerance, sympathy for others, and humane treatment for all. Miss Emily, the former director of Hailsham, believes that her cause was just: "Together, we became a small but very vocal movement, and we challenged the entire way the donations programme was being run" (261). She urges that "Hailsham was considered a shining beacon, an example of how we might move to a more humane and a better way of doing things" (258) and that Kathy and Tommy have "turned out well" (256). She has sacrificed her own comfort and most of her possessions to the cause, and she is consoled by "the knowledge that we've given you better lives than you would have had otherwise" (265). In the end, however, her reformist movement racked up only isolated victories before being swept away by the negative wave of reaction to the Morningdale scandal. Whatever

successes she achieved were short lived and confined to the personal realm; they did not touch the material conditions of the clones' existence, whether political, economic, or biomedical. Structural change proved beyond Miss Emily's reach, perhaps even her imagination.

What do we make of the crushing failure of Miss Emily's liberal, reformist movement and the humanistic values that inform it? Shameem Black sees the failure of art and liberal reform as an indictment of humanism and Romantic conceptions of sympathy in favor of the more radical potential in posthumanism. Black writes, "the novel indicts humanist conceptions of art as a form of extraction that resembles forced organ donation" and "the concept of the soul invokes a fundamentally exploitative discourse of use value" (285). These contentions seem wrong to me, or at least overstated. Art as forced organ donation? The concept of the soul as an exploitative discourse of use value? Most readers' experience of the novel involves intense empathy for the humanity of Kathy and the other clones (Groes and Lewis 2). Like the Romantic predecessors to Ishiguro's characters from Frankenstein's creature onward, Kathy's painful growth to adulthood, poignant losses, and imminent death mobilize the repertoire of sympathetic response and gradual insight that is another strength of the realistic novel – mobilize it to impress us with her shared humanity.

Yet despite Black's overstatement, her larger point seems reasonable, that liberalism's answer to coercion is tainted by its acceptance of the values that determine who qualifies for rights – the values that determine the human. Invoking Giorgio Agamben's concept of "bare life," Black notes how the boundaries of Hailsham, a protective environment, are also depicted in terms that remind us of the Nazi concentration camps. Like the prisoners in those camps, the clones are stripped of "any forms of political identity [and] denuded of citizenship" (Black 789). I agree. Ishiguro's novel severely qualifies any simple affirmations of art, humanism, and the sympathetic imagination. The failure of these values to counter the dystopian conditions of a society that is all but identical to contemporary England represents a powerful critique of this belief.[12]

There is a difference between challenging a naïve faith in humanism, which is what I think the novel does, and abandoning the human as a measure of basic rights. Abandoning the human as a metric is an increasingly prominent ethical position, advocated in other contexts by writers such as Donna Haraway, Cary Wolfe, and Jane Bennett, but it is not a position this novel endorses. Nothing in the story suggests that the cloned organ donors are anything but profoundly human individuals, deserving of

the same human rights as all other people on the planet. Instead, Ishiguro's novel asks us to expand our conception of the human to encompass categories of people and states of being that have too often been excluded.

What *is* radical about *Never Let Me Go* is its critique of the institutions and safeguards of the modern state for having failed to prevent the exploitation of marginalized populations.[13] What is radical is the exposure of the subterfuges of biopower, which blind the beneficiaries of an immoral medical system to the inequities upon which that system depends. For better or worse, there is nothing posthuman about the clones in *Never Let Me Go*, only the sad spectacle of what can be done to those disempowered populations who have been made to seem less than human.

## Memory and Consolation

No aspect of *Never Let Me Go* highlights its vexed relationship to humanism more than the novel's treatment of memory. From the first moment when Kathy confesses that she has given in to her patients' frequent pleas that she tell stories about her childhood at Hailsham to the final paragraph when she closed her eyes and "imagined this was the spot where everything I'd ever lost since my childhood had washed up" (287), memory casts a melancholy, even elegiac tone over the book. Recollected in that strange tranquility that bewilders and intrigues so many readers, Kathy's memories serve as her sole consolation for all she has lost. Matthew Arnold saw Wordsworth's poetry of consolation as a source of his greatness, and the compensatory structure of Kathy's memories recalls that poet's most affecting passages.

Like Wordsworth, Kathy takes solace from the "memories [she] value[s] most" (*Never* 286). After all the deaths she has witnessed, she too finds "strength in what remains behind," in the "thoughts that spring / Out of human suffering" (Wordsworth, "Intimations Ode" ll. 185–88). Her memories take a "sober colouring from an eye" that has literally "kept watch o'er . . . mortality" ("Intimations Ode" ll. 201–2). "For such loss," Kathy believes, memory serves as "abundant recompense" ("Tintern Abbey," ll. 87–88). In perhaps her most poignant affirmation of the consoling power of memory, she insists, "I lost Ruth, then I lost Tommy, but I won't lose my memories of them. . . . I'll have Hailsham with me, safely in my head, and that'll be something no one can take away" (*Never* 286–87).

More than thirty years ago, in *Romantic Vision and the Novel*, I explored a compensatory structure common to Wordsworth, George Eliot, Dickens, and other Victorian novelists in which the loss of youthful

intensity is replaced by a "higher" state of consciousness. These authors – or their characters – accept this compensatory exchange as recompense for what they have left behind, but they understand that such acceptance does not cancel out loss. Rather, loss is enshrined in the act of memory that provides consolation. Recently, David James has noticed that several "prominent writers from recent decades" have begun to theorize consolation, "often in the most unlikely genres and forbidding scenarios" (486), including Cormac McCarthy's postapocalyptic *The Road* (2006), W. G. Sebald's postholocaust fiction *Austerlitz* (2001), and Ishiguro's biodystopia. James notes that "the provision of solace in fiction can be coterminous with sorrow" (486), a paradox only partially explained by the bravery of acknowledging loss as the price of self-knowledge. Solace comes to the reader from understanding the loss as our own. Gerard Manly Hopkins gave expression to this insight in his beautiful, Wordsworthian poem about Margaret grieving over autumn leaves: "It is the blight man was born for / It is Margaret you mourn for" ("Spring and Fall," ll. 14–15).

Three places focus *Never Let Me Go*'s elegiac power in the manner of Wordsworthian "spots of time": Hailsham after it has been closed; a boat stranded in a field far from the sea; and a corner of Norfolk where the children pretend that all the things they have lost will one day be found. The memory of these spots flashes up unexpectedly from time to time, with startling power. "These moments hit me when I'm least expecting it, when I'm driving with something else entirely in my mind" (286). In Norfolk, she finds a copy of a cassette tape she had lost years before, and her emotions at this recovered piece of her childhood bring her the mingled pleasure and pain characteristic of Romantic melancholy. "Then suddenly I felt a huge pleasure – and something else, something more complicated that threatened to make me burst into tears" (172). The novel ends on another of these spots of time. Kathy stands before a windswept field in Norfolk and imagines that the rubbish tangled in a fence is where everything she has lost – her childhood and Ruth and Tommy – have come to rest. The first two times I read the novel, I found myself near tears at the end. "A good deal of fiction's poignancy," David James observes, "stems from its moving apprehension of what ultimately cannot be repaired" (484), words that nicely capture how *Never Let Me Go* intensifies the sense of our shared mortality. But Ishiguro turns away from pathos in the last sentence. Kathy straightens her back and returns to her car, "to drive off to wherever it was I was supposed to be" (Ishiguro 288).

The irony of these last few words underlines how thoroughly Kathy has internalized her professional obligations and speaks to her acceptance of

her own death as the price of that calling. Just as important, the irony marks a distance from Wordsworth, a shift in tone that is as crucial to the meaning of the novel as is its pervading melancholy. Acceptance of loss as the price of maturity may be the burden of famous works by both authors, but how different the weary phrase "supposed to be" sounds from Wordsworth's ringing endorsement of a "faith that looks through death" in the final lines of the "Intimations Ode" (l. 189). This ironic tone in Ishiguro is characteristic of a larger pattern in his works of capitalizing on the formal and thematic resources of nineteenth-century literature while simultaneously questioning some of the assumptions that that tradition has perpetuated.

Take, for example, the frequent invocation of George Eliot and Charles Dickens in *Never Let Me Go.* Kathy dedicates her final school project to a study of the Victorian novel, focusing particularly on George Eliot's *Daniel Deronda*, and readers have been struck by the significant parallels between Miss Emily, headmistress at Hailsham, and Miss Havisham in Dickens's *Great Expectations*. The parallel becomes especially apparent during Miss Emily's final appearance in the novel when her withered, wheelchair-bound form emerges from the shadows to justify her conduct to Kathy and Tom. Once again, however, the differences between Ishiguro's novel and its predecessors are significant. At the end of *Great Expectations*, Pip demonstrates that he has put aside his childhood dreams and entered adulthood by embracing that most Victorian of all values, hard work. He dedicates himself faithfully to a career in the service of repaying his debts to his friend, Herbert Pocket, and gives up not only his former unrealistic dreams but also a family of his own. "I lived happily with Herbert and his wife," Pip writes, "and lived frugally, and paid my debts, and maintained a constant correspondence with Biddy and Joe" (Dickens 489).

Dickens's novel registers the sad diminishment of Pip's expectations, but it does not turn aside from Victorian beliefs about the value of hard work, paying one's way, and doing one's duty. Instead, it sees the acceptance of loss as a sign of maturity. The satisfactions of fulfilling a professional vocation, however modest, are presented without irony, and the elegiac tones with which Pip remembers his foolish dreams and lost chance for love go uncontradicted in his final meeting with Estella, the woman around whom those dreams had revolved. The compensatory structure of Pip's exchange of youthful hopes for mature self-knowledge is as clear in the concluding chapters of *Great Expectations* as it is in the final lines of Wordsworth's "Tintern Abbey" and "Intimations Ode." And the same

compensatory exchange structures the ending of *Never Let Me Go*. Only the last ironic line signals that Ishiguro means for us to question the trade-off that Kathy has accepted.

David James maintains that Kathy questions her own rationalizations, reinforcing the critical judgment that readers often make about Kathy's submission to the society she lives in. Grounding his reading in a discussion of description's power to contradict the explicit meaning of a passage, James argues that there are stylistic traces of "Kathy's apprehension of consolation as an illusion" (498). This seems right, especially when James adds that the novel's ending strengthens "our apprehensiveness about the gruesome destiny she's now set to fulfilll" (498).

Where David James looks to description for traces of the "friction" between style and action (485), I want to turn to the novel's unusual point of view for insight into a related tension, that between irony and the author's affection for traditional realism. The novel's conversational first-person narrative addressed to an unnamed "you" is in essence an extended dramatic monologue, a colloquial version of the form Robert Browning introduced in the nineteenth century. In Browning's hands, the dramatic monologue forged a new mode of poetic realism, a lyrical narrative that led readers to sympathize with the subjective experience of the narrator even when they felt profoundly critical of his actions (remember the Duke's inadvertent revelation of his murderous jealousy in "My Last Duchess"). Robert Langbaum identified the tension between "sympathy and judgment" as the distinguishing characteristic of dramatic monologues – readers experience a pull between the sympathy the narrator evokes and their powers of critical judgment (75–108). Although Kathy's companionable voice does not resemble Browning's taut verse, the novel uses the dramatic monologue form to similar ends. It solicits our sympathy for Kathy while provoking us at every turn to wonder about the narrator's obvious evasions and suppression of self-knowledge. The narrative voice almost compels us to treat it symptomatically, to hear notes of critique in the very words that disavow it.

Observe, for example, the prominent use of deixis to smooth over the many temporal jumps in the story. "Deixis" is a lexical marker that points to a person, place, or time – a word or phrase that cannot be fully understood without reference to the speaker or listener: "I," "you," "here," "there," "then," and "now" are standard examples. Inevitably, deixis will have a special importance in dramatic monologues in which the reader overhears a speaker talking to a particular person. In *Never Let Me Go*, phrases such as "Looking back now" or "My memory of it" occur

throughout – I count more than twenty variants. References to Kathy's listeners carry equal deictic force: versions of the phrase "I don't know how it was where you were" occur often, implicating the unnamed listener (and momentarily, the reader) in the story being told. Deictic language plays an important role in autobiographical writings too, where it locates an event from the speaker's life in relation to the moment of the telling. It anchors memory in relation to both past and present. In Ishiguro's dramatic-monologue-as-*bildungsroman*, deixis is responsible as much as anything else for the prevailing mood of melancholy.

Yet deixis has a disruptive effect in a dramatic monologue that it does not possess in ordinary first- or third-person narrative. A phrase like "I don't know how it was where you were" momentarily brings the reader up short, making us wonder if we are being addressed by the narrator. Anne Whitehead remarks: "Ishiguro's use of second-person address throughout the novel, a device commonly used in Victorian fiction to enhance sympathetic connection ... acts rather to unsettle the reader" (58). It "raises the question of the reader's relation to the dystopic world that is depicted in the novel. Is Kathy addressing someone within her own world, or, finding no empathetic listener there, does she seek to bear witness to an unknown and unknowable future reader?" (Whitehead 73–74). This momentary confusion turns our judgment on biodystopia back on ourselves. *How is it where we are?* we ask, and the question prompts us to wonder whether the pleasures of realism have led us to overlook inquiries we ought to pursue – inquiries not only about the novel we are reading but about our own world.

To come to terms with Kathy's society, we must come to terms with the voice of the character it has forged. In a novel where the point of view has been shaped by the conditions of abjection, the pull between sympathy and judgment becomes acute. We might say that the novel has found an ideal voice for biodystopia. The critical force of the genre is simultaneously displaced and channeled through the text's odd repetitions, preternatural calm, and idiomatic phrasing. In a similar way, the tension between the pleasures of nineteenth-century realism and the irony about what those pleasures encode is rendered equally acute.

## Time and Sorrow

Every sorrow has its own time signature. Some are short and sharp. These concentrate the present, blotting out any thought of a future without pain. Others prolong the present, stretching it out into what seems an

interminable durée. Still others deepen the present moment, binding it to a cherished past and infusing it with borrowed meaning. This last is the sorrow that underwrites Kathy's memoir.

In the nineteenth century, this sorrow went by the name of Romantic melancholy. Its compensatory structure still had the power to console, braced as it was by self-recognition in Wordsworth, George Eliot, Hopkins, and the late Dickens. Knowledge of the diminishment of life's expectations was the sorrow these authors were willing to bear for the growth of a writer's mind. But if Romantic melancholy can now seem maudlin or self-pitying, it is because the Romantics seemed to be mourning themselves as they remembered their past. We miss the irony with which Ishiguro chastens his characters' sorrow.

For most of my life, this kind of sorrow has bound our collective present to a planetary future we wanted to avoid but feared we could not. During the Cold War, it was fear of nuclear holocaust and an end that Jonathan Schell memorably captured in his book on nuclear winter. Today, this future is mostly associated with ecological disasters consequent on climate change. It is not the present we mourn for but the future our children may not have. Or if we mourn the present, it is a present that encompasses past and future as well, a swollen, guilt-stained, accusatory present, implicated in all the misdeeds of the era we have come to call the Anthropocene and shadowed by all the extinctions to come. But the vast temporal apprehensions of climate change are not the form sorrow takes in Ishiguro's novel. Just as Romantic melancholy is banished by irony, so large-scale planetary concerns are set aside by the intimate proportions of this *bildungsroman*.

The concept of genome time is an appropriate way to understand the short, sad lives of these genetic creations, the clones, made only to give up their bodies for others. Their sorrow is one that all creatures share, the sorrow of mortality, yet it is expressed differently in every person's life. The personal scale of a life-form shaped by biotechnology, of memories that will be "lost like tears in the rain,"[14] is well served by a spatiotemporal image that begins at the nanoscale and extends to all life-forms on the planet – perhaps most of all, to each of us. Ishiguro hardly refers to science at all, but the metaphor of the genome, shared by us all as our inheritance and our legacy, infinite yet unique, common as mortality yet exceptional in every case, encapsulates the sorrow this novel evokes.

# *Conclusion*

One week in late April 2016, my wife and I traveled to Paris to attend the European Union Workshop on Human Genome Editing. Ellen was a member of the international committee commissioned to come up with guidelines for regulating research and therapy in this contentious area. I was along as an amateur ethnographer, observing the rituals of this highly educated, ideologically diverse tribe called the "policy community."

Over the years, I had been to enough such meetings to know some of the principal players by name. There was the cochair, Alta Charo, a plain-spoken, fiercely intelligent law professor from the University of Wisconsin. Born in Brooklyn, with a bachelor of arts degree in biology from Harvard and a juris doctor degree from Columbia, she has served on numerous bioethics committees over the years and became a member of the National Academy of Medicine in 2006. She loves old movies, Jane Austen, and science fiction, and is about as amiable a companion as you can have for an afternoon exploring the little side streets of l'Hôtel-de-Ville. Sharon Terry was there, the president of the Genetic Alliance, one of the most successful patient advocacy groups in the world. A former nun with a master of arts degree in religious studies, she became interested in genetics when both her children were diagnosed with pseudoxanthoma elasticum (PXE), an autosomal recessive disease of the connective tissue that can cause vision loss, narrowing of the arteries, pain during exercise, and other symptoms. Jeffrey Kahn, one of the current leaders in bioethics, was a speaker. He is a handsome man who looks a bit like he came from a lost branch of the Kennedy family. His doctorate is in philosophy, and he has an unusual ability to argue clearly about complex matters in a considerate, thoughtful tone.

The meetings were held in the august chambers of the Académie Nationale de Médecine on Rue Bonaparte, and in honor of the gathering, its library had assembled an exhibit of letters about medical education received by members of the French Academy from Benjamin Franklin and John Adams. The proceedings followed the same format as countless

literature conferences I have attended over the years. Only the panels were titled things like "Potential Applications for Germline Editing," "International Governance Perspectives," and "Regulatory Orientations." Some readers of this book might quail at the thought of spending several days in an auditorium listening to talks on such topics, but in fact, the presentations touched on issues of concern for every citizen, and like most policy talks, they were easy to understand.

Just as interesting as the speakers were the participants in the audience. As I circulated during the breaks, I met representatives from Doctors without Borders, the Defense Advanced Research Projects Agency (DARPA), the World Health Organization, the Wellcome Trust, the LeJeune Foundation (a Down syndrome and antiabortion advocacy group), the Chinese Academy of Science, and the Vatican. I talked with scientists who specialized in genetics, cancer biology, nanotechnology, artificial intelligence, physical chemistry, and pharmacology. I met a sociologist, a futurologist, and a professor of science communication. We heard from the entrepreneur who founded Bento Bio, which makes home laboratories that let you "experience genetics anywhere." The representative from the Vatican made clear his opposition to meddling with the human genome, but I could not get much out of the well-dressed, young woman from DARPA – "Genetically modified super soldiers?" I hinted, striving to make my Southern accent so artless that butter would not melt in my mouth. But she just smiled and said "DARPA sends me to all kinds of interesting events."

The committee was convened in response to the advances that CRISPR/Cas9 has made possible in changing the human genome. For the first time, scientists can now edit sequences of DNA with relative safety and precision, making possible the kind of direct intervention in the genome that people expected to follow hard on the heels of sequencing the human genome back in the early 2000s. Those were heady days. President Clinton compared Francis Collins and Craig Venter, the leaders of the two teams that had raced to complete the map of the human genome, to Lewis and Clark and Galileo, and he proclaimed, "Today, we are learning the language in which God created life." People were predicting fabulous new cures for existing diseases in short order. President Clinton joined the chorus: "it is now conceivable that our children's children will know the term 'cancer' only as a constellation of stars" (Clinton). At the same time, there were dire predictions of designer babies made to order over the internet; of a super-intelligent elite ruling over the unenhanced masses; and of terrible mutations sweeping through the species like a pandemic.

After a few years, however, scientists came to realize that progress was not going to be quick or easy. The existing methods of delivering genome therapies were not accurate enough to reach targeted regions of DNA consistently, and the risk of unintended changes in other parts of the genome was far too high for human interventions to be permissible. As more than a decade passed without the astounding advances promised by some of the architects of the Human Genome Project, disillusionment set in. But CRISPR/Cas9 changed all that. Once again, we are in a time of high promise and imminent peril.

An international committee like the one meeting in Paris was imperative, because attitudes toward editing the genome vary widely across the globe. When it comes to heritable modifications, the UK regulation is more flexible than that of the United States, France, or Germany. Some countries in Latin America are vigorously opposed to *any* heritable intervention in the genome. China, on the other hand, was the first to engage in CRISPR/Cas9 research that could be used to alter the genetic makeup of humans, and a renegade Chinese scientist subsequently announced the birth of gene-edited twins.

After the Paris meeting, the international committee held another public hearing in Washington, DC, and then went into intensive private sessions in which they hammered out a set of "Global Principles for Research and Clinical Use" and developed recommendations for regulatory approaches to basic laboratory research, somatic genome editing, germline editing, and enhancement. Like all National Academy reports, it is available for free at the Academy's website (*Human Gene Editing*).

The recommendations are sensible, in my view, and will be useful in clarifying the options for governments, medical professionals, disciplinary organizations, and funders around the world. The Global Principles were fairly anodyne, as any set of international ethical principles would have to be. Still, they were worth stating: "Promoting Well-Being, Transparency, Due Care, Responsible Science, Respect for Persons, Fairness, and Transnational Cooperation." There were some surprises in the report, however. The committee found that current regulatory structures were adequate for laboratory research and somatic genome editing, but they suggested some restrictions. Countries should "limit clinical trials or therapies to treatment and prevention of disease or disability at this time" (i.e., no enhancement); "evaluate safety in the context of risks and benefits"; and "require broad public input." For germline editing, the committee was more cautious, recommending that clinical research trials be permitted only for "compelling purposes of treating or preventing serious

disease or disabilities, and only if there is a stringent oversight system" (National Academies, *Human Genome Editing*).

What many people found surprising was that the committee had suggested letting human germline editing go forward at all. Some in the press treated this conclusion as astounding. The *New York Times* said the National Academies had for the first time "lent its support to a once-unthinkable proposition" (Harmon). The *Washington Post* characterized it more temperately: "the new report takes a slightly more permissive, forward-thinking position, saying that, if and when such interventions are proved safe – which could be in the near future – and if numerous criteria are met to ensure that such gene editing is regulated and limited, it could potentially be used to treat rare, serious diseases" (Achenbach).

It will be interesting to watch how the ethical debate and regulatory process proceeds over the next few years. The National Academies report does not carry the force of law, of course – none of the studies produced in the policy sphere does. But it will have great influence on future discussions.

On the last night of the Paris meeting, I was invited along with the other spouses for a dinner cruise on the Seine. As I dressed for the evening, I could not help feeling a bit amused. A dinner cruise for tourists? The night promised to be cold, and it was already raining. But I shouldn't have worried. After the intensity of the deliberations, everyone was ready to relax and set aside disagreements. When you counted up committee members, staff, and all their guests, we were more than forty in number, seated on both sides of a long table stretching nearly the full length of *Le Calife*, one of the familiar tourist boats that ply the Seine nightly. We set sail on choppy waters, but the buildings lit up on either bank slipped by in undiminished splendor. I was seated across from a sociologist of religion and a communications scholar from Germany and was flanked by two geneticists. They were delightful companions, full of entertaining stories to complement the good wines and somewhat rubbery *le blanc de poulet*.

When my dinner companions heard about the book I was writing, they wanted to know which was my favorite novel about genetics. It all depends on my mood, I replied. Some are beautiful, others melancholy, some fierce, some complex, and some simply thrilling. Later came a more pressing question: Why do novels matter? It was the geneticist to my left asking, and perhaps he really meant, why should he care what a novelist had to say about science. I was not going to rise to the bait, but I could not help reflecting on the components that were going into the consensus statement they were working so hard to prepare. Each committee member

on that boat spoke from a position of authority, but where did that authority come from? I looked down the long table and suddenly found myself imagining I was in one of those satiric dinners so common in novels by Thomas Love Peacock, where each character bore an allegorical name: Science, Religion, Law, Philosophy, Public Opinion, Commerce, Personal Experience. If deference were to be paid to Religion, why not to the "wise books, bright windows, in this life of ours," invoked by the narrator of *The Island of Doctor Moreau*? If Commerce, in the guise of a marketer of home genetics kits, can advise on the law governing gene editing, why not someone who has thought deeply about dystopian visions of the future? If Personal Experience of children with a genetic disease is to have her say, why not Margaret Atwood too? If Leon Kass and Francis Fukuyama can premise their arguments against tampering with the genome on simplistic readings of *Brave New World*, why not someone who understands Huxley in the context of both his own time and today? If we listen to Public Opinion, why not to the poetry that forestalled violence at the end of Ian McEwan's *Saturday*:

> Ah, love, let us be true
> To one another! for the world, which seems
> To lie before us like a land of dreams,
> So various, so beautiful, so new,
> Hath really neither joy, nor love, nor light,
> Nor certitude, nor peace, nor help for pain;
> And we are here as on a darkling plain
> Swept with confused alarms of struggle and flight,
> Where ignorant armies clash by night.
>
> Mathew Arnold, "Dover Beach"

Some believe that gene editing promises to save lives. Some believe that genetics will one day be able to predict our entire future. Some believe science will ultimately discover the Truth about the universe. Literature offers other forms of meaning. It gives access to different kinds of truth and has the power to heal the spirit if not the body. Art may not literally save our lives, but it might make us better understand why lives are worth saving. Yes, the promise of literature often seems more diffuse and metaphysical than that of science. But there is one pragmatic function of literature that this book has urged us to embrace, and that is the role that literature might play in dialogues about the values our societies hold dear at a time when the world needs such voices more than ever.

Our dinner cruise was nearing its destination, the Eiffel Tower. We had heard that each night at nine, the tower lit up in a grand display. The

dinner had been festive, but the room was growing hot and loud with the windows closed against the rain. While we waited for dessert, Ellen and I decided to walk outside where an awning at the front of the boat gave us partial shelter against the weather. The tower loomed above us in the night, impressive even in the dark. As we watched, the structure burst into light, strands of gold blazing from the base to the very top. It was a glorious sight, and it did away with any lingering weariness we were feeling from the din of the party. Then it was time to go back inside. There was dessert to be enjoyed and farewells to be said.

# Notes

## Preface

1 A small sampling of prize-winning works in this vein would include A. S. Byatt's *Possession* (Booker Prize, 1990), Richard Powers's *The Gold Bug Variations* (*Time Magazine* Book of the Year, 1991), Andrea Barrett's *Ship Fever* (National Book Award, 1996), Roger McDonald's *Mr. Darwin's Shooter* (National Fiction Award, Australia, 1998), Simon Mawr's *Mendel's Dwarf* (*Los Angeles Times* Book Prize, 1999), Zadie Smith's *White Teeth* (James Tait Black Memorial Prize and Whitbread Award, 2000), Jeffrey Eugenides' *Middlesex* (Pulitzer Prize, 2002), Margaret Atwood's *Oryx and Crake* (Orange Prize and Governor General's Award, 2003), Ruth Ozeki's *All over Creation* (American Book Award, 2003), David Mitchell's *Cloud Atlas* (British Book Award, 2004), Kazuo Ishiguro's *Never Let Me Go* (American Library Association Award, 2005), Ian McEwan's *Saturday* (James Tait Black Memorial Prize, 2005), Gary Shteyngart's *Super Sad True Love Story* (Bollinger Everyman Wodehouse Award, 2010), and Karen Joy Fowler's *We Are All Completely beside Ourselves* (PEN/Faulkner Award, 2013).

2 ELSI is a program of the National Human Genome Research Institute of the National Institutes of Health. The ELSI program funds research on the "Ethical, Legal, and Social Implications" of genetics. I will have more to say about the history and achievements of ELSI in Chapter 1.

3 This paragraph has been adapted from my discussion of "Genome Time" in *Charles Dickens in Cyberspace*.

## Chapter 1

1 CRISPR/Cas9makes it possible to insert or delete short sequences of DNA with greater precision than previous techniques, allowing medical geneticists to consider using the process to treat devastating heritable diseases. It also raises the specter of genetic engineering to enhance specific human traits such as size, strength, intelligence, or appearance, an ethical worry that once loomed only in the future. For the National Academies' report on this topic,

see National Academies, *Human Genome Editing* (available as a free download at www.nap.edu/catalog/24623/human-genome-editing-science-ethics-and-governance).

2 Policy is an example of what Vayena and Blasimme call "governance," forms of indirect oversight that do not rely "on binding legal norms or pure market mechanisms." Governance

> refers to activities such as self-regulation; soft law; codes of conduct; review bodies; auditing mechanisms; expert advice; coordination initiatives among public authorities, researchers, and private actors; deliberation; citizens' forums; and public engagement initiatives. Some governance mechanisms aim at channeling the activity of stakeholders in ways that correspond to public expectations or to previously declared principles (including ethical principles) (123).

3 Daniel Callahan, head of the Hastings Center in New York, one of the two oldest bioethics centers (the other being the Kennedy Center in Washington, DC), commented in 1976 that bioethics was still "not yet a full discipline" (qtd. in Rothman 242). Following the Baby Doe controversy in 1982, a president's commission under Ronald Regan recommended the creation of ethics committees in all hospitals with neonatal care units, and the American Medical Association, the American Academy of Pediatrics, and the American Hospital Association made similar recommendations (Rothman 255).

4 Rothman dates the first IRBs to 1966, when the NIH began requiring them to review all grant proposals for federal funds (89). The Surgeon General commented at the time, "this action has introduced an important element of public policy review in the biomedical research process" (qtd. in Rothman 90). For a detailed history and assessment of the strengths and weaknesses of IRBs, see Robert Levine.

5 A classic statement of this perspective is Robert K. Merton's "The Normative Structure of Science." Henrika Kuklick summarizes this older view of science: "Insulation from social pressures guaranteed a high level of social responsibility rather than its absence" (127).

6 Steven Shapin assembled a short anthology of quotations by scientists and philosophers in the first part of the twentieth century – Alfred North Whitehead, Ludwig Wittgenstein, Thorstein Veblen, Max Weber, Albert Einstein, among others – to the effect that science, in Veblen's words, "knows nothing of policy or utility, of better or worse" (Shapin, *The Scientific Life* 9–13).

7 For discussions of the role of transdisciplinary teams and project-oriented research groups in contemporary science, see Klein; Powell and Owen-Smith; and Wuchty et al.

8 Brint in *In an Age of Experts* argues that most policy experts have "limited mandates and limited influence" (135), but his conception of influence relies on an older model of individuals directly shaping the outcome of debates through their advice to politicians and does not take into account the mediation of the policy arena, which disseminates the advice of experts through a set of social institutions (IRBs, ethics committees, professional

societies, patient groups, etc.). The recommendations of ethics panels can have an indirect effect in setting norms of practice and framing issues, regardless of whether they are enacted in law. Brint himself acknowledges this more diffusive type of power: "Expert influence tends to be maximized when experts successfully define matters of substance as narrowly technical issues, or when they successfully define responses to issues as based on the protection of a central cultural value" (141).

9 See Condit, *The Meanings of the Gene*; Condit, Ofulue, and Sheedy, "Determinism and Mass Media Portrayals of Genetics"; Nelkin, "Promotional Metaphors and Their Popular Appeal"; and Nelkin and Lindee, *The DNA Mystique: The Gene as a Cultural Icon*.

10 For the aesthetic and formal turn in literary criticism, see Elaine Scarry and Caroline Levine. For influential discussions of surface reading, see Best and Marcus, and Love. A related trend toward "postcritical" methods of reading understands that interpretation is only the first stage in a two-step process, the second of which, in the case of policy work, is an effort to propose recommendations that address a larger ethical, legal, and social problem (see Felski).

11 Influential accounts of metaphor in scientific language include Keller, *Refiguring Life: Metaphors of Twentieth-Century Biology* and *Making Sense of Life*; Lewontin, *The Triple Helix*; and Kay, *Who Wrote the Book of Life?*

12 This paragraph borrows wording from the NIH grant proposal that Priscilla Wald and I coauthored in 2003.

13 See the consensus study from the National Academies of Science, Engineering, and Medicine, *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree* (2018) and the report by the American Association for the Advancement of Science, *Facilitating Interdisciplinary Research and Education* (2012).

14 See "AAU Announces Major Initiative to Improve Undergraduate STEM Education" (2011).

15 Jon D. Miller, "The Measurement of Civic Scientific Literacy" and "Civic Scientific Literacy: A Necessity in the 21st Century." Michael Dougherty, writing in the *American Journal of Human Genetics*, says: "A scientifically literate public is essential if citizens are to engage effectively with policymakers on issues of scientific importance. Perhaps nowhere is this conjunction more personally meaningful than in human genetics and medicine" (6).

16 Later chapters will take up the shifting balance of fortunes between science and literature in each of the three periods I study. This matters in part because the reputation of science is an important topic of concern in the policy world (see Bernard Davis).

17 Readers will meet Bach's *Goldberg Variations* again (invariably played by Glenn Gould) in Powers's *The Gold Bug Variations*, Margaret Atwood's *Oryx and Crake,* and David Mitchell's *Ghostwritten*. I suspect Douglas Hofstadter's wonderful *Gödel, Escher, Bach: An Eternal Golden Braid* (1979) started the craze by including the double helix along with Bach's *Goldberg Variations* as prime examples of braided structures.

18 A more impressionistic but still influential work in this vein was Ruth Hubbard and Elijah Wald's *Exploding the Gene Myth* (1993). Hubbard and Wald similarly point out that "the myth of the all-powerful gene is based on flawed science that discounts the environmental context in which we and our genes exist. It has many dangers, as it can lead to genetic discrimination and hazardous medical manipulations" (p. 6).

19 There are numerous models for how this process occurs. Roland Barthes would argue that texts constitute the "*subject* of reading." Michel Foucault looks at the effect of what he calls "discursive formations in constituting meaning." Fredric Jameson says that a text's place in historically evolving genres allows narrative to become a "socially symbolic act." Hans Robert Jauss maintains that texts establish their own "horizons of expectation that govern interpretation." These are just a few of the most influential models in the literary world for how texts position readers within larger cultural frameworks. Different as these models are from one another, they all provide insights into the cultural work of texts that are not dependent on how an individual reads any particular story. My own approach, with its emphasis on the cultural work of genres, is closest to that of Jameson.

20 Hetan Shah, chief executive of the British Academy, calls for the inclusion of humanists in science policy: "More could be done to connect the policy community with external social science and humanities expertise. . . . Without the humanities and social sciences, hard science and technology can do little to resolve complex societal challenges" (295).

21 The anthology, a 628-page paperback titled *Being Human: Readings from the President's Council on Bioethics*, was distributed free upon request until the Council ran out of copies, the only one of its six publications to do so. It was subsequently reissued by a commercial publisher.

22 For a transcript of the first meeting, see https://bioethicsarchive.georgetown.edu/pcbe/transcripts/jan02/jan17session2.html.

23 For valuable accounts of this development, see Readings, *The University in Ruins*; Newfield, *Ivy and Industry*; and Tuchman, *Wannabe U: Inside the Corporate University*.

24 I proposed a model of disciplinary alliances as an alternative to older notions of interdisciplinarity in the conclusion of *Charles Dickens in Cyberspace* (2003). Sander Gilman made a similar proposal in his contribution to a symposium issue of *Critical Inquiry* devoted to the future of literary studies (386). Wailoo, Nelson, and Lee also advocate a "multidisciplinary approach" (4) to research on race and genomics in their "Introduction" to *Genetics and the Unsettled Past: The Collision of DNA, Race, and History*.

## Part II

1 Charles Taylor, in his magisterial *A Secular Age*, writes: "[T]he story linking God and humans in the Fall and Redemption . . . imposed a shape on things

which sets an outer limit to any sense of unfathomable, bewildering depths in physical reality" (349). Sue Zemka drew my attention to this passage in a talk she gave at the Robert Penn Warren Center, Vanderbilt University (since published as "Sacred and Secular Time in Literature").

2 See Chakrabarty. For foundational works that put literature in the context of deep time and climate change, see Dimock; Heise, *Sense*; Hensley and Steer; and Zemka, *Time*.

## Chapter 2

1 According to Karpowicz et al., "[t]erms like 'chimera' or 'hybrid' are widely used in experimental biology." After reviewing the differences among the usages in the fields of molecular biology, cell biology, embryology, and genetics, they conclude with the definition of "chimera" they will adopt: "finally, there are interspecies xenografts of tissue into postnatal hosts" ("Ethical" 331). This definition could easily apply to the method that Moreau uses in his surgical laboratory, although Karpowicz and his collaborators have in mind the transplantation of small numbers of cells rather than of large organs. The IOM committee similarly restricts its use of the term "chimera" to a meaning relevant to *Doctor Moreau*: "Chimeras, unlike genetic hybrids, consist of mixtures of cells (or, in some cases, tissues) from two different kinds of animals. Unlike the situation in hybrids, there is no commingling of genetic material in individual cells of a chimera" (Institute of Medicine, *Guidelines for Human Embryonic Stem Cell Research* [hereafter cited as *Guidelines*] 32–33).

2 See Institute of Medicine, *Guidelines*. Until its name was changed to the National Academy of Medicine in 2015, the Institute of Medicine was the branch of the National Academies responsible for providing expert advice to the government, scientists, the medical community, and the public at large. For reports published before the name change, I shall continue to refer to them as prepared by IOM committees.

3 For other policy publications that cite *Doctor Moreau*, see Bonnicksen (25, 59); Brem and Anijar; D. Bennett (347); and Hinterberger (455). Numerous articles and reports discuss similar creatures from myth and fiction. See, especially, Harris, who comments: "we may be letting our expectations of what humanimal [*sic*] creatures would look like . . . be conditioned by mythology, by what we might call the 'mermaid myth,' which involves the belief that if you mix the genes of a man and a fish you will necessarily make a creature . . . that is half fish and half human" (12).

4 See Stiles; Haynes (*From Faust to Strangelove: Representations of the Scientist in Western Literature* and "Frankenstein: The Scientist We Love to Hate").

5 Lankester, another student of Thomas Huxley, would soon become one of Wells's closest friends. Lankester's work on degeneration established, in Stephen Jay Gould's words, "that Darwin's mechanism of natural selection

led only to local adaptation, not to general progress, and that such immediate improvement will often be gained . . . by morphological simplification and loss of organs" ("A Darwinian Gentleman" 3). Both the idea of immediate, if short-term, improvement in a species through loss of organs and the attack on the notion of evolution as progress are relevant to Wells's novel.

6 The IOM *Guidelines*, like other recent commentaries on chimeras, brackets the question of animal rights, noting that animal experimentation is governed by existing regulations. Here is how one article by a large multidisciplinary working group, published shortly after the IOM *Guidelines*, circumscribes its focus on chimeras: "Some group members have serious ethical concerns over *any* use of nonhuman primates in invasive research. However, we set aside broader controversies to focus on ethical challenges specific to human-to-nonhuman primate (H-NHP) neural grafting" (Greene et al. 385).

7 In "Human Evolution, An Artificial Process," an essay published the same year as *Doctor Moreau*, Wells endorses Weismann's "destructive criticisms of the evidence for the inheritance of acquired characters" (Wells, *Early Writings* 211). Huxley's "Evolution and Ethics" (1893), which I shall discuss shortly, also criticizes the fallacy of believing in the inheritance of acquired characters.

8 Karpowicz et al. write:

> The neurological functions of the nonhuman brain would remain unaltered because their organization would be governed by the animal host. The human cells would change with their environment to mimic the nonhuman host's native morphology and function and their genetic dissimilarity relative to the host would make no difference in the way in which the host brain functioned. They would become the practical equivalent of mouse or monkey cells. ("Developing Human-Nonhuman Chimeras" 124)

9 For discussions of professionalization in the sciences from the 1830s through the 1860s, see Cannon; Morrell and Thackray; Yeo; and Chapter 3 of my book *Charles Dickens in Cyberspace*. Graff has documented the birth of the discipline of English in the 1880s. The rise of the social sciences around the same period has been treated by Novick.

10 For the development of professionalism in the nineteenth and twentieth centuries, see Larson. Among the many studies of relations between the sciences and the humanities, I have found John Guillory's work most useful (see his book *Cultural Capital* and his articles "The Sokal Affair" and "Literary Study and the Modern System of the Disciplines").

11 For Wells's advocacy of science education and accessible science writing, see his series of articles for *Nature* in 1894, "Popularizing Science," "Science: In School, and After School," and "The Sequence of Studies."

12 The next chapter of this book looks closely at late-Victorian theories of the inheritance of acquired characters.

13 Huxley's unusual insight into how culture might function as a feedback mechanism is prescient; it looks forward to cybernetic models of intelligence formulated by Norbert Wiener in the 1940s and still current in much artificial intelligence research today. Huxley likely derived this understanding of

governors from James Clerk Maxwell's pioneering article of 1868, "On Governors." Otto Mayer traces the origins of cybernetics back to Maxwell's paper. My thanks to Megan Ward for drawing my attention to Maxwell's article in an illuminating conversation following a presentation drawn from this chapter.

14 Steven Johnson, in his introduction to contemporary theories of emergence, also detects foreshadowings of the concept of emergence in the writings of several Victorians (22).

## Chapter 3

1 Kelvin's calculations, based on estimates of thermal transfer within the earth and from the sun, vastly underestimated the age of the earth. It was not until the discovery of radioactive decay that a more accurate picture of the age of the solar system came into focus.

2 See Bowler, *The Eclipse of Darwinism: Anti-Darwinian Evolution Theories in the Decades around 1900*. Peter Bowler's work shaped my initial research on this topic. Peter Morton's comprehensive account of literary responses to competing theories of evolution was invaluable as well.

3 Laura Otis has written an important account of the intellectual background and cultural persistence of the analogy between memory and heredity during this period. See Otis, *Organic Memory: History and the Body in the Late Nineteenth and Early Twentieth Centuries.*

4 These were the publications that convinced H. G. Wells that the neo-Lamarckians were wrong. Peter Morton cautions that none of these figures – not even Huxley or Weismann – was without their doubts about one aspect or another of Darwin's ideas (20–21). Just as the term "neo-Lamarckism" encompasses a range of views, some in conflict with others, so the notion of a "pure Darwinian" in the period needs to be hedged with reservations.

5 Classic accounts of the formal similarities between the realist novel and Darwin's *Origin of Species* include Beer (*Darwin's Plots*) and Levine (*Darwin and the Novelists*).

6 Jessica Staley first drew my attention to the fit between plot-driven genres and sensationalized responses to evolution in a comment following my paper at the North American Victorian Studies Association (Madison, September 28, 2012).

7 Morton writes, "It is almost unnecessary to remark that post-Darwinian biology entered in some form into the fabric of practically every one of the temporal Utopias written after 1870" (97). By "temporal Utopias," he means novels set in a distant future, not a spatially remote region. Of course, many utopias set in remote places rather than times also featured neo-Lamarckian themes, including *The Coming Race* and *Erewhon*.

8 These are the aspects of the novel David Amigoni, who has written on neo-Lamarckism, says that he and his students enjoy (conversation following my

talk at the "Biology and Culture Workshop" at the University of Exeter, September 2011). Bulwer-Lytton's vision strikingly foreshadows a recent biodystopia, Naomi Alderman's *The Power* (2016).

9 Galton did not coin the term "eugenics" until 1883.

10 No one had to read Darwin at this period to acquire ideas about evolution. As Morton remarks, evolutionary concepts were disseminated widely through

> Huxley's "lay sermons" and the close-knit articles directed at the concerned layman by Alfred Russel Wallace and H. G. Wells; the "popular essays and addresses" of a dozen scientific sages; the lesser productions of popularisers now utterly forgotten: all of these helped to establish the human interest of the new biology in a way not markedly different from the fictional writers. (Morton 12)

11 For comment on this motif, see Etherington (xviii).

12 See Annie Besant (153). Janet Oppenheim remarks: "The great majority of British spiritualists harbored no unsettling doubts about the implications of evolution. They eagerly embraced the idea of organic change, finding that Darwin served to confirm their own scenario of progressive development beyond the veil" (270).

13 My reading thus differs from that of Nina Auerbach, who asserts that "Ayesha rules because she shares the vital metamorphoses of an unfixed world" (37). It is hard to understand how Auerbach came to this conclusion since Ayesha revels in her unchanging devotion, the ageless perfection of her beauty, and her isolation from the tumult of history outside her hidden cavern stronghold.

14 For foundational statements of literary Darwinism, see Gottschall and Wilson, *The Literary Animal: Evolution and the Nature of Narrative*. For a powerful critique of the movement, see Kramnick.

## Chapter 4

1 There is debate over whether or not contemporary fiction that uses metahistorical techniques to explore nineteenth-century North America should be considered neo-Victorian. Signal examples of such works include Octavia Butler's *Kindred* (1979), Charles Johnson's *Middle Passage* (1990), Margaret Atwood's *Alias Grace* (1996), Steven Millhauser's *Martin Dressler* (1997), Thomas Mallon's *Two Moons* (2000), Edward P. Jones's *The Known World* (2003), and Michael Cunningham's *Specimen Days* (2005).

2 I am grateful to Herbert Tucker for pointing out the pertinence of Mill's comparison of Bentham and Coleridge following a presentation I gave on this material at North American Victorian Studies Association 2015.

3 For a discussion of Barrett's story about Darwin in *Ship Fever*, see my book, *Charles Dickens in Cyberspace*, 170–72.

4 A comment by my colleague Rachel Teukolsky about the increased interest today in animal studies and climate change versus the 1990s when Barrett and Byatt's stories were published stimulated my thinking about the different emphasis these three authors put on the question of extinction.

5 Mitchell registers the influence of Wells on his Pacific chapters by having a later character compose an unfinished opera on the theme of Wells's *The Island of Dr. Moreau* (Mitchell 84).
6 In narratology, the chronological order of events is termed the "fabula" or "story," while the events as rearranged in the telling is termed the "sjuzet" or "discourse" (Chatman). Thus, the chronological end of events in the fabula comes at the center of the novel, while the end of the sjuzet occurs on the final page of the book.
7 To underline the allusion encoded in Adam's name to the story of creation in Genesis, the opening scene of Zachry's chapter shows his older brother, named Adam, being abducted by a fierce rival tribe, resulting in his disappearance from the narrative entirely.
8 Other chapters have equally deep roots in memory and personal narrative – "Letters from Zedelghem" in the personal letter, "An Orison of Sonmi-451" in the criminal confession narrative.

## Chapter 5

1 See Peter J. Bowler, *The Eclipse of Darwinism*.
2 See Haldane's "Darwinism Today," in *Possible Worlds* (1927), where the words are ascribed to Henri Belloc, and *The Causes of Evolution* (1932), where they are flippantly attributed to "Any sermon."
3 See Fredric Jameson, *The Political Unconscious*. In *Life between Two Deaths*, Wegner nominates Jack London's *The Iron Heel* (1908) as the first dystopian fiction. Tom Moylan, in *Scraps of the Untainted Sky: Science Fiction, Utopia, Dystopia*, calls London's work a "proto-dystopia" (307) and proposes E. M. Forster's short story "The Machine Stops" (1909) as the founding text of the new genre.
4 Susan Merrill Squier is one of the few literary critics to have discussed this circle. Her *Babies in Bottles: Twentieth-Century Visions of Reproductive Technology* perceptively explores the fiction of Charlotte Haldane and Naomi Mitchison (Haldane's sister) in relation to modern biology and has valuable readings of Julian Huxley's story "The Tissue Culture King" and *Brave New World.* See also Squier's "Sexual Biopolitics in *Man's World*," "Reproducing the Posthuman Body," and "Conflicting Scientific Feminisms: Charlotte Haldane and Naomi Mitchinson"; and Judith Adamson, *Charlotte Haldane: Woman Writer in a Man's World*.
5 We know Aldous Huxley was still reading Haldane's work from Huxley's review of Haldane's essay collection in the *Week-End Review* on December 10, 1932 (Bradshaw, *The Hidden Huxley* 6). For Lawrence's arguments with the Huxley brothers, see Sybille Bedford, *Aldous Huxley: A Biography*.
6 Critics of the novel have done an excellent job in recording Aldous's intellectual debts to Haldane's "Daedalus" as well as to numerous other important sources. For the influence of Haldane's "Daedalus" (1923), see Peter Edgerly

Firchow, *The End of Utopia* (40–45). For Bertrand Russell's *The Scientific Outlook* (1931), see Philip Thody, *Aldous Huxley: A Biographical Introduction* (50–51); for E. A. Burtt's *The Metaphysical Foundations of Modern Physical Science* (1924), see Nicholas Murray, *Aldous Huxley: A Biography* (175); for J. B. Watson's *Behaviorism* (1924), see Firchow, *End of Utopia* (45–46); for Henry Ford's *My Life and Work* (1922) and Ford's vocal critics, see Robert S. Baker, *"Brave New World": History, Science, and Dystopia* (85–87); and for Sir Alfred Mond's *Industry and Politics* (1927), see James Sexton, "*Brave New World* and the Rationalization of Industry" (93–100).

7 Firchow observes that Aldous Huxley

> knew a great deal about science and about scientists, as the genuine respect with which these and other eminent scientific friends and acquaintances treated his scientific knowledge makes clear. As June Deery points out, his reading included not merely popularized science, but material drawn directly from journals such as *Nature* and *The Lancet*, to both of which he subscribed, as well as scientific textbooks, especially in the areas of biology and psychology. ("Aldous and Julian: Men of Letters, Men of Science," 218)

8 For her memories of this episode, see Naomi Mitchison, *As It Was: An Autobiography (1897–1918)* (44–46).

9 Julian Huxley records that conversations with Aldous about biology were mutually beneficial: Aldous knew a great deal about "biological facts and ideas . . . from his miscellaneous reading and from occasional discussions with me and a few other biologists, from which we profited as much as he" ("Aldous Huxley" 22).

10 Compare Huxley's "Measurable and Unmeasurable" (1927) and "Varieties of Intelligence" (1927) with Haldane's "The Inequality of Man" (1932). Huxley argues that IQ tests cannot measure the varieties of talents found in people; Haldane agrees that individuals have special talents but cites Spearman's concept of "g," the sum of special and general abilities, as a possible way around Huxley's objections.

11 See the last chapter of Aldous Huxley's *Antic Hay* (1923) and Haldane's *Possible Worlds* (78).

12 The historian of science Vassiliki Betty Smocovitis notes that almost no work has been done on placing the modern synthesis within the larger context of modernity: "Outside of the few studies on Julian Huxley (the most obvious politically and publicly engaged of the architects) no one had examined how . . . the movement toward a progressively secular and liberal worldview, and other cultural movements including 'internationalism,' 'modernism,' and the drive to create a unified global community" affected the effort to unify biology (50–51).

13 Among historians of biology, a divide exists between those who follow William Provine, who stresses the mathematical work of population geneticists such as Fisher, Wright, and Haldane in the 1920s and early 30s, and those who follow Ernst Mayr in also attending to the contributions of naturalists, paleontologists, and systematists such as himself, from the

mid-1930s and 1940s. The debate is summarized in Ernst Mayr and William Provine's coedited volume, *The Evolutionary Synthesis: Perspectives on the Unification of Biology*. I do not mean to take a position on this controversy. My focus on the earlier group merely reflects this chapter's concern with Aldous Huxley's relationship to Haldane and Julian Huxley.

14 See Bowler, *Evolution: The History of an Idea* (333–35).

15 Russell, *The Scientific Outlook* (129). Russell's dismissal of Bergson is amusing: "The metaphysic of Bergson . . . is undoubtedly pleasant: like cocktails, it enables us to see the world as a unity without sharp distinctions, and all of it vaguely agreeable, but it has no better claim than cocktails have to be included in the technique for the pursuit of knowledge" (76). See also Julian Huxley, *Evolution* (568).

16 Ortega and Huxley's conviction that some modernists "repudiated reality" would apply equally to some of the modern physicists, such as Arthur Eddington, that Haldane, Russell, and Julian Huxley criticized. Robert Caserio, in an unpublished manuscript that he generously shared with me, notes this feature in the writing of the physicists Sir James Jeans and Arthur Eddington. Caserio writes:

> Eddington's *The Nature of the Physical World* (1928) sounds the note that Jeans repeats. "We are haunted by the word *reality*," Eddington complains. It is useless for science to attempt to tie down the meaning of reality, or the entity that goes by the name, in a single-minded way. Eddington likens the physicist, in his relation to atoms or electrons, to the artist, "who tries to bring out the soul in his picture [but] does not really care whether and in what sense the soul can be said to exist."

Haldane and Julian Huxley always thought it was important that the picture they drew could be said to exist.

17 This is Charlotte Haldane's criticism of *Brave New World*: "It is throughout a parody of the scientific point of view" ("Review in *Nature*," 208).

18 Haldane *fils* only demurs at the implication that his fictional avatar was unsuccessful in his own extramarital affair (Clark 57).

19 May Sarton in an interview describes the process more forthrightly: "Maria Huxley, you know, tamed women for Aldous. The young tigress, you know, she broke them in" (quoted in Murray 148).

20 For an analysis of current approaches to the "new modernist studies," see Mao and Walkowitz; Friedman. For global modernism, see Wollaeger.

21 "Satire" is a capacious term. As a mode, it is more of a tone of ridicule directed at the world's folly, and it can be present in any genre: poem, drama, novel, or essay. Even as a genre, its form is notoriously protean. The principal theorists of satire in the twentieth century – Northrop Frye, Alvin Kernan, Ronald Paulson, Gilbert Highet, and Dustin Griffin – emphasize satire's open form, its difficulty with closure, and its digressive, episodic, parodic, or rhetorical impulses. Most distinguish among formal verse satire, Peacockian satire, and the learned Menippean satire, which Northrop Frye calls "encyclopedic satire" or "anatomy" (*Anatomy of Criticism* 308-14). According to Ronald Paulson,

> Satire enjoys the episodic forms, the collection of stories or anecdotes, the list, the large dinner party or the group conversation, the legal brief, the projector's pamphlet, the encyclopedia, and the calendar. When it assumes a less accommodating form it always exploits only those aspects that serve its own end; when it does not find those aspects in the form parodied it superimposes them. (5)

For good treatments of Huxley as a satirist, see Peter Edgerly Firchow, *Aldous Huxley: Satirist and Novelist* and Jerome Meckier, *Aldous Huxley: Satire and Structure*.

22 Huxley denied that Rampion was a portrait of D. H. Lawrence, writing to a correspondent: "Rampion is just some of Lawrence's notions on legs. The actual character of the man was incomparably queerer and more complex than that" (Aldous Huxley to Mrs. Mabel Dodge Luhan, in *Letters of Aldous Huxley*, 340). Insofar as it is Rampion/Lawrence's ideas about science that are our concern, the accuracy of the sketch of Lawrence's character is of secondary importance.

23 Some commentators have seen Rampion's values as the touchstone of *Point Counter Point*. See Bradshaw, "Modern Life: Fiction and Satire," and Rosenthal, "Isherwood, Huxley, and the Thirties." This notion is belied both by Huxley's comments on Lawrence's ideas about evolution and the portrayal of Rampion as blustering and dogmatic.

24 Fredric Jameson is only the most prominent recent critic to focus renewed attention on the genre of utopia and its relationship to dystopia. In *Archaeologies of the Future*, Jameson urges the importance of utopia as a "meditation on radical difference, radical otherness, and on the systemic nature of the social totality" (xii). Following Moylan, he distinguishes between critical dystopias, dystopias, and anti-utopias, the last of which (typified by Orwell's *Nineteen Eighty-Four*), he sees as "informed by a central passion to denounce and to warn against Utopian programs in the political realm" (199).

25 According to Zola, the experimental novelist first observes "the facts," and then "sets his characters going in a certain story so as to show that the succession of facts will" reveal "the determinism of the phenomena under examination" (8).

26 Squier traces the concept of ectogenesis to the trio of Haldane, Julian Huxley, and Aldous Huxley, and she assesses its positive and negative implications for women (*Babies in Bottles* 63–99).

27 James Sexton points out that the name Bokanovsky is most likely an allusion to Maurice Bokanowski, a "high-profile advocate of the rationalization of industry" like "his counterpart [Alfred] Mond in England," the source for name of the World Controller, Mustapha Mond (Sexton 85).

28 *Brave New World* is something of a bogeyman for Kass. He devotes an entire section of his book *Life, Liberty and the Defense of Dignity: The Challenge for Bioethics* to a simplistic reading of Huxley's novel and cites it in numerous other articles and reports, always as compelling evidence that society should not permit certain types of genetic engineering. For other references to *Brave New World* in Kass's oeuvre, see "Preventing a Brave New World: Why We Should Ban

Human Cloning Now"; "Ageless Bodies, Happy Souls: Biotechnology and the Pursuit of Perfection"; "L'chaim and Its Limits: Why Not Immortality?"; and his President's Council's report, *Human Cloning and Human Dignity: An Ethical Inquiry*, especially the section "Human Cloning from Popular Literature to Public Policy: From *Brave New World* to the Birth of Dolly."

## Chapter 6

1 The passages are drawn from the following sources:

1. Harris, *Enhancing Evolution: The Ethical Case for Making Better People* (2007), 3
2. Clarke, *Childhood's End* (1953), 181
3. Kass, *Life, Liberty and the Defense of Dignity: The Challenge of Bioethics* (2002), 265
4. Van Vogt, *Slan* (1946), 187
5. Stock, *Redesigning Humans: Our Inevitable Genetic Future* (2002), 17
6. Heinlein, *Methuselah's Children* (1958), 43
7. Annas, "Genism, Racism, and the Prospect of Genetic Genocide," (2001)
8 Sturgeon, *More Than Human* (1953), 170

2 The irony is that Ronald Green is one of the few bioethicists to discuss SF at any length. He is to be commended for providing thoughtful examinations not only of *Brave New World* but of works by Nancy Kress and Octavia Butler, as well as short comments on Greg Bear, a story by Ursula K. Le Guin, more mainstream works such as *Oryx and Crake, Never Let Me Go,* and *The Time Machine,* and the films *Gattaca* and *The Boys from Brazil*. All the same, he thinks that Kress and Butler, his principal examples of SF, are outliers in the genre when the reverse is the case: disaster scenarios are the outliers.

3 The phrase "more than human" also serves as the title of a book advocating biological enhancement, although the author does not think it worthwhile to nod to Theodore Sturgeon. See Ramez Naam's *More Than Human: Embracing the Promise of Biotechnology* (2005).

4 The forgettable 2009 science fiction film *Surrogates*, starring Bruce Willis, makes apparent the connection between "science fictionality" and the predictions in this academic field by intercutting news clips from interviews with noted bioethicists, including Gregory Stock, one of the authors quoted at the beginning of the chapter.

5 Gordijn and Have call this genre "anticipatory bioethics" and relate it to the field of futurology, as I do later in this chapter. They argue that practitioners of this form of bioethics need to develop more methodological rigor if they want to "avoid being panned as bad Sci-Fi writers" (324).

6 Cary Wolfe, one of the few literary critics who has explored this field, accurately notes that the "institutionally powerful forms of bioethics" are "less

an ethics per se than a branch of policy studies" (xxvii). I treat the two fields, bioethics and policy studies, in tandem.

7 As was common in the field, most of these works were serialized in pulp magazines, in many cases years before they appeared reworked as novels (or "fix-ups," as the fan phrase had it). *Methuselah's Children*, for example, first appeared as a novel in 1958, even though it had been serialized in John W. Campbell's *Astounding Science Fiction* over three installments in 1941.

8 The echo of "anticipatory bioethics" is intentional in my choice to refer to this vein of futurology as "anticipations."

9 For an account of social Darwinist themes throughout Heinlein's canon, see Philip Smith. Heinlein's advocacy of free enterprise, his role as an anti-communist Cold Warrior, and his often sexist portrayal of women have been frequently canvassed (see, e.g., Bruce Franklin [28–36, 47–52], Seed [28–39], and Tucker).

10 Bruce Clarke provides a good reading of Arthur C. Clarke's novel as shaped by a "kind of Anglo-American United Nations wish fulfillment" that portrayed telepathy as "the social communication needed to heal the divisions of a Cold-Warring and decolonizing world," brought down from "the galactic first world to the underdeveloped backwater of Earth on wings of mystic good will alone" (Bruce Clarke 38).

11 Another landmark SF novel from 1953, Bester's *The Demolished Man*, winner of the Hugo Award for that year, also revolves around a minority population in the future that possesses telepathic powers. Although the novel does not explore evolutionary themes or the posthuman, eugenics plays a peripheral role. The Esper Guild's "Eugenic plan" attempts "to bring Extra Sensory Perception to everyone in the world" (18). The closest the novel comes to the major themes explored here is a comic aside: "Those damned mindreaders are supposed to be the greatest advance since Homo sapiens evolved. E for Evolution. Bastards! E for Exploitation!" (8–9).

12 Heinlein's assumption that every cell contained 48 rather than 46 chromosomes reflected an ongoing debate among scientists as late as the 1950s, and a character's remark that "Genetics remained practically at a standstill for a century before ultramicroscopy reached the point where genes could really be seen" (*Beyond* 142) must have seemed plausible a full decade before Rosalind Franklin's X-ray photographs captured the helical structure of DNA.

13 "Surface Tension," the third chapter of the published novel, was written before Watson and Crick's discovery came out, but the only trace of genetics in the 1957 version of the story comes in the "Prologue," which was a piece of the connective tissue added in 1957 to "fix-up" the five separately published stories for release as a novel.

14 The affective appeal of this self-contradictory stance helps explain notorious elements of SF in the period, such as Heinlein's celebrations of group love and shared consciousness (recall grokking in *Stranger in a Strange Land* or the orgies of *Time Enough for Love*), side by side with his Cold War paranoia about communist mind control in *The Puppet Masters* or the hive

mind in *Starship Troopers*. Franklin comments on Heinlein's inability "to reconcile this vision of extreme individualism with his belief in social cooperation" (87).

15 But see Molly Wallace who argues that the Xenogenesis trilogy deterritorilizes identity only to reinscribe genetic essentialism within the bounds of neoliberalism. Her strong reading of the novel testifies to the tenacity of genetic essentialism as an ideological construct in spite of Butler's posthumanism.

16 Stanley Kubrick's *2001: A Space Odyssey* (1968), co-written by Arthur C. Clarke, reflects Clarke's roots in the science fiction of the 1950s. The conceit of sudden species change brought to humanity by a superior alien intelligence draws on motifs from *Childhood's End*, while its depiction of the embryonic posthuman in the film's final sequence universalizes evolution's next step rather than emphasizes diversity. The movie *2001* ends up portraying the posthuman in very different terms from the SF that is published in the years leading up to 2001.

17 *Darwin's Radio* conforms to the paradigm of the contagion narrative described by Wald in *Contagious: Cultures, Carriers, and the Outbreak Narrative*. Heather Schell discusses the "socially conservative ideas about gender, race, imperialism, and human society" encoded in Bear's novel (H. Schell, "Sexist Gene" 806). Lynch joins Schell in criticizing Bear's work as a "sociobiological celebration of human development" and sees "The generic collapse between the outbreak thriller and the science-fiction novel" as a sign of how a medical story about containing an epidemic can become "a rallying cry for the arrival of the posthuman" (Lynch 71, 73). For my own reading of *Darwin's Radio*, see *Charles Dickens in Cyberspace* (175-79).

18 Nicholas Rescher, philosopher and former RAND Corporation researcher, begins his book on the epistemology of forecasting with this distinction: "Since prediction thus deals – or intends to deal – with what the future *will* be, it is something quite different from scenario projection, and so from science fiction as well, that is, with mere speculation about what *might* be" (37). A fascinating article by R. John Williams traces the origins of scenario thinking at the RAND Corporation to plural temporalities and "charismatic, avant-gardist, quasi-religious . . . Oriental philosophies" (478), clarifying why Rescher fears scenario projection might be linked to science fiction. Theo Reeves-Evison also distinguishes between "Cold War faith in prediction" (722) and the "multitude of *possible* scenarios" in contemporary scenario planning (734–35). My argument is that futurology of the sort practiced in scientific jeremiads is a speculative form that is closer to SF than to scenario thinking. For popular books on the successes and failures of futurology, see Margolis; Samuel.

19 John Harris has presented the most thorough account of what he sees as the inadequacies of Kass and Sandel's arguments concerning human nature and human dignity ("Taking the 'Human' out of Human Rights"). See also Pinker, "The Stupidity of Dignity."

20 Dystopia also has a functional dimension. The genre is a call to action, related to the jeremiad, but more committed to a narrative logic and persuasive world-building. That is one of the reasons it can be valuable to distinguish dystopia from other forms of science fiction.

21 Nordmann and Rip draw attention to the reduction of multiple possibilities to a single "if-then" structure in much speculative ethics:

> "If-and-then" statements begin by suggesting possible technological developments and then indicate consequences that seem to demand immediate attention. What looks like a merely possible, and definitely speculative future in the first half of the sentence (the "if"), turns into something inevitable in the second half (the "then"). As the hypothetical gets displaced by a supposed actual, the imagined future overwhelms the present, (273)

22 See Gregory Stock's *Redesigning Humans* (2002), Joel Garreau's *Radical Evolution* (2004), Ramez Naam's *More Than Human* (2005), John Harris's *Enhancing Evolution* (2007), Ronald M. Green's *Babies by Design* (2007), Anders Sandberg's "Upgrading the Brain" (2011), and Julian Savulescu's *Enhancing Human Capacities* (2011).

## Part IV

1 Of the fifty-four companies that offer "family relationship" services, which promise to identify people who are genetically related to you, 59.3 percent have no published privacy policy and another 13 percent state that your data will or might be shared with third parties (Hazel and Slobogin, "Who Knows What, and When?").

## Chapter 7

1 Auerbach goes on to write, "and strictly, in the eyes of God, it is something eternal, omni-temporal, something already consummated in the realm of fragmentary earthly event" (74). The "already consummated" status of future events nicely captures Delany's idea.

2 Kay elaborates at several points in her book: "The analogy did not remain an external aid to the scientific imagination but rather became constitutive of the decoding analyses and interpretations" (152). "Once the elementary unit of life became informational, the imagery of the 'word' served to reconfigure the larger biological terrain, including theories of the origin of life and evolution" (295).

3 Benjamin offered a similar explanation for the transition from an oral society to an information economy in his essay "The Storyteller." In today's world, Benjamin notes, it is difficult even to comprehend the temporality of oral storytelling: "The time is past when time did not matter" (*Illuminations* 92).

4 Tyler Bradway, in *Queer Experimental Literature*, notes that "queer literary criticism often looks to Delany's work for inspiration" (52).

5 Halberstam, by contrast, identifies with "antisocial queer theories," not just reparative criticism (see Halberstam's contribution to the PMLA Forum on "The Antisocial Thesis in Queer Theory" [Halberstam, "Antagonism"]). But it is worth noting, as I do earlier, the discussion of "potentiality" and of Eve Sedgewick's "reparative impulse" in Halberstam's *In a Queer Time and Place*.
6 Bradway argues that Delany "exemplifies how some queer hermeneutics might be deconstructive, but not necessarily paranoid" (60).
7 Sexuality, however, is never far from the surface when literature confronts questions of evolution or genetics.
8 See my discussion of the prominence of scalar thinking in contemporary literature about science in *Charles Dickens in Cyberspace* (2003), 183–85.
9 Steven Pinker criticizes the religious underpinnings of the President's Council report in "The Stupidity of Dignity." Dawkins contrasts secular conceptions of the genetic origin of life with religion in several books, most notably *The God Delusion*.
10 The use of a DTC-GT company to locate the Golden State Killer made many people wake up to the lack of privacy protections in place at many of the more than 90 such companies operating in the United States alone, and there is some sign that enrollment in these services is beginning to slack off. For a comprehensive account of the wide variation in privacy protections at DTC-GT companies, see Hazel and Slobogin, "Who Knows What, and When?"

## Chapter 8

1 There are exceptions, of course, such as Nevil Shute's heartbreaking *On the Beach* (1957) and Colson Whitehead's *Zone One* (2011).
2 Again, there are exceptions, including the film with which I began, *Gattaca*. But, as I've argued elsewhere, the redemptive ending of this movie springs from its heteronormative subplot and reveals its ideological confusion.
3 Compare with Shteyngart's *Super Sad True Love Story* where every scrap of information about a person – including biometrics and favored sex acts – is not only recorded but may be broadcast to nearby mobile devices and uploaded to a worldwide open network.
4 For a list of reported violations of medical privacy, see the "Breach Portal," colloquially known as the HIPAA Wall of Shame maintained by the United States Department of Health and Human Services at https://ocrportal.hhs.gov/ocr/breach/breach_report.jsf.
5 The characters' incessant racial slurs make this book a challenge for anyone who wants to try teaching it, but it is no more disturbing than other works that are sometimes taught, such as *A Clockwork Orange*.
6 Atwood draws attention to her debt to both novels in her quasi-autobiographical study of science fiction, *In Other Worlds* (39) .
7 Other similarities, such as the descriptions of walled corporate enclaves with private security forces, as well as episodes of corporate espionage, kidnapping,

and murder, descend from influential science fiction texts of the intervening years, such as Frederik Pohl and C. M. Kornbluth's *The Space Merchants* (1953) and Neal Stephenson's *Snow Crash* (1992). Notably, Pohl and Kornbluth's novel anticipates the bioengineered ChickieNobs in *Oryx and Crake* (202), one of the more famous internet memes springing from Atwood's novel. *The Space Merchants* featured a virtually immortal chicken without head or limbs – essentially a huge mound of white breast meat – from which commercial servings could be carved off year after year.

8 Like virtually all genetic "creation stories," Atwood's tale is rife with references to Genesis. Crake creates his new species in a hermetically sealed dome called "Paradice." The leader of God's Gardeners is named Adam One, and of course, there is the "Waterless Flood."

9 In 2016, the National Academy of Science released a new report on safety questions related to GM foods.

## Chapter 9

1 Schwarzenegger, Keaton, and Bart Simpson are cloned in *The 6th Day*, *Multiplicity,* and "Send in the Clones," respectively.

2 See Houghton et al.; Thacker; and Weinberger and Greenbaum.

3 A number of literary works, by contrast, feature clones who turn out *not* to share the personalities and desires of the original (or of their creator), causing disappointment or sorrow to their creator. See Nussbaum's, "Little C," Kress's, "Sex Education," and Picoult's *My Sister's Keeper*. The television series *Orphan Black* dramatizes the difference upbringing would make by giving radically different personalities to each of the eleven principal clones of the central character, all played by the virtuosic Tatiana Maslany. Hamner published one of the first critical readings of this series, emphasizing particularly the religious motifs prominent in the conflict between Leeke's transhumanism and the Prolethean anticloning cult, as well the sexual and queer imagery used to dramatize Helena's feminist revenge against her religious captors. More recent interpretations include Casey and Clayton, and the articles collected in a special issue of *Science Fiction Film and Television*, volume 11, issue 3 (2018).

4 For a typical example of clones experiencing flashbacks of memories from the life of their originals, see the 2005 film *The Island*. Samuel Butler's belief in unconscious memories is discussed in Chapter 3.

5 A search of available databases undertaken by our research team in the Genetic Privacy and Identity in Community Settings project found 147 film and television shows that contain episodes involving human clones as of August 2020, and new films featuring clones have continued to be produced at a strong pace in the years since (Gibbons, Stovall, and Clayton).

6 A partial exception in this respect is Ridley Scott's film, *Blade Runner* (1982). Despite the mayhem created by the escaped clones (called "replicants"), this

futuristic film noir evokes sympathy for the replicants in ways more characteristic of the literary tradition. For more about this film's depiction of clones, see J. Clayton, "Frankenstein's Futurity: Replicants and Robots."

7 There are exceptions, of course. The works by Butler, Atwood, and Bacigalupi lean more toward science fiction than the others on this list.

8 Several critics have noticed the parallel with Victor Frankenstein's decision to flee to a remote island off Scotland when he agrees to create a bride for his monster in Shelley's *Frankenstein* (1818). See Byron and Ogston (463n5), Tsao (214–32), and Hamner (113).

9 One character is depicted as literally shuddering at the possibility of being touched by a clone (35–36).

10 Stefanie Fricke outlines the several ways *Never Let Me Go* revises the conventions of dystopian fiction.

11 Nathan Snaza's article is the most extensive of several treatments of Ishiguro's critique of "Hailsham's humanizing mission," which Snaza relates to Friedrich Schiller's *Letters on the Aesthetic Education of Man* (1795) and other classic statements of humanism.

12 My position on these issues resembles that of Anne Whitehead, who writes that Ishiguro "meditates on the role and value of literature within a profit driven, materialist culture. Is it still possible, the novel asks, to subscribe to the Romantic myth that literature can somehow redeem us?" Whitehead answers this question with a qualified yes. "Although Kathy['s] . . . belief in the notion that art can save her. . . is revealed to be a false faith, . . . the novel, it seems, cannot altogether abandon hope in the literary enterprise" (63).

13 See Bruce Robbins for a compelling reading of the novel as a protest against the failures of the modern welfare state.

14 "Tears in the rain" is a phrase uttered by the clone, Roy Batty (played by Rutger Hauer), as he is dying in the film *Blade Runner*.

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