

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/Cas9 makes 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/jano2/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 unfixd 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 *files* 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 Ederly 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 deterritorializes 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 Sedgwick’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 “Paradise.” 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*.