

*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.

Biodystopia should be distinguished from a closely aligned genre, which is also enjoying a vogue (Alter) and often features genetic disasters: post-apocalyptic 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 chromospheres 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 pigeons' 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 reimaged 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 varieties 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 BlyssPlus pill. (The emphasis on life and beauty-prolonging treatments brings to mind Shteyngart's satire of the rejuvenation treatments marketed by Post-Human Services.) BlyssPlus 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 pigeons 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 pigeons, 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."

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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, pigeons, 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.