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As Gods: A Moral History of the Genetic Age, by Matthew Cobb. New York: Basic Books, 2022

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Does our ability to manipulate genes give humans godlike powers? And if so, are we worthy of the accompanying responsibility? These are the implicit questions asked by Matthew Cobb in his newest book, on the history of genetic engineering. Titled *As Gods: A Moral History of the Genetic Age* in the United States, the book is perhaps more fittingly named *The Genetic Age: Our Perilous Quest to Edit Life*, as it is titled in the United Kingdom. To be sure, Cobb raises ethical, social, and cultural issues and questions throughout the book, but it is the stories about genetic advances and their implications—and the *humans* involved in these stories—that really take center stage.

Cobb, a professor of zoology in the School of Biological Sciences at the University of Manchester, has authored several books on the history of science. In 2021, the Genetics Society honored Cobb with the JBS Haldane Lecture, an annual award given to "an individual for outstanding ability to communicate topical subjects in genetics research, widely interpreted, to an interested lay audience" (The Genetics Society n.d.). *As Gods* confirms Cobb's talent in this area. By focusing on the scientists, Cobb effectively conveys the positive and negative emotions—excitement, satisfaction, disappointment, hope, and fear—associated with the science.

Cobb was motivated to write the book to explore his own misgivings about three technologies made possible by genetic engineering: heritable human genome editing; the use of gene drives to alter characteristics of living organisms, species, and ecosystems; and so-called gain-of-function research on disease-causing pathogens. Accordingly, many of the chapters concentrate on these issues. However, Cobb spends a lot of time covering other topics, including commercial uses of recombinant DNA technology, the history of somatic gene therapy, the discovery of CRISPR (a genome editing technology that has emerged in the past decade), and the development of—and political reaction to—genetically modified foods. Written during the COVID-19 pandemic, each chapter of the book is thoroughly researched and referenced and clearly benefits from information Cobb gained from interviewing many prominent researchers directly involved in the events.

The book provides such rich description that even the most knowledgeable readers, those who are familiar with the field and history of genetics, will learn something new. For example, Cobb reveals fascinating backstories related to the 1975 Asilomar conference,

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which led to the development of safety guidelines for recombinant DNA research: Janet Mertz, then a graduate student in biochemistry at Stanford, shared her plans for a cutting-edge, but potentially dangerous, experiment involving recombinant DNA with Bob Pollack, a postdoctoral fellow at Cold Spring Harbor, in the early 1970s. Pollack called Mertz's distinguished supervisor, Paul Berg, to express concerns but was initially rebuffed. However, further consideration of Pollack's concerns ultimately led Berg to organize the Asilomar conference. In another chapter, Cobb informs readers that Bob Swanson, a recently unemployed venture capitalist, cold-called a list of Asilomar attendees and convinced one of them, Herb Boyer, to start a company focused on commercialization of recombinant DNA technology (Genentech). Later in the book, Cobb shares that, unbeknownst to the American organizers of Asilomar, three Russian scientists who attended were involved in establishing a bioweapons program for their country.

Readers without scientific training may find the book less accessible as it does get technical and detailed at times, but it will reward those who are interested in the topic with a deeper appreciation of the power, limitations, and potential dangers of genetic engineering. Three significant, particularly thought-provoking high-level themes emerge from Cobb's book. The first is the allure of genetics as compared to alternative, less "sexy" methods of improving human lives. Second is the balance between pessimistic and optimistic perspectives on the potential benefits and risks of genetic engineering. And third is the tension between unrestricted pursuit of scientific knowledge and the need for regulation.

At several points in *As Gods*, Cobb emphasizes scientists' attraction to understanding and leveraging genetics to solve problems and contrasts it with the tendency to discount other types of solutions. For instance, Cobb describes the development of and opposition to Golden Rice, which is genetically engineered to have higher levels of β-carotene to address Vitamin A deficiency in certain populations. Notwithstanding all the attention on Golden Rice, Cobb notes that non-genetic solutions to Vitamin A deficiency, such as public education and capsule supplementation, have been successful in the Philippines. Regarding human heritable genome editing, Cobb shares prominent genome editing researcher Fyodor Urnov's assessment that it is a solution in need of a problem, adding his own appraisal that "it is a distraction from the problems we have now, on planet Earth" (282). In the chapter on bioweapons, Cobb reminds readers that releases of organisms such as anthrax and *Salmonella* can wreak significant havoc and destruction in the absence of any genetic engineering. Cobb questions "why genetic engineering solutions are often seen as a priority" (361) when these solutions elicit ethical issues and may not appropriately address complex, socially driven problems.

Whether to take a pessimistic or optimistic viewpoint on the power of genetic engineering is another issue that Cobb contemplates: he seems to identify strongly with both perspectives at various times in the book. Clearly, Cobb recognizes the power and potential of genetic engineering. However, he also stresses that hopes for the technology often exceed reality: "Real-world problems, most of them social and not amenable to simple technofixes, have repeatedly brought a sharp dose of reality to the dreams of the genetic engineers" (348). In a discussion about CRISPR, Cobb points out that some scientists believe that metaphors such as "editing" and "targeting" bely this underlying complexity: experiments don't always go as planned. Cobb recognizes CRISPR as a powerful tool but stresses that it isn't a panacea for human disease—and it does not give humans absolute control over genomic DNA. Cobb agrees with one of his interviewees, Sheila Jasanoff, a prominent technology studies scholar who speculates that, with respect to genetic research and the power of science, both "warriors" ("hope people") and "worriers" ("fear people") are needed in society to keep these perspectives in check and in balance (363).

Finally, Cobb also explores the pros and cons of restrictions on genetic engineering. Describing the mood at the Asilomar conference, in which approximately 140 scientists convened with the aim of developing "biosecurity guidelines that would allow [recombinant DNA] research to recommence" (78), Cobb notes that many of the attendees felt that "'academic freedom' effectively gave them the right to do whatever they wanted" (78). Although Cobb highlights four moments in history, including Asilomar, in which scientists voluntarily chose to pause their work to carefully consider risks, he advocates for broader public involvement—and regulation—going forward: "it is clear to me that the model of self-regulation adopted in the 1970s cannot meet the needs of the discoveries of the twenty-first century" (365). The issues are "too important to be left to the scientists" (13). After reading his comprehensive book on the history and promise of genetic engineering, Cobb's point is well taken. Humans are *human*, after all.

Author contribution Carolyn Riley Chapman wrote this book review.

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Declarations

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Reference

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