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Book Review: Genetics for Everyone

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BOOK REVIEWS

Genetics for Everyone

M. Caitlin Fisher-Reid

Siddhartha Mukherjee, *The Gene: An Intimate History* (New York: Scribner, 2016).

As an evolutionary biologist, I can't help but notice that everyone seems to understand the concept of heredity at some level. New parents' social circles seem always to be full of amateur geneticists wanting to *interpret* new babies: "He has your smile," or "She has your eyes." As a child grows, parents enter their own claims: "He has my sense of humor," or "She gets her independence from me." My own experience of this phenomenon with friends and family makes me think that Siddhartha Mukherjee's latest book will find an already primed and receptive audience.

In *The Gene: An Intimate History*, Siddhartha Mukherjee walks the reader through the long and winding path to our current understanding of heredity, from the earliest hints at the existence of a fundamental unit of heredity to today's exciting and terrifying world of whole genome sequencing and *in situ* gene editing using CRISPR-Cas9. It is a fascinating journey, filled with intrigue, leaps of intuition, and countless missteps. Throughout his scientific history, Mukherjee frames the story of the gene around his own family's experiences with mental illness. In candid and poignant memoirs woven throughout the book, Mukherjee recounts how his extended family deals with and understands his uncle Rajesh's bipolar disease, and his uncle Jagu's and cousin Moni's schizophrenia. Their mental illnesses dominate family life and the potential role of heredity in their illnesses is not lost on Mukherjee.

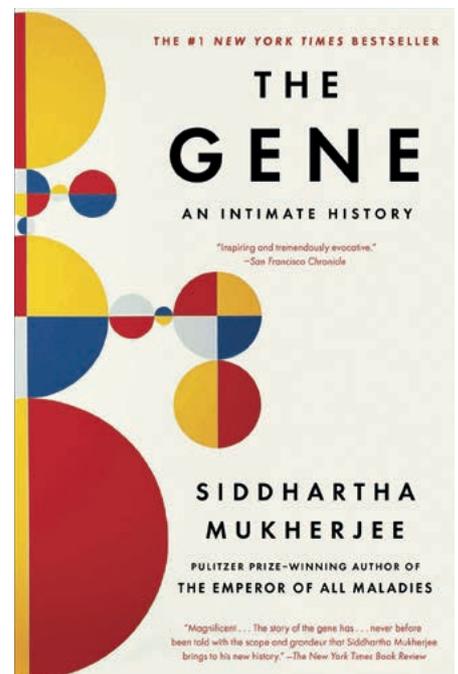
This is a narrative I, too, can relate to, as the neurotypical older sister to two younger siblings who both have high-functioning Autism. I often think about how the genetic hand I was dealt is so ordinary compared to theirs, yet we came from the same starting material, our parents, and through them share roughly 50% of our DNA.

Mukherjee is an oncologist by training, a doctor whose previous Pulitzer Prize-winning book *The Emperor of All Maladies: A Biography of Cancer* (2010) might seem more exciting and relevant to our everyday lives than genetics. However, *The Gene* is no dry, academic history of science. Rather, it is an artfully written compendium of all we have learned since the Augustinian monk Gregor Mendel (1822–84) uncovered the existence of genes by breeding pea plants 150 years ago. A knowledge of genes and genetics is essential to helping us understand and

treat diseases like cancer and mental illness, and Mukherjee makes this case in clear and engaging prose.

After a prologue introducing his family, Mukherjee formally begins *The Gene* in St Augustine's Abbey in the Czech city of Brno in the 1850s. There, Mendel, a shy man who had just failed the exam to become a high-school science teacher, is taking courses to improve his chances of passing the exam on a second go. In class, Mendel faces questions like why animals are grouped the way they are, and why do offspring look like their parents? Mukherjee reminds us that this preoccupation with understanding "likeness" had long predated Mendel, going all the way back to Greek philosophers Pythagoras and Aristotle.

Even in his own time, Mendel was not alone with these questions. Twenty years earlier, young Charles Darwin (1809–82) was leaving on his famous trip around the world aboard the HMS *Beagle*, which catapulted him down a more than 20-year path to developing



the theory of evolution by means of natural selection and the resulting pattern of common ancestry. Darwin's "dangerous idea" that nature passively *selected* those individuals best suited to survive and reproduce in their environments hinged on the presence of heritable material, something that well-suited, well-*adapted* parents could pass on to their offspring so that they too would be well-adapted to the environment.

Somehow, Darwin and Mendel never connected scientifically. Mendel's work on the inheritance of traits among pea-plant hybrids was published just seven years after Darwin's on *The Origin*

identified a mechanism of inheritance. After Darwin's death, the focus in biology shifted away from selection and towards common ancestry, until Mendel's work was rediscovered around 1900.

Mukherjee spends the rest of his book detailing the rapid birth and growth of the field of genetics, helping us get to know the science and personalities who drove the discoveries. The infant field of genetics quickly gave rise to the horrors of eugenics and Nazi experiments. Scientists raced to determine the structure of DNA. Experiments to understand inheritance found a golden goose in the common fruit fly. Mukherjee

of voluntary guidelines for and prohibitions on future research, an experiment in self-regulation that had never been seen before in science, not even with the physicists who developed the atom bomb.

What I enjoyed most about Mukherjee's book is his ability to tell an exciting and engaging story about the very predictable (some would say mundane) process of science: from observations to questions, from questions to hypotheses, and from hypotheses to tests upon tests, often resulting in more questions than conclusions. Science is a process for understanding the world around us. It is *tentative*: yesterday's "eureka moments" are built upon, modified, and tweaked so that an unknown future "eureka" may turn everything on its head. Each one is preceded by years, decades, or even centuries, of failure. The rampant failure and uncertainty makes many uncomfortable, especially those who want to succeed or be "right," those whose intellectual hubris blinds them to new, paradigm-shifting discoveries. Mukherjee reveals these truths about science as the backdrop to the development of one of the most dynamic fields of biology, and he does so by highlighting the personal stories of the scores of men and women who have pushed genetics ever forward, one tentative step at a time.

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of *Species* rocked both the scientific and cultural landscapes. Not only did Mendel's critical paper fade into scientific obscurity, but he died in 1884 thinking himself a failure. He had tried to reproduce his pea-plant work in hawkweed, a plant which reproduced primarily asexually, and rarely hybridized (a requirement for his experiments). All of his pea-plant rules, what posthumously became known as the laws of Mendelian inheritance, failed to predict the pattern of inherited traits in hawkweed. Darwin had died just two years earlier, believing in the strength of natural selection, but not having

charts every leap forward and every step back in a scientific journey rife with controversy and ego. One of the more interesting stories is of the geneticists in the early 1970s who first began to develop the techniques of recombinant DNA and cloning, the techniques that have allowed us, for example, to use bacteria to produce human insulin for diabetics. These scientists realized the power of the tools they were developing, and fiercely debated the risks against the potential of their work. The result was the crafting of a remarkably self-aware document (*Summary Statement of the Asilomar Conference on Recombinant DNA Molecules* [1975])



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