Songlines

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A Song for Molly
by Jeremy Bernstein
World Scientific Publishing, 148 pp., $28.00.

Jeremy Bernstein earned his doctorate in theoretical physics in 1955 at Harvard University under the direction of Nobel laureate Julian Schwinger, just as I did a few years afterward. We have stayed in touch ever since, most recently as frequent contributors to *Inference*. Bernstein was a *New Yorker* staff writer for several decades and has written over a dozen books on such diverse matters as computers, cosmology, cryptography, quantum mechanics, and mountain climbing. Having published many short stories, he has now ventured into longer fictional forms. Could it be an accident that the text of his enchanting novella fills just 137 pages, a prime number that once fascinated such luminaries of physics as Arthur Eddington, Wolfgang Pauli, and Richard Feynman?[1]

A Song for Molly is a fantasy in the form of fictional autobiography from which Bernstein declines to "pick out the real parts." The protagonists of Bernstein's love story are Jeremy,[2] his psychiatrist, his two serially owned dogs both named Molly, and two eligible women, Anne and Elena. It is also a fine example of episodic storytelling, as Jeremy expounds on disparate disciplines and their fascinating proponents. What we are in for is hinted at in the preface, where we briefly encounter Ludwig Wittgenstein, Kurt Gödel, J. Robert Oppenheimer, and Philipp Frank.

A Song for Molly opens as Jeremy accidentally acquires, comes to adore, and then sadly loses his first, but sickly, Molly. We soon come upon his psychiatrist, Dr. Levman; and Anne, his friend, then traveling companion, lover, and, ultimately, his wife.[3] Jeremy and Anne discuss and soon become disenchanted with Wittgenstein and his formidable *Tractatus Logico-Philosophicus*, whose opening and closing paragraphs begin, respectively, "The world is all that is the case," and "Whereof one cannot speak, thereof one must be silent." Of this, Anne remarks that only a man would write "a whole book about something that he says he cannot write about." Jeremy finds him to be "an odd dude" who would ask such disturbing questions as whether dogs could be taught to simulate being in pain or why some syntactically correct sentences, such as "Socrates is identical," are meaningless. En passant, we learn that Wittgenstein and Adolf Hitler entered the same school at the same time, where Wittgenstein skipped a grade and Hitler was left back. We enjoy a profound discussion of the nature of language, with scattered allusions to Albert Einstein, Sigmund Freud, John Maynard Keynes, G. E. Moore, Bertrand Russell, and the Vienna Circle. Jeremy dreams of a conversation about dogs between Wittgenstein and Dr. Levman. Waking, he decides to buy a puppy to replace his beloved Molly.[4] Many more of Jeremy's imagined dreams find their way into this book.

As Jeremy weaves around many seminal intellectual achievements, he drops many names: Robert Axelrod, Émile Borel, Richard Dawkins, Dian Fossey, Eugène Ionesco, James Joyce, Herman Kahn... Need I go on? This curious pattern may seem intrusive and digressive in an oddly cerebral love story with neither citations nor index, but the many facts and fables Jeremy relates about these amazing people and their remarkable doings make Bernstein's song all the more delightful.

The next two chapters offer challenging discourses about mathematical undecidability, transfinite numbers, and the continuum hypothesis. We learn much about Gödel's troubled life and his close friendship with Einstein. Jeremy sets himself the trying task of explaining Gödel's dramatic discovery of undecidability to Anne: "It will be ... a case of the myopic leading the blind," he confesses. Nevertheless, Jeremy successfully provides a clear exposition of Gödel's simplified construction of an undecidable mathematical proposition, one such that neither the proposition nor its negation may directly be demonstrated.

Jeremy takes Molly to a dog park where she bonds with another dog, Stanley, belonging to the elegant young widow, Elena. The dog owners bond as well, but Jeremy fears commitment and plans to introduce Elena to Anne, who is at this point still a friend, hoping "she can convince Elena that she has had a narrow escape." Elena, aware that Jeremy plans to tell Anne about Gödel's work, asks "whether you were going to tell her only about the *unentscheidbare* papers or also about the ones on the con-

tinuum hypothesis," a neat segue to the next chapter, where we meet the nineteenth-century mathematician Georg Cantor, inventor of set theory, discoverer of transfinite numbers, and poser of the famous continuum hypothesis.

After a fascinating riff involving Einstein, Gödel, John von Neumann, and Alan Turing about quantum mechanics and the probability that Elena, Jeremy's chance acquaintance, would be familiar with undecidability and the continuum hypothesis, the conversation turns to Cantor and how he learned to compare infinities. Two sets, finite or not, are said to be equal in size if a one-to-one correspondence can be established between them. With that definition of equality, the infinite set of all primes and that of all rational numbers, seemingly so vastly different in size, are equal because each can be counted or labeled by the integers. Can it be, Cantor asked, that all infinite sets are countable?

Following Cantor's diagonalization argument, Jeremy explains that not all infinities are equal, because the set consisting of all real numbers is larger than the set of integers. Having proven that there are at least two distinct infinities, Cantor strove to find another lying between the two. Unable to do so, he became convinced that no infinity exists that is greater than the one and less than the other. This became known as the continuum hypothesis and was the first of twenty-three unsolved mathematical problems put forward by David Hilbert in 1900.

Gödel solved part of the puzzle in 1940. Assuming the consistency of the standard set theory axioms, he deduced that the continuum hypothesis cannot be proven to be true. In 1963, the brilliant mathematician Paul Cohen proved that the continuum hypothesis cannot be proven to be false. Unless the standard axioms of set theory are incomplete or inconsistent, the continuum hypothesis is an undecidable proposition. Cohen won the Fields Medal for this work.[5] Mathematicians continue to examine variants of set theory in which the continuum hypothesis is decidable. On another note, decidability poses a problem for Jeremy with respect to his friends: Anne, who is weak in math, and Elena, who has a PhD in game theory.

Not until chapter four do we learn how Jeremy and Anne first meet and make their platonic deal. Anne will outfit Jeremy's kitchen and cook for him. "In return," says Anne, "you will take me along on those intellectual rocket ships you seem to go off on." But she will neither live with him nor sleep with him.

Their first virtual adventure takes them to Crete, where they meet Arthur Evans soon after he discovers two distinct scripts inscribed on tablets unearthed at Knossos. Evans deduces that one, which he calls Linear A, is the predecessor of the other, Linear B, and that both represent syllabary languages read from left to right. Evans can decipher neither script. No one could for half a century, until Michael Ventris, an architect, succeeded with the assistance of the linguist John Chadwick.[6] They discovered that Linear B is an early version of ancient Greek. Linear A uses some of the same signs, but has not yet been deciphered. The Chadwick–Ventris discovery was announced in 1953, shortly after the first successful ascent of Mount Everest. Here, Bernstein emerges to boast of chatting with both Edmund Hillary and Tenzing Norgay in Kathmandu.

Having become friendly with Elena, Anne learns that her specialty is the theory of games. "What is that?" she asks Jeremy, and thus begins the next adventure: from tic-tac-toe to checkers, the prisoner's dilemma, nuclear strategy, and RAND gamesmanship. The principal characters here are von Neumann and Oskar Morgenstern, authors of the classic treatise *Theory of Games and Economic Behavior*; John Forbes Nash, who shared a Nobel Prize for his pioneering analysis of equilibria in noncooperative games; and Kahn, who is largely responsible for the distressing doctrine of mutually assured destruction, a real-life application of the theory of games.

After describing his trip to the Congo to view mountain gorillas, Jeremy tells Anne that if he had to be a biologist, he would like to have been John Maynard Smith. "Who's that?" she asks, and off they go again. Smith studied biology under the geneticist J. B. S. Haldane, but thereafter became "what one might call a mathematical biologist." While visiting the University of Chicago, Smith came up with the idea of evolutionary stable strategies, which are biological analogs to Nash equilibria. Thus did game theory enter the armamentarium of the life sciences. The simple game called the prisoner's dilemma is pointless when played once, but when iterated many times with the same two cooperative but noncommunicating players, the optimal so-called "tit for tat" strategy is likely to evolve. In this simple game, biologists saw a possible genetic explanation for the development of cooperative behavior among members of a species, about which Dawkins had a great deal to say in his book *The Selfish Gene*.

Jeremy deals lightly with cosmology and biology. Anne cannot accept that there was nothing before the Big Bang, which leads Jeremy to mention multiverses. He also explains how Gregor Mendel discovered the laws of inheritance as Charles Darwin completed *On the Origin of Species*, with neither aware of what the other was doing. He recalls von Neumann explaining the need for a biological mechanism of data storage and transfer well before James Watson and Francis Crick identified the double helix. DNA and RNA are introduced, as well as the ribosomes that read their encoded genetic data, but Jeremy does not develop these ideas. He has other concerns. He discovers that Molly has been spayed and is unable to have puppies. More urgently, Elena confesses her desire to remarry, and Dr. Levman suggests to Jeremy that he and Anne are in love.

"Let's take a trip together," Jeremy suggests to Anne. "I might," she says, "But only if we can sleep in separate cities." She chooses Venice because of her fond memories

of Katharine Hepburn cavorting about *la Serenissima* in the movie *Summertime*. Jeremy installs Anne in the Gritti Hotel on the Grand Canal, while he stays less grandly across the waters in Lido. They meet each morning at the vaporetto stop in Venice for a day of touring, dining, and talking about Thomas Mann and *Death in Venice*. Mention of Marcel Proust leads Jeremy to Harry Levin's magnificent Harvard course called "Proust, Joyce and Mann," which I audited as a Harvard graduate student. Much later, with the precipitous decline of Mann's popularity, Levin's course became "Proust, Joyce and Kafka."

The penultimate chapter includes a fascinating discussion of Immanuel Kant, Leonhard Euler, and the elegantly solved classic mathematical puzzle, "The Seven Bridges of Königsberg." It also describes Jeremy's two dreams about Kant's ghost. The book concludes as Anne and Jeremy visit Paris together, recognize their love for one another, return home, and wed. Neither Jeremy nor Anne has living relatives, so the marriage is simple yet operatic. It involves all of the principal protagonists of Bernstein's *Song*: Dr. Levman as the first man, Dr. Levman's wife, and Elena as bridesmaid, along with her dog Stanley and Jeremy's dog Molly.

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1. A single pure number characterizes quantum electrodynamics: its dimensionless coupling strength α, whose inverse once seemed to lie suspiciously close to the prime number 137. In 1935, Max Born, one of the creators of quantum mechanics, wrote and spoke of "The Mysterious Number 137." George Gamow, Leon Lederman, and Pauli shared his enchantment. See Arthur Miller, *137: Jung, Pauli and the Pursuit of a Scientific Obsession* (New York: W. W. Norton & Company, 2010). Later experiments showed that 1/α is neither an integer nor a constant. At low energy its value is about 137.036, less when measured at larger energies. Our Standard Model of particle physics involves not one but dozens of dimensionless numerical parameters akin to α.
2. Hereafter I reserve *Bernstein* for the author and *Jeremy* for his semi-fictional alter ego.
3. Counter-chronologically, Jeremy tells of his earlier encounters with this "very attractive" and "well put together" woman much later in the book.
4. I sympathize with Anne. I also struggled with Wittgenstein's *Tractatus* and Rudolf Carnap's *Logical Syntax of Language* while I was a sophomore at Cornell. I found both books to be impenetrable, but to my then housemate and now brother-in-law Daniel Kleitman they were just relaxing bedside reading. Now a renowned mathematician and an *Inference* author, Dan had been another of Schwinger's many graduate students.
5. I spent a weekend in Washington, DC, with Cohen in 1950, when we found ourselves among the forty finalists of the Westinghouse Science Talent Search. Neither of us were chosen to be among the top ten finalists to receive substantial scholarships. We each returned home to New York City with $100 consolation prizes.
6. Jeremy notes that the American linguist Alice Kober played a key role in the decipherment of Linear B but died of lung cancer in 1950.

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