



## Steven Weinberg Glimpses the Promised Land

David Kordahl

At eighty-five, Steven Weinberg knows that he has lived an enviable life. “I married my college sweetheart,” he tells us at one point in *Third Thoughts*, his latest collection of essays. During his remarks after accepting an honorary doctorate, he talks about the city where he has spent the past three decades. “As you probably can guess, I like living in Austin.” He has also witnessed great scientific progress. “I recall both cosmology and elementary particle physics in the early 1960s as cacophonies of competing conjectures,” he writes. “Now in each case we have a widely accepted theory, known as a ‘standard model.’” Here he tactfully omits that he was one of the main architects of the standard model for elementary particles—for which he won the 1979 Nobel Prize in Physics.

Now Weinberg stands as the grand old man of physics, as much a fixture at the *New York Review of Books* as he is at the *Physical Review*. In the preface to *Third Thoughts* he hopes this book will not be his last, despite “actuarial realities.”

By his standards, this is a genial collection, though Weinberg still isn’t the sort of man who makes you guess after his opinions. The book has three separate pieces touching on why human space exploration is a waste of money. By the last one, “Against Manned Space Flight,” Weinberg begins with a note on how he has tried to avoid “seeming to beat a dead horse.”

The topics Weinberg circles in the book have occupied him for decades.

*Third Thoughts*  
By Steven Weinberg  
Belknap ~ 2018 ~ 223 pp.  
\$25.95 (cloth)

He remains one of science’s staunchest proponents of “reductionism,” believing that beneath the world of appearances, a single theory explains all of nature’s plans—if only we could find it. He vigorously opposes those who suggest that science is anything other than a noble and cumulative encounter with reality, a stance that has led him to spar with many philosophers and historians. Weinberg’s previous book, *To Explain the World: The Discovery of Modern Science* (2015), contended that the pre-scientific era can show us just how badly things go if we ask the wrong sorts of questions, but

argued that we've kept basically on track since Newton, building models, doing experiments, getting to the heart of the matter.

This pedal point sounds throughout *Third Thoughts*—in the preface, Weinberg describes his point of view as “rationalist, realist, reductionist, and devoutly secular”—but longtime listeners will hear new dissonances in the counter-melodies. To understand how Weinberg has changed, it's helpful to track his public writing from the beginning.

Despite his interest in individual scientists and the history of science, Weinberg has always been quicker to give science a central role for humans than humans a central role in science. His first book for general readers, *The First Three Minutes* (1977), was mainly occupied with explaining the then-new scientific consensus on the origin of the cosmos. But after all the discussions of the Big Bang, primordial nucleosynthesis, and Hubble expansion, Weinberg ended with a vision of the dead universe, past the possibility of any human survival. In the book's famous closing lines, he wrote:

The more the universe seems comprehensible, the more it also seems pointless.

But if there is no solace in the fruits of our research, there is at least some consolation in the research itself....The effort to understand the universe is one

of the very few things that lifts human life a little above the level of farce, and gives it some of the grace of tragedy.

This sort of performative pessimism has disappeared from Weinberg's later writing—mainly, it seems, because Weinberg found the reader responses annoying. As he would elaborate on the “pointless” line in his first essay collection, *Facing Up: Science and Its Cultural Adversaries* (2001):

This one sentence got me into more trouble with readers than anything else I've ever written, but all I meant was that if we search in the discoveries of science for some point to our lives, we will not find it. This does not mean that we can't find things that give point to our lives.

Weinberg, in other words, is an atheist, not a maniac.

His second book for general readers, *The Discovery of Subatomic Particles* (1983), was an early foray into what he now likes to call “whig history,” the sort that freely interjects present attitudes into discussions of the past. The book grew from a course Weinberg taught at Harvard and the University of Texas, an attempt “to engage students who were not assumed to have any prior training in mathematics or physics” by weaving the standard concepts of modern physics into a fetching story of past discovery.

Weinberg had not, by that point, launched his vendettas against historians and philosophers of science. Those would first show up in *Dreams of a Final Theory: The Scientist's Search for the Ultimate Laws of Nature* (1992), a book that laid out as well as any ever written the aims and pretensions of modern theoretical physics. It belongs alongside G. H. Hardy's *A Mathematician's Apology* (1940) and James Watson's *The Double Helix* (1968) as one of the classic books in which a brilliant scientist has given his motivations full vent. But while Hardy and Watson portrayed science as a quest for personal glory, Weinberg portrayed it as a quest toward some final explanation, one that would undergird all others.

In its willingness to romanticize the idea of a "final theory," *Dreams* was less a scholarly account than a call to arms. Weinberg forcefully advanced his view of reductionism, in which all the world's diverse phenomena flow from the laws at the bottom, where nature holds its secrets. Those who work on "fundamental" physics are out to divine these secrets. Everything else in science is ultimately secondary, and anyone who disagrees with this hierarchy is worthy of ridicule and dismissal, or at least of sharp rebuke.

Such fealty oaths sat uneasily alongside the sections of exposition, where Weinberg was typically thoughtful and clear. In a chapter titled "Against Philosophy," the pragmatic

scientist and the blustery pundit jostled against each other. To start, Weinberg observed that his scientific work hadn't been helped one whit by philosophy, and neither had the work of any other physicist in his acquaintance. Eventually he hedged, noting, for example, that Einstein put relativity theory in terms of clocks and trains under the philosophical influence of Ernst Mach. But he ultimately concluded that philosophy had done science more harm than good—after all, Mach's fixation on observable phenomena led him to reject the reality of atoms.

Weinberg was especially vexed by those who understood the science well enough but still questioned whether it got at truths that were independent of the social and historical processes of their discovery. While naming Thomas Kuhn as the godfather of such offenses, he also singled out Andrew Pickering's 1984 book *Constructing Quarks: A Sociological History of Particle Physics*, which argued that the social negotiations of particle physicists affected their scientific conclusions. Weinberg charged Pickering with mistaking process for product:

It is simply a logical fallacy to go from the observation that science is a social process to the conclusion that the final product, our scientific theories, is what it is because of the social and historical forces acting in this process. A party of mountain climbers may argue over

the best path to the peak, and these arguments may be conditioned by the history and social structure of the expedition, but in the end either they find a good path to the peak or they do not, and when they get there they know it. (No one would give a book about mountain climbing the title *Constructing Everest*.) I cannot prove that science is like this, but everything in my experience as a scientist convinces me that it is.

For those of us who suspect history and process are indeed relevant, this is a frustrating statement. It goes from begging the question to an appeal to authority (Weinberg's own) within the span of a single paragraph. And as with so much of the book, the most frustrating thing here was that within the bad argument, Weinberg had a point.

Suppose that Weinberg is right to claim that scientists don't need philosophy to keep on moving forward. Allowing that much, one can still reach a different philosophical conclusion. Even if we scientists are wise to treat the physical entities we deploy as picking out things that literally exist *out there*, beyond our brains, this realist stance might just be a fruitful shorthand, a way of forcing ourselves to expect more from our models than we might otherwise. Realism, that is, might be taken as not a metaphysical position but a methodological one, a way of warping our imaginations so as to goad ourselves toward further

heights. On this deflationary view, climbing a mountain is just a matter of leaning forward and hoping that your boot lands.

**D***reams of a Final Theory* had a dual aim, not only of inspiration but advocacy. When it was published in 1992, Weinberg and other scientists were lobbying Congress for the Superconducting Super Collider (SSC), a proposed next-generation particle accelerator to be built near Waxahachie, Texas, less than a three-hour drive from Weinberg's home in Austin. The SSC would have been much larger than the later Large Hadron Collider, allowing for particle collisions three times more energetic than those at the LHC, and thus furnishing greater ability to test theories. The cancellation of the SSC in 1993 has haunted much of Weinberg's work ever since—including, notably, his recent essays against public funding for human space travel.

*Facing Up*, published in 2001, traces Weinberg's path afterward. The essays collected there were shaped by his experience of lobbying for the SSC; "I found that I had a taste for controversy," he wryly noted in the preface. Weinberg accepted invitation after invitation to expound his views, and he stumped for reductionism, Whig histories, and objectivity with grueling repetitiveness. Along the way, he improved his rhetoric but rarely changed his mind.

Throughout the 1990s, Weinberg took on all comers against the idea that scientific findings are human constructions, not objective discoveries. The final entry in *Facing Up*, “Finding Peace in the Science Wars,” reviews philosopher Ian Hacking’s 1999 book *The Social Construction of What?* “This review,” Weinberg commented in his introduction to the essay, “is probably the last time that I will get into this debate, as it is not likely that there is anyone left whose opinions on these issues are still susceptible to change.”

But Weinberg gave it one last try, gamely addressing what Hacking had identified as the “sticking points” between Weinberg and the constructivists. Did Weinberg think that what we discover is contingent on history? Nope, not when science continues to make progress. Is science stable, or is it open to radical “paradigm shifts”? Stable since Newton, next question. Do scientific theories pick out real parts of the external world, or are they “only man-made ways of organizing our experiences”? Real stuff, so far as it matters. “Without claiming to solve such ancient philosophical problems, I would argue that scientific theories share those properties of rocks—stability and independence of societal setting—that lead us to call rocks real.”

Weinberg admitted in the final paragraph of his review, “I am one of those unfortunate souls who do not enjoy reading most philosophers, from Aristotle and Aquinas

to the moderns.” Given this, it’s puzzling that he opted to fight them for so long. But as the new millennium opened, he abandoned this dead end—a dead end for him, that is, since he seemed only peeved by these questions. This was fortunate, because he had plenty else to say.

Smash cut forward to today. The death of the Superconducting Super Collider was a bad thing for the U.S. physics community, but a good thing for Steven Weinberg as an essayist. Failure is fascinating in a way that success just isn’t, and the SSC would give Weinberg a taste of that human experience, with all the shadings of anger and regret that most of us take for granted. The SSC’s cancellation also took away his need to advocate for physics as a pugilistic activist, allowing him simply to speak for himself, as an individual.

*Third Thoughts* reflects this gradual shift. Unlike his other collections of odd scraps, *Facing Up* and *Lake Views* (2009), which were ordered by chronology, *Third Thoughts* groups its essays by topic: “Science History,” “Physics and Cosmology,” “Public Matters,” and “Personal Matters.”

The last of these sections comes as a surprise, bringing a new intimacy and a softer tone. “Writing about Science,” a piece where Weinberg contextualizes his own public work within the history of popular science, is a better introduction to his writing

than anything I've offered here. "The Craft of Science, and the Craft of Art" shows that Weinberg is more eager than one might expect to compare scientists to creative artists—both, he argues, submit to constraints—but it also reveals him to be a self-described "cultural reactionary" who hates most modern art. (*Mystic Raven*, a black metal sculpture that used to stand in front of a bank in downtown Austin, is singled out for special abuse.)

As far as "Public Matters" go, Weinberg has never been shy to wade into politics. *Facing Up*, though dominated by science-war polemics, included an essay defending secular Zionism. In *Lake Views: This World and the Universe*, more ink was spilled on this world than the universe, with pieces on missile defense, nuclear arms, and science funding. This time around, we are informed that Weinberg didn't vote for Obama a second time, that global warming is real, and that some tax loopholes (donations to universities, say) are best left open.

But the most original parts of his politics return to the SSC, that old wound, and tie together science funding, public priorities, and the future of physics. Decades have passed since the SSC was canceled, but some grudges linger. Previously, Weinberg blamed some of his fellow physicists for their congressional testimonies opposing the SSC. His most famous frenemy was Philip W. Anderson, the condensed-matter theorist and

Nobel laureate, author of the (arguably) anti-reductionist article "More Is Different," who insisted it would be better to fund numerous smaller projects than a single behemoth. But having considered the matter for a few more decades, Weinberg has identified a new villain in the SSC's demise: human space travel.

Weinberg's attacks on sending people to space come from many directions, but his core objection is that the outcomes are worthless. "The only technology for which the manned space flight program is well suited is the technology of keeping people alive in space," he writes. "And the only demand for that technology is in the manned space flight program itself." Sure, astronauts have serviced the Hubble Space Telescope (which Weinberg considers a worthwhile scientific venture), but without the space shuttle program, "so much money would have been saved that instead of servicing a single Hubble we could have had half a dozen Hubbles in orbit, making servicing unnecessary." For those who would gesture toward long-term human survival, Weinberg agrees with the goal but counters that we first need to work on making a self-supporting colony. "Perhaps we should start with Antarctica," he deadpans.

In "The Crisis of Big Science," Weinberg connects the space shuttle to the SSC. He reviews how scientists have built ever larger particle accelerators to probe ever smaller

subatomic scales. But particle accelerators are expensive, and the legislators who fund them often grant far less importance to science than their primary goals, like finding jobs for voters and cutting government spending. Weinberg believes that such conflicts led to the death of the SSC:

Before the Texas site was chosen, a senator told me that at that time there were a hundred senators in favor of the SSC, but that once the site was chosen the number would drop to two. He wasn't far wrong. We saw several members of Congress change their stand on the SSC after their states were eliminated as possible sites.

Once the SSC site was set in Texas, Weinberg presumes that the Clinton administration needed to choose either the International Space Station (ISS) or the collider, since the ISS was managed from Houston, and so “both were seen as Texas projects.” In the end, the ISS won—probably, Weinberg argues, because it let others in on the action: “The Space Station had the great advantage that it cost about ten times more than the SSC, so that NASA could spread contracts for its development over many states. Perhaps if the SSC had cost more, it would not have been canceled.”

**F**rom a writer with a different temperament, *Third Thoughts* might have functioned as a victory lap. After

all, in 2012 physicists at the Large Hadron Collider found something that looked a whole lot like the Higgs boson, a particle whose existence is a key prediction of the theoretical scheme introduced by Weinberg in his landmark 1967 article “A Model of Leptons.” (He explains all this—he tries, anyway—in the “Physics and Cosmology” section of his new book.) So why, given this, is Weinberg pessimistic about the outlook for fundamental physics, warning in his essay “The Crisis of Big Science” that confirmation of the Higgs “would be a gratifying verification of present theory, but it will not point the way to a more comprehensive future theory”?

It's an odd quirk of the scientific personality that pessimism can result just as readily from a lack of outstanding problems as from their continued presence. Like many particle physicists, Weinberg looks fondly back to the 1970s, when there were many open problems and many new solutions. For scientists working in the field since then, the fact that forty-year-old theories have explained nearly all the intervening high-energy experiments represents a sort of existential crisis. There are plenty of proposals to push physics “beyond the standard model,” to use a clichéd phrase, but if it ain't broke—well, the fix becomes a much harder sell.

The LHC may well continue gathering evidence to support the standard model, but it's probably not powerful

enough to generate any unexpected results that might point the way past. In political terms, though, lobbying for a bigger accelerator might prove impossible. Once again, Weinberg has the SSC on his mind. “My pessimism comes partly from my experience in the 1980s and 1990s in trying to get funding for another large accelerator.” The possibility of a future without mega-experiments leads to a specter of finality quite apart from the sort Weinberg envisioned in *Dreams of a Final Theory*:

There are things that can be done in fundamental physics without building a new generation of accelerators. We will go on looking for rare processes, like an extremely slow conjectured radioactive decay of protons. There is much to do in studying the properties of neutrinos. We get some useful information from astronomers. But I do not believe that we can make significant progress without also pushing back the frontier of high energy. So in the next decade we may see the search for the laws of nature slow to a halt, not to be resumed again in our lifetimes.

This finality is not that of an ultimate explanation, but of a dream deferred—a future where fundamental inquiry halts. But where would that leave us? Did we get close to the final answer?

Of all the pieces in *Third Thoughts*, the one most discussed by physicists

when it was first published was “The Trouble with Quantum Mechanics,” less for what it said than for who said it. “I’m not as sure as I once was about the future of quantum mechanics,” Weinberg admits. “It is a bad sign that those physicists today who are most comfortable with quantum mechanics do not agree with each other about what it all means.” But, true to form, Weinberg quotes N. David Mermin’s parody of postwar physics—“Shut up and calculate!”—as one “reasonable response” to all the fuss. When he speculates about where our present picture of quantum mechanics might need modification, rather than hanging much hope on the interpretations favored by philosophers, he suggests that the equations might need more terms.

Elsewhere in the volume, Weinberg takes on other speculations, from the “anthropic principle,” which explains why some scientific theories seem suspiciously fine-tuned to favor life by pointing out that this question can only be posed by living beings, to Stephen Hawking’s suggestion (as Weinberg summarizes) that “perhaps there is no underlying theory, that all we will ever have is a number of approximate theories, each valid under different circumstances, and agreeing with each other where the circumstances overlap.” This is a possibility that Weinberg—no surprise—continues to reject.

There’s a strange tension that holds throughout these essays. Weinberg



is fundamentally conservative in his view of knowledge, treating the human lineage of discovery as a single quest from ancient times to the present, and in “Science History,” the section that starts this book, he insists on the continuity of scientific goals so emphatically as to court comedy. (Few others would levy Aristotle’s failure to estimate the radius of the Earth as one of his major faults.) In this, Weinberg casts himself as just another investigator, incidental to the larger story. At heart, he still seems committed to the vision of scientific finality that he described in his *Dreams of a Final Theory* and *Facing Up*, where the historical quirks of the actors who make scientific discoveries are gradually “refined away, like slag from ore,” leaving only purified results.

Yet given Weinberg’s role as one of the creators of the standard model in particle physics, it’s hard to take him seriously. As Weinberg himself writes in his essay on the parallels between science and art, “We theorists....sit at our desks, pretty much free to create theories any way we like, with any variety of particles and forces, just as a poet or a composer

is free to put any words or notes he likes on paper, or a painter to put any paints he likes on canvas.” This sounds like the very opposite of a process likely to culminate anytime soon. Even if bigger accelerators are never funded, it seems likely that people will continue to invent new descriptions of nature so long as we continue to have imagination and will.

Of course, this much is easy to assert. Those of us who want science to be open-ended are content to describe scientists as artists of a peculiar type, painting upon a pre-stretched canvas of fact. But Weinberg has always wanted more than this. He has always reached past the personal, beyond mere beauty or explanatory efficiency or creative redescription, toward that ineffable quality—The Truth. This leaves Weinberg less in the position of a brilliantly successful creative artist than of a latter-day Moses on Mount Nebo, high enough up to glimpse the promised land, only for his journey to end just outside.

*David Kordahl is a graduate student in physics at Arizona State University.*