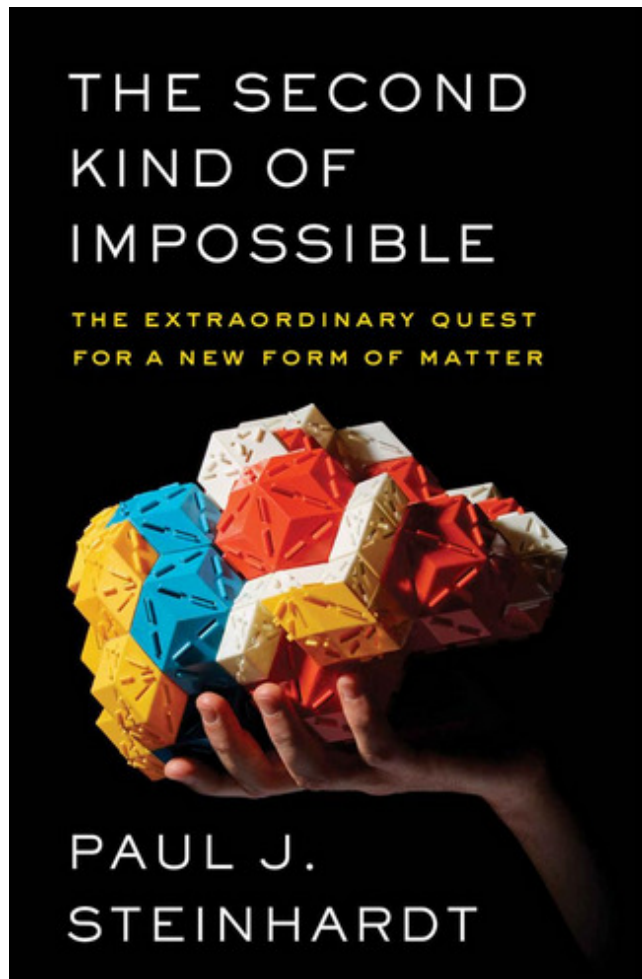


Epic tale delivers answer to ‘Why should we care?’

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“*The Second Kind of Impossible: The Extraordinary Quest for a New Form of Matter*,” by Paul J. Steinhardt. New York: Simon & Schuster, 2019, 400 pages, \$27 (hardcover).



“In the early 1980s, my student and I discovered a scientific loophole in one of the most well-established laws of science and, exploiting that, realized it was possible to create new forms of matter,” Paul J. Steinhardt explains near the beginning of “*The Second Kind of Impossible: The Extraordinary Quest for a New Form of Matter*,” a surprisingly enlightening personal account of his quest to achieve the impossible.

“In a remarkable coincidence, just as our theory was being developed, an example of the material was accidentally discovered in a nearby laboratory,” he continues. “And soon, a new field of science was born. But there was one question that kept bothering me: Why hadn’t this discovery been made long ago? Surely nature had made these forms of matter thousands, or millions, or perhaps even billions of years before we had dreamed them up. I could not stop myself from wondering where the natural versions of our material were being hidden and what secrets they might hold.”

So begins Steinhardt’s epic tale of how he and his associates made a paradigm-shifting contribution to our understanding of how the physical world is constructed and how that

knowledge could potentially be used to create new substances that could be of infinite value both scientifically as well as commercially. The central theme of the book revolves around what are known as quasi- crystals. In simplest terms, quasicrystals are clusters of atoms that form a pattern that never repeats itself identically. This characteristic, along with the fact that there can be more than one type of building block, is what distinguishes quasicrystals from their distant cousins, ordinary crystals.

At this point, many readers are probably saying to themselves, “That’s fascinating, but why should we care?” That was my initial reaction as I was making my way through Steinhardt’s inherently interesting yet somewhat enigmatic prose. Well, as it turns out, quasi- crystals allow for substances that are harder than steel and as slippery as Teflon. Suddenly the applications became obvious. Imagine how building materials with these and even more coveted qualities could be exploited in today’s world.

The “Second Kind of Impossible” consists of 22 chapters arranged in three sections: “Part I: Making the Impossible Possible,” “Part II: The Quest Begins,” and “Part III: Kamchatka or Bust.” The author provides several pictures and illustrations throughout the text – including an eight-page color insert in the middle of the book – that serve to bring the manuscript to life in a way that would not have been possible otherwise. The book also operates on two levels; first as an exposition of scientific research and second as an adventure story as the principal characters are forced to navigate a cultural realm decidedly outside their comfort zone.

Structurally, the book is presented in strict chronological order, with each chapter usually beginning with a location and a date (typically a year). For example, the inaugural chapter, “Impossible!” starts off with “Pasadena, California, 1985,” and the narrative reads more or less like a journal as it winds its way through the people and events relevant to the task at hand. Quasicrystals had been unintentionally synthesized in the lab at a time when most scientists did not think they could exist at all, much less occur naturally. The story culminates in the “middle of nowhere” (his language) in the Kamchatka Peninsula, which is situated between the Sea of Okhotsk and the Bering Sea in eastern Russia. It is here that Steinhardt and his team discovered quasi- crystals that had been created by nature. What really held my attention, however, was the description of the obstacles and difficulties the scientists had to confront and overcome in this remote and unforgiving part of the world.

In order to fully appreciate the significance of the work Steinhardt highlights in this intriguing and often complex foray into the fundamental nature of reality, it helps if the reader has had at least a rudimentary exposure to basic physics. I believe the book is accessible to a general audience – unlike many of his scholarly papers – although it will take some effort to fully dissect many passages. For example, consider this excerpt from “The Secret Secret Diary,” one of the more challenging chapters:

“The fact that the metal had melted but not reacted with oxygen in the melted silicate was also significant. Melted metal is normally highly reactive because the metal atoms are free to move around and chemically react with any oxygen atoms that happen to be in their surroundings. But here was a clear-cut case of melted aluminum making contact with an oxygen-rich liquid silicate and not reacting. A logical explanation was that the metal solidified ultra-rapidly, before it could react with the oxygen bonded to the silicate. Ultra-rapid cooling would also explain the oddly contorted shapes. Yet rapid cooling at such a high rate would not normally occur as part of any natural process on the surface of the Earth or in an ordinary laboratory.”

Did you get that?

Steinhardt is the Albert Einstein Professor in Science at Princeton University as well as the director of the Princeton Center for Theoretical Science. He received his B.S. in physics from Caltech (where he worked with Richard Feynman); his M.A. and Ph.D. (both in physics) are from Harvard University, where his doctoral advisor was Sidney Coleman. A fellow in the American Physical Society, he was elected to the U.S. National Academy of Sciences in 1998.

I enjoyed this one much more than I thought I would when it first arrived in my mailbox. My sense is that if you are a naturally curious person, you will have a similar experience.

– *Reviewed by Aaron W. Hughey, Department of Counseling and Student Affairs, Western Kentucky University.*