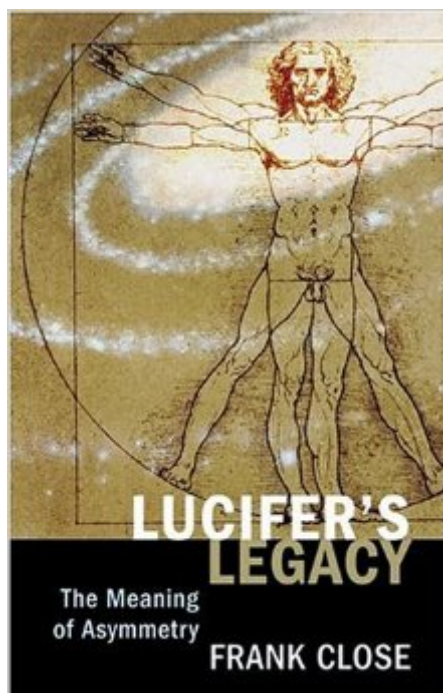


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# Lucifer's Legacy: The Meaning Of Asymmetry



## Synopsis

For many centuries, scientists have investigated the "fearful symmetry" that seemed to underlie the Universe. But increasingly, it looks as though life is the result of cosmic asymmetry, and scientists are now preparing to uncover the asymmetries at the heart of the Big Bang. As we begin a new millennium, it becomes clearer that true understanding of our Universe will come only from identifying and understanding the asymmetries that surround us. While modern scientific theory describes a uniformly perfect and symmetrical creation, we know that were that so, matter would have been destroyed within an instant of its appearance and nothing that we now know could ever have happened. Not only cosmic life but our own everyday variety is full of other examples of asymmetry, from the human body to the molecules of life. In *Lucifer's Legacy*, physicist Frank Close explores the origins of asymmetry from the molecular level to the Universe at large, and asks whether this multitude of examples can be traced back to a single event that took place at the origin of our Universe. Inspired by a chance encounter with a statue of Lucifer in the Tuilleries gardens in Paris, Close takes the reader on a sweeping tour of asymmetry in the world around us, from the development of human embryos to the mysterious Higgs boson. His tour culminates in the research now underway at CERN to recreate the Big Bang in Switzerland in 2005 and thus to solve this mystery of the original asymmetry. Vividly and engagingly written, *Lucifer's Legacy* reveals that whenever asymmetry occurs in Nature, it points towards deeper truths.

## Book Information

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## Customer Reviews

Frank Close has already provided several popular science standards, and in his new book takes us

on a guided tour of modern science, following a theme whose study started early in 19th century: the fascination and appeal of the underlying symmetry of Nature, and its attendant asymmetry. First the author reviews symmetry at large, with examples taken from everyday life. One of the enigmas dealt with is my own favourite, Martin Gardner's puzzle: why does a mirror invert left and right, but not top and bottom? Here the author adds much of his own insight and wit ('the muscles which close a mouth are stronger than those which open it - as is well-known to all who have sat in committees'). The result is a fascinating panorama, down to the molecular level, of the asymmetries around us. Life, intrinsically related to asymmetries, is the theme of this book, and the author revisits what has already been written on this theme, offering us an absorbing, lively and scientifically correct account of symmetry and its deep implications. Yves Sacquin /Saclay

The author beautifully narrates to laypersons how broken symmetry, i.e., asymmetry born from symmetry is important in the natural world for the existence of life, molecules, atoms and elementary particles. The riddle of the symmetry associated with the last of these items when the universe was created is yet to be solved in the near future. At the end of the book, the reader will be surprised to learn that Pasteur anticipated the importance of asymmetry in 1860. In an early chapter the author writes about the moderately well-known teaser "Why do mirrors reverse left and right but not top and bottom?" His answer to this is astonishingly simple. However, he should have been careful to give a more educational answer that includes the explanation for the reversal of the left- and right-handedness in mirrors, because he describes about "mirror asymmetric" left-handed and right-handed molecules, right-handedness of DNA and left-handedness of "the mirror DNA," etc. in a later chapter. [The latest academic articles on the mirror reversal problem can be found in M. C. Corballis, *Psychonomic Bulletin & Review* Vol. 7, No. 1, pp. 163-169 (2000) and T. Tabata and S. Okuda, *ibid.* pp. 170-173 (2000).] This book would also be interesting for scientists to learn how they can talk well about scientific topics to laypersons. It would have been much better for the book to include a bibliography for citations and further reading.

The book is extremely well written, fascinating, and easy to read. But the best part is the little errata sheet that comes with the book that may make it a collector's item. There is a drawing in the book of the Tulleries Garden in Paris meant to show the symmetry humans wish to achieve. The drawing has an error that breaks the symmetry, just like the one headless Lucifer statue in the Garden broke the symmetry when the author visited it, giving him a starting point for this book. The errata sheet attempts to restore the symmetry with a new drawing, but the irony has already made its point;

human attempts at symmetry are doomed to fail in an asymmetric universe.

The world is full of symmetries, broken and unbroken, according to *Lucifer's Legacy: The Meaning of Asymmetry* (Oxford University Press) by Frank Close. It may be that disrupted symmetries are essential for our very being, and experiments planned for this decade may give us an answer about this. The world of subatomic particles and basic forces is very weird, and so Close spends much of his book discussing symmetries that are a bit easier to understand. For instance, human bodies are mostly symmetric on the outside, but there are interesting exceptions to this rule. Some molecules come in left and right handed forms, and our own molecules are of the left form, as are most biological molecules. (It makes a difference; the molecule limone comes in right and left forms, too, and we can tell the difference: one smells like lemons and one like oranges.) Close tells us why mirrors reverse right and left but not up and down (they don't, really) and why bathtubs drain in different directions in different hemispheres (they don't, really). Symmetry can break up for all sorts of reasons. Billions of years ago in the Big Bang, for instance, there was equal matter and antimatter. For some reason, as far as we know, matter prevailed. Why? Are there packets of antimatter galaxies in the universe that are buffered from us by light years of separation? How did the asymmetric increase of matter over antimatter come to be? Why is there more matter, and when it comes down to it, why is there anything? These are questions that the newest generation of particle accelerators will be trying to tackle in the next decade. Close's book does a good job of examining these confusing issues and trying to make some sort of sense of them for the layman. He has a gift for the felicitous metaphor, and his writing on strange subjects is clear.

This book is a pleasant, painless introduction to particle physics and the applications of symmetry in the universe. I could see how it might annoy an experienced physicist with entire chapters full of metaphors and analogies intended to solidify the reader's understanding of the concepts, but for a beginner these are quite helpful. It also includes a long and detailed history of the major discoveries in atomic physics, which is a tiny bit too long, but still informative and well written. I am a junior in high school, and I enjoyed this book immensely.

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