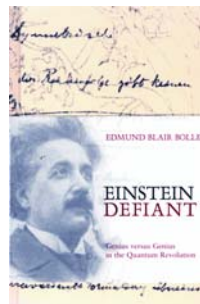


Dramatic Discourse on Wave–Particle Duality

Einstein Defiant: Genius Versus Genius in the Quantum Revolution

Edmund Blair Bolles
*Joseph Henry Press, Washington,
DC, 2004. \$27.95 (348 pp.).
ISBN 0-309-08998-0*

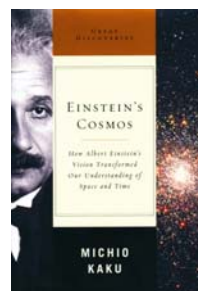


shows, at different times, both Einstein and Niels Bohr promoting erroneous ideas. Although Einstein and Bohr were the main protagonists, many other great physicists were involved: Max Planck, Arthur Compton, Satyendra Nath Bose,

The main physics story surrounding Einstein is well known. Bohr was adamant that the electromagnetic field was not quantized, which was the dominant view until the critical experiments of Compton, Hans Geiger, and Walther Bothe demolished Bohr's arguments and confirmed Einstein's heuristic paper of 1905. One should stress that Einstein had been almost alone in believing such "nonsense." But a few years after 1926, Einstein in turn could not accept as final the probabilistic interpretation of the wave–particle duality, which Bohr readily accepted. Einstein's failure to accept the new vision is no disgrace; no one understands quantum mechanics.

Einstein's Cosmos: How Albert Einstein's Vision Transformed Our Understanding of Space and Time

Michio Kaku
*Atlas Books / W. W. Norton,
New York, 2004. \$22.95 (251 pp.).
ISBN 0-393-05165-X*



Louis de Broglie, Paul Dirac, and Max Born, for example.

Bolles describes the history of the ideas and the main participants in fascinating detail. He follows Einstein's life almost week by week, with tremendous attention to his character and the personal decisions he had to make. In comparison with previous biographies on Einstein, such as Abraham Pais's *"Subtle Is the Lord . . .": The Life and Science of Albert Einstein* (Oxford U. Press, 1982), and books on the history of the period, *Einstein Defiant* gives a much more vivid picture of the drama—not so much in physics but in terms of personalities and the cultural and political life of the era. A small example is the author's narrative on the simultaneous release of the 1918 Nobel prize to Planck and the 1919 Nobel prize to Johannes Stark. The news was eclipsed by the results of the British expedition on the bending of light a few days earlier. The German press was devoted mainly to Einstein and Planck. Stark, however, was hardly mentioned and so became a bitter enemy of Einstein, which is ironic because from 1911 through 1913 he had been the main supporter of Einstein's 1905 heuristic proposal of light quanta.

In another example of his colorful profile of Einstein, Bolles writes how the animosity of many entente scientists toward Germans lasted long after World War I. Einstein was the only German to be invited to several international conferences, and he maintained solidarity with his German colleagues by not going. The important role of the Netherlands and Denmark as neutral territories for researchers to communicate with German scientists is partly due to such postwar political circumstances.

Although the physics described in the book is quite familiar, it is the personal detail and context that are most illuminating. The following is a brief excerpt from the book:

"Einstein and Bohr's first meeting had something of the mutual caution you expect whenever a prophet and a poet come together. Each knew the other was doing something related to and yet profoundly unlike his own work. . . . And their mutual thank you letters have the tone of the obsequious headwaiter who has received an overlarge tip. . . ."

Bolles's book covers the Einstein–Bohr debate only until 1931. As is well known, later developments—such as Einstein, Boris Podolsky, and Nathan Rosen's paradox (better known as the EPR paradox) and the contributions of John Bell and Alain Aspect—indicate even more clearly that "spooky actions at a distance," as Einstein put it, do indeed occur, as predicted by quantum mechanics. Einstein's guess on the future of quantum theory looks even more improbable now, an outcome described well and in detail in Kaku's book but not mentioned by Bolles.

The Bohr–Einstein debate is the finest example of a civilized controversy. Their discussions were always restricted to physics and never became personal; Bohr and Einstein were not only giants of physics but

Reviewed by Gabriel Karl

The huge fascination with Albert Einstein's life and work shows no sign of decrease. *Einstein Defiant: Genius Versus Genius in the Quantum Revolution* by Edmund Bolles and *Einstein's Cosmos: How Albert Einstein's Vision Transformed Our Understanding of Space and Time* by Michio Kaku respond to the public's thirst for more about Einstein during the centenary year of his 1905 papers. The first is written by a professional writer and excels in giving a lively picture of the person and his times; the second, by a theoretical physicist, is stronger on the physics. No mathematical formulas are used in either book, and both rely on information from previous books about Einstein.

Einstein Defiant is devoted to the period from 1918 through 1930, the golden age of theoretical physics. The story is centered on the struggle to understand the quantization of the electromagnetic field: Must light be regarded as coming in particlelike quanta, or is the wave description correct? It is a good story because it

Gabriel Karl is University Professor Emeritus at the University of Guelph in Ontario, Canada, and teaches physics at the University of Waterloo, also in Ontario. His research is in theoretical physics.

also great human beings. In enumerating facts or explaining physics, many books are superior to *Einstein Defiant*, but I believe I understand Einstein and his unique personality much better after reading Bolles's book. It illuminates a bygone era when the greatest revolution in physics took place.

Einstein's Cosmos by Kaku is very much a physics book. The author is not a historian or a psychologist, and his book reflects his profession. He details Einstein's private life and the political events of the day, but the main focus is physics, with connections to modern day research: strings, black holes, and so forth.

The strength of Kaku's book is its concise style that allows the whole of Einstein's life and work to be reviewed in a slim volume. However, the book makes no attempt to analyze Einstein's motives, and the historical detail is garbled. For example, Yugoslavia did not exist when Archduke Franz Ferdinand was murdered, so he could not have been called "Yugoslavian." (In Bolles's book, the only erroneous detail I found is his assertion that Peter Debye was at the University of Zürich and Erwin Schrödinger was at ETH Zürich. The reverse was true.) The last chapter, "Einstein's Prophetic Legacy," makes connections between recent theoretical and experimental work in physics and Einstein's ideas. The chapter is ideal for a physics graduate student or an intelligent layperson. It does provide a quick survey of much recent research, from Bose-Einstein condensation to superstrings. Kaku's book also has a nice review of the waves-versus-particles controversy, including recent developments.

Both *Einstein Defiant* and *Einstein's Cosmos* offer enjoyable reading, for different readers. One is about the story of a great man; the other, about great physics.

Volcanism

Hans-Ulrich Schmincke
Springer-Verlag, New York, 2004.
 \$79.95 (324 pp.).
 ISBN 3-540-43650-2

The science of volcanology has made tremendous progress over the past 40 years, primarily because of technological advances and because each tragic eruption has led researchers to recognize the processes behind such serious hazards. Yet scientists are still learning a great deal because of photographs that either capture those processes in action or show us the critical factors left behind in the rock record.

Volcanism by Hans-Ulrich Schmincke has photos of the best quality I have ever seen in a text on the subject. I found myself wishing that I had had the photo of Nicaragua's Masaya volcano, which was the subject of my dissertation, but it was Schmincke who was able to include it in his book. In addition, the schematic figures in their wide range of styles are clear, colorful, and simplified to emphasize the most important factors while including all significant features. The book's paper is of such high quality that at times I felt I had turned two pages rather than one.

I have really enjoyed reading and rereading Schmincke's book. It fills a great gap in texts available for teaching any basic course in volcanology. No other book I know of has the depth and breadth of *Volcanism*. I was disappointed that the text did not arrive on my desk until last August, when it was too late for me to choose it for my course in volcanology. I am also disappointed about another fact—the book's binding is already becoming tattered because of my intense use of it!

The recent discovery on Mars of rocks called "blueberries" has my colleagues in planetary geology proposing that the rocks are concretions formed within sediments because of the presence of free water. Meanwhile, a sedimentologist and mineralogist argue that they are accretionary lapilli formed by explosive volcanism. The photographs, photomicrographs, and discussions of those lapilli in Schmincke's book are superior to any previously published. I have thus shared *Volcanism* with my colleagues to their significant benefit, and I am more convinced of its value for a broad range of Earth and planetary scientists.

Schmincke is a volcanologist who, in 1967, first published papers on sedimentary rocks of volcanic origin, the direction traveled by lava flows millions of years ago, and the structures preserved in explosive ignimbrites, or pumice-flow deposits, that reveal important details of their formation. Since then, his studies in Germany's Laacher See, the Canary Islands, the Troodos Ophiolite of Cyprus, and many other regions have forged great fundamental advances. Such contributions have been recognized with his receipt of several international awards and clearly give him a strong base for writing the book.

However, as a scientist who has focused on the challenges of monitoring the very diverse activities of volca-

noes, I think that the text's overriding emphasis on the rock record has its cost. The group of scientists who are struggling with their goals to reduce or mitigate the hazards of the eruptions of tomorrow need to learn more about the options of technology, instrumentation, and methodology that are currently available. More than 500 million people live near the more than 1500 known active volcanoes and are constantly facing serious threats of eruptions. An extremely energetic earthquake caused the horrific tsunamis of 2004. However, the tsunamis of 1792, 1815, and 1883, which were caused by the eruptions of Japan's Unzen volcano and Indonesia's Tambora and Krakatau volcanoes, each took a similar toll.

The 445 references cited in the book provide an important resource for all advanced studies. However, there are puzzling omissions. For example, George Walker has long been acknowledged as a critically important leader for the second half of the 20th century, but only one of his many solely authored contributions is cited. With his passing in January, I think such an oversight on Schmincke's part is especially sad. Walker was one of those scientists who sincerely encouraged newcomers to the broad field of volcanology by the positive comments and constructive suggestions he always offered. Alex McBirney is certainly another major force in the science; he continues to make many important contributions but is only cited as the second author of the valuable textbook *Volcanology* (Freeman Cooper, 1979), which has served as the text on volcanology for more than 20 years.

Undoubtedly, I will use *Volcanism* for my upcoming courses in volcanology. I will also never hesitate to recommend it to others. Many geoscientists from very different subdisciplines will benefit from adding the book to their personal libraries. Schmincke has done all of us a great service by undertaking the grueling task of writing the book—and it is much better that he alone wrote it.

The many volumes that have been typically produced by teams of dedicated editors have often been disappointing because of the painfully inconsistent levels and depths at which the authors wrote their chapters. In addition, the very different styles of writing leave students confused and frustrated by the effect of "too many teachers," which often hinders efforts at team teaching.

