tury did scientists regain political influence. Her account is nonsense. Franklin is a false starting point, and the history of European politics during the 19th century is strewn with men of letters and science.

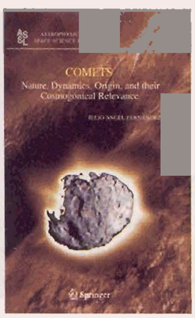
As a historian, I do not find it gratifying to admit to readers of PHYSICS TODAY that my colleague's attempt to make sense of their science has fallen so short. Two more of Chaplin's blurbists, Dudley Herschbach, a Nobel laureate in chemistry, and Lawrence Krauss, a distinguished physicist, judge *The First Scientific American* to be admirable in concept and execution. The book is full of "verve, insight and wit," according to Herschbach, and, according to Krauss, offers, a "fascinating . . . comprehensive exploration of [Franklin's] scientific side." Herschbach and Krauss's uninformed tolerance is misplaced. The cracks between the cultures of science and history should not be safe havens for work that would not survive in either.

Comets

Nature, Dynamics, Origin, and Their Cosmogonical Relevance

Julio Angel Fernández
Springer, Dordrecht, the Netherlands, 2005. $159.00 (383 pp.).
ISBN 1-4020-3490-3

The study of comets is currently in a remarkable period. Progress is often stimulated by the appearance of bright comets such as Hyakutake in 1996 and Hale–Bopp in 1997, or by a space mission to examine comets. The *Stardust* mission encountered comet Wild 2 on 2 January 2004 and returned samples of cometary dust for laboratory analysis. On 4 July 2005 the *Deep Impact* mission to comet Tempel 1 performed the first experiment on a comet by delivering 19 gigajoules of kinetic energy to the surface of the comet's nucleus and recording the effects.



Against this backdrop of recent comet research, Julio A. Fernández's *Comets: Nature, Dynamics, Origin, and Their Cosmogonical Relevance* treats extensively a part of cometary physics that is not closely linked to single events but instead is based on Newtonian mechanics. Research based on Newtonian mechanics is not always considered at the cutting edge of science—but it certainly is for studies of asteroids and comets in the solar system. Understanding their long-term orbital histories requires approaches and techniques far beyond simple Keplerian orbits. Fernández, a professor of astronomy at the University of the Republic in Uruguay, is a leading authority in the field and has presented an excellent account up to January 2005. The text has references to published material through 2004 and to some papers in press in 2005.

One serious quibble concerns the title of the book versus the goals stated in the preface and the actual content. Despite what the subtitle suggests, the book contains about four times more discussion on dynamics than on nature. As a result, the text is not a suitable introduction to comets. For comprehensive coverage at the research level, readers can consult *Comets II* (U. Arizona Press, 2004), edited by Michèl C. Festou, H. Uwe Keller, and Harold A. Weaver; at the tutorial level they can look at the second edition of *Introduction to Comets* (Cambridge U. Press, 2004), which I coauthored with Robert D. Chapman.

Nevertheless, Fernández's monograph is a lucid account of cometary dynamics and related topics that is an important contribution to the literature. His style combines a readable narrative with order-of-magnitude estimates and detailed mathematics where necessary. Among the topics discussed are the dynamics of long-period comets and the Oort cloud. The author explains how encounters with passing stars and giant molecular clouds, as well as galactic tides, influence comets in the Oort cloud and send some of them into the inner solar system. But getting into the inner region is not simple because Jupiter and Saturn act as gravitational barriers. In fact, the fate of most comets is ejection from the solar system. Advances in the understanding of orbits and dynamics have influenced the descriptions of them. Although such terms as short period and long period are still used, researchers also speak of "Jupiter-family" and "Halley-type" comets.

The need to pin down the source of the Jupiter-family comets naturally leads to a discussion of the belt of trans-Neptunian, icy objects. Fernández gives a nice, brief history of the confusion over the name of that belt—whether it should be called the Kuiper belt or the Edgeworth–Kuiper belt. The structure and evolution of the trans-Neptunian belt is fascinating. Many objects, called plutinos, and including Pluto, are in a stable mean-motion resonance with Neptune. The scattering of the icy planetesimals or cometesimals in the early solar system is responsible for the major outward migration of Neptune's orbit.

The formation of comets is a topic closely related to the formation of the solar system. The dynamics presented in the book take comets from their formation to their end states. The author also covers the dynamical issues related to the hypothesis that comets supplied Earth with water and the seeds of life. The need for an external source seems clear, but the relative contributions from comets and asteroids remain to be determined. Fernández's brief closing discussion of comet missions is somewhat out of date, a problem common to all recent comet treatises.

Comets provides an important and extremely readable summary of cometary dynamics and related topics. It is accessible to anyone with a basic knowledge of celestial mechanics and astronomy. Many scientists, including astronomers, can benefit from reading it. And despite the book's high price, they should buy a copy for themselves.

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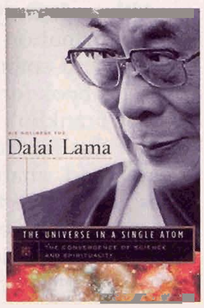
The Universe in a Single Atom

The Convergence of Science and Spirituality

Dalai Lama
Morgan Road Books, New York, 2005. $24.95 (216 pp.).
ISBN 0-7679-2066-X

Last November, amid some controversy, Tenzin Gyatso, Dalai Lama XIV, addressed more than 10 000 scientists at the Society for Neuroscience's annual meeting in Washington, DC. He spoke about recent developments in the "neuroscience of meditation" and the ethical implications of science. The Dalai Lama's talk was the most recent instance of his lifelong interest in science, a story engagingly told in his *The Universe in a Single Atom: The Convergence of Science and Spirituality*.



The Dalai Lama articulates the need for what he terms an "urgent engagement" between Buddhist philosophy and science. He writes that both traditions seek to reduce human suffering, but each uses complementary methods: Science labors to understand and to master the outer conditions of humanity; Buddhist philosophy seeks insight into and mastery over the inner causes of suffering. Both are necessary in his view, and society can only benefit by an open and sustained dialog between the two traditions.

In the book one reads about the Dalai Lama's childhood fascination with telescopes, watches, and automobiles in a Tibet that, outside the Potala Palace where he lived, lacked all modern machines. As a child it seems he was unique in his curiosity concerning Western science and technology. His flight from an occupying Chinese army in 1959 brought him squarely into a contemporary Indian society that was fast becoming a technologically sophisticated culture, a fact that impressed him mightily. As both the temporal and spiritual leader of the Tibetan government in exile, the Dalai Lama traveled widely, and he sought out scientists for conversations, both technical and philosophical. For example, he spoke often with Carl Friedrich von Weizsäcker and David Bohm, each of whom became his friend and mentor and whom he describes with great appreciation. By the mid-1980s, he had also begun extensive conversations with neuroscientist Francisco Varela, who in 1987 organized the first of a dozen Mind and Life discussions in which five or six scientists would meet with the Dalai Lama for an intensive five-day exchange concerning important topics at the intersection of science and philosophy. I have been part of several of these remarkable meetings, most actively in those dealing with physics and cosmology. *The Universe in a Single Atom* is the fruit of those many Mind and Life dialogs, as well as conversations with scientists during his travels.

Varela recognized that Buddhist meditative introspection could offer an important complementary perspective to that granted by conventional third-person methods of investigating the mind that are common to Western neuroscience. In cognitive neuroscience the combination of Buddhist meditative introspection and Western neuroscience has been remarkably fruitful, with experiments running at the University of Wisconsin–Madison, Princeton University, Harvard University, and the San Francisco and San Diego campuses of the University of California that can be traced back to the Dalai Lama dialogs.

Not until 1997 did a Mind and Life dialog on physics and cosmology take place, for which I was the scientific organizer. Since then, attendees Anton Zeilinger, Steven Chu, Piet Hut, George Greenstein, David Finkelstein, and others have worked with the Dalai Lama, explaining the subtleties of quantum mechanics, relativity, and astrophysics—as well as debating their philosophical implications. The Dalai Lama's special interest in modern physics stems from the manner in which it challenges naive views of reality. How should we as a society conceptualize reality, and what is the appropriate philosophical attitude toward theories and their primitives? The critical analysis of reality advanced by Buddhism is primarily philosophical, not empirical. It argues against naive realism or an immutable independent reality, and for what Buddhists term "emptiness." For example, to the Dalai Lama, the problem of observation in quantum mechanics appears as "resonant" with the logical arguments of Buddhist philosophy, particularly the Prasangika school's view of co-dependent origination. And the property of quantum entanglement resonates with the Buddhist concept of interdependence. He considers such exchanges as genuine aids to a deeper understanding of reality, thus becoming a basis for the mitigation of suffering.

I expect that many scientists will approach the book with skepticism. What can one learn that is relevant to science from the leader of a world religion? Some Mind and Life participants arrive at the dialog sessions with such an attitude, but the Dalai Lama quickly establishes his openness to well-reasoned arguments and data, even if it entails abandoning long-established Buddhist doctrine. His enthusiasm for science and its contributions to society is genuine, but he distinguishes between the findings of science and the philosophical position of scientific materialism. Not surprisingly, he rejects the latter in favor of a fuller view of reality, a view I share.

The Universe in a Single Atom is an important exemplar of open-minded engagement between different intellectual traditions, an engagement that enriches our shrinking planet. The Dalai Lama, like us physicists, recognizes the powerful role that science has had and continues to play in shaping the world. He has listened and learned much from those scientists who have generously given their time to working with him. He has repaid us with a thoughtful and challenging volume that I believe will become a small classic in the dialog between science and religion.

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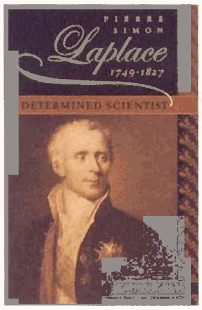
Pierre Simon Laplace, 1749–1827

A Determined Scientist

Roger Hahn
Harvard U. Press, Cambridge, MA, 2005. $35.00 (310 pp.).
ISBN 0-674-01892-3

When Pierre Simon Laplace died on 5 March 1827, his eulogists had difficulty finding matters of human interest to lighten the life story of France's most illustrious mathematician. Born in Normandy to a family of prosperous farmers, Laplace impressed many during his childhood with his skill in mathematics, yet he prepared for a life in the Catholic Church. His professors at the University of Caen recognized his mathematical ability, but it took nerve for the 20-year-old to forsake a secure religious career and travel to Paris with the hopes of making a livelihood as a scientist. Fortunately, Laplace was able to impress Jean d'Alembert, the reigning mathematician at the Paris Academy of Sciences, who took the young man under his wing and obtained a teaching position for him at the École Militaire.



Cut off from family and the church, Laplace was on his own. He knew that admission to the Paris Academy of Sciences was essential for future success. He produced 13 mathematical papers in 3 years and gained admission to the academy in 1773, beating out older, better-established mathematicians in the process. In the next 4 years he produced 20 more papers, and he didn't slow down until he reached age 75. Evidently, the eulogists' frustration came from the fact that Laplace never had time to do anything interesting except work.

In *Pierre Simon Laplace, 1749–1827: A Determined Scientist*, Roger Hahn does not attempt a technical account of Laplace's work. For that he refers readers to the lengthy entry on Laplace in the *Dictionary of Scientific Biography*