

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

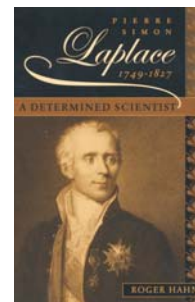
Roger Hahn

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*



(Scribner, 1970–80), edited by Charles C. Gillispie. Hahn provides new insight into Laplace's religious and philosophical reflections. Laplace was willing to tell Napoleon that there was no need for the "hypothesis" of a God in science, so one might expect him to have had little interest in religion and philosophy. However, Laplace's popular writings, such as his 1796 *Exposition du système du monde* (*Exposition of the World System*) and his *Essai philosophique sur les probabilités* (*Philosophical Essay on Probability*), published in 1814, reveal a penchant for philosophical speculation.

Hahn, who has studied Laplace for many years, had access to new non-scientific manuscripts that demonstrate Laplace's early religious concerns and allowed Hahn to flesh out this part of Laplace's life. Hahn concludes that once Laplace abandoned the church for science, his philosophy remained remarkably consistent throughout his life. Laplace was convinced that all events were determined by the laws of nature and that even the science of probability was merely a sign of our ignorance of those certain laws. Hahn does a better job than Laplace's previous biographers in showing the context of Laplace's commitment to determinism.

Perhaps Laplace's constant labor explains how he survived the French Revolution, the Napoleonic era, and the restoration of the monarchy while heads rolled around him. His close associates, the Marquis de Condorcet, Antoine Lavoisier, and Jean Sylvain Bailly, all died during the Reign of Terror—but not Laplace. After the coup of 18 brumaire (9 November 1799), Napoleon Bonaparte made Laplace minister of the interior and appointed him to the senate. Earlier in 1784, Laplace had become an examiner of the Royal Artillery Corps; in 1785 he inspected and passed the young Napoleon, thereby confirming his military career. After Napoleon was exiled to Elba, it was Laplace, the leading member of the senate, who welcomed Louis XVIII to Paris. His detractors called him a "weathercock," always turning with the wind; his supporters described him as the ideal public servant, indispensable to anyone in power.

Laplace's greatest works, *Traité de mécanique céleste* (*Celestial Mechanics*), published between 1798 and 1825, and the 1812 *Théorie analytique des probabilités* (*Analytical Theory of Probability*), reveal a powerful mind concentrating on mathematical applications. He had little interest in pure mathematics. His

emphasis on the applied might explain his collaboration with Lavoisier on the study of heat and chemical combustion, which was an opportunity for Laplace in several ways. Laplace gained access to the best-equipped laboratory in the world, although it meant sacrificing time from his beloved mathematical work. Lavoisier's great wealth also helped Laplace's father through an embarrassing financial predicament. And Laplace's later studies of sound, light, and capillary action stem from his commitment to applied mathematics and to his laboratory work with Lavoisier.

It is doubtful that Laplace ever returned to the piety of his youth, although some accounts of his death suggest that he might have been inclined in that direction. *Pierre Simon Laplace, 1749–1827* first appeared in French as *Le système du monde: Pierre Simon Laplace, un itinéraire dans la science* (Gallimard, 2004). The author has translated and slightly amended the original, and has added appendices. The biography will be gratefully received by everyone interested in this major figure in the history of mathematics and physics.

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