

COSMOLOGY

A physicist's final reflections

An unfinished tome reveals the late Stephen Hawking's musings on life's biggest mysteries

By Andrew Robinson

The death of cosmologist Stephen Hawking earlier this year happened to fall on the birthday of Albert Einstein. This felt like an appropriate coincidence, given the centrality of Einstein's general theory of relativity in Hawking's much-celebrated life as a scientist.

Einstein is mentioned in Hawking's posthumously published book—*Brief Answers to the Big Questions*, which he left unfinished—far more frequently than any other scientist, past or present, including Isaac Newton, Hawking's illustrious predecessor as Lucasian professor of mathematics at the University of Cambridge. Indeed, the concluding “big question” of the 10 explored in 10 chapters, “How do we shape the future?” begins with Einstein. “Where did his ingenious ideas come from?” asks Hawking. He answers, “A blend of qualities, perhaps: intuition, originality, brilliance. Einstein had the ability to look beyond the surface to reveal the underlying structure. He was undaunted by common sense, the idea that things must be the way they seemed. He had the courage to pursue ideas that seemed absurd to others. And this set him free to be ingenious, a genius of his time and every other.”

Was Hawking a genius, too? He never won a Nobel Prize, and the book gives no indication that Hawking regarded himself as a genius. On the other hand, he was one of the very few scientists since Einstein to become a household name. As his close collaborator, Nobel laureate Kip Thorne, remarked in his eulogy: “Newton gave us answers. Hawking gave us questions. And Hawking's questions themselves keep on giving, generating breakthroughs decades later. When ultimately we master the quantum gravity laws, and comprehend fully the birth of our universe,

it may largely be by standing on the shoulders of Hawking.”

Hawking was well known for two additional reasons unrelated to his mind-boggling cosmological theories. The first was his 1988 book, *A Brief History of Time*, an international bestseller that sought to explain the physics of time to the general reader without using mathematical equations. The second was his courageous struggle with motor neuron disease, which rendered him wheelchair-bound and dependent on a computer screen and speech synthesizer to communicate. “[A]s someone who at the age of twenty-one was told by their doctors that they had only five years to live, and who turned seventy-six in 2018, I am an expert on time in an-



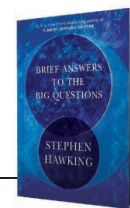
Hawking enjoys a moment of weightlessness in zero gravity in 2007.

other sense, a much more personal one,” he writes. “I am uncomfortably, acutely aware of the passage of time, and have lived much of my life with a sense that the time that I have been granted is, as they say, borrowed.”

Some of Hawking's “big questions” and answers are firmly rooted in science—for example, “What is inside a black hole?” and “Is time travel possible?”—whereas others inherently cannot be, such as “Will we survive on Earth?” “Should we colonize space?” “Will artificial intelligence outsmart us?” and “Is there a God?” To the last question, he answers, “If you like, you can call the laws of science ‘God,’ but it wouldn't be a personal God that you would

Brief Answers to the Big Questions

Stephen Hawking
Bantam Press, 2018.
255 pp.



meet and put questions to. Although, if there were such a God, I would like to ask however did he think of anything as complicated as M-theory in eleven dimensions.”

Certain of Hawking's assertions may be considered questionable and at times myopic. As an ardent advocate of space travel, he believes, “Not to leave planet Earth would be like castaways on a desert island not trying to escape.” Indeed, he goes much further and claims that space colonization

is the only hope for the survival of the human race after the “almost inevitable” destruction of Earth, which he predicts will happen within the next 1000 years.

Regarding artificial intelligence (AI), he anticipates, “AI may automate our jobs, to bring both great prosperity and equality” in the medium term. Looking further ahead, he writes, “the future of communication is brain-computer interfaces. ... If we can connect a human brain to the internet it will have all of Wikipedia as its resource.” Perhaps it is not surprising that someone who was intimately dependent on information technology should

have held such an opinion about its future. Although Hawking acknowledges potential negative scenarios, referring to HAL, the highly intelligent computer in the film *2001: A Space Odyssey* that unsuccessfully attempts to destroy its human masters, he remarks merely, “but that was fiction. We deal with fact.”

Nonetheless, the final testament of this unique scientist is well worth reading. One cannot help but be moved by Hawking's lifelong struggle to lead a creative life. “[R]emember to look up at the stars and not down at your feet,” he sums up. ■

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