



Shadows of the Mind: A Search for the Missing Science of Consciousness

By Roger Penrose

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A *New York Times* bestseller when it appeared in 1989, Roger Penrose's *The Emperor's New Mind* was universally hailed as a marvelous survey of modern physics as well as a brilliant reflection on the human mind, offering a new perspective on the scientific landscape and a visionary glimpse of the possible future of science. Now, in *Shadows of the Mind*, Penrose offers another exhilarating look at modern science as he mounts an even more powerful attack on artificial intelligence. But perhaps more important, in this volume he points the way to a new science, one that may eventually explain the physical basis of the human mind.

Penrose contends that some aspects of the human mind lie beyond computation. This is not a religious argument (that the mind is something other than physical) nor is it based on the brain's vast complexity (the weather is immensely complex, says Penrose, but it is still a computable thing, at least in theory). Instead, he provides powerful arguments to support his conclusion that there is something in the conscious activity of the brain that transcends computation--and will find no explanation in terms of present-day science. To illuminate what he believes this "something" might be, and to suggest where a new physics must proceed so that we may understand it, Penrose cuts a wide swathe through modern science, providing penetrating looks at everything from Turing machines (computers programmed from artificial intelligence) to the implications of Godel's theorem maintaining that conscious thinking must indeed involve ingredients that cannot adequately be stimulated by mere computation. Of particular interest is Penrose's extensive examination of quantum mechanics, which introduces some new ideas that differ markedly from those advanced in *The Emperor's New Mind*, especially concerning the mysterious interface where classical and quantum physics meet. But perhaps the most interesting wrinkle in *Shadows of the Mind* is Penrose's excursion into microbiology, where he examines cytoskeletons and microtubules, minute substructures lying deep within the brain's neurons. (He argues that microtubules--not neurons--may indeed be the basic units of the brain, which, if nothing else, would dramatically increase the brain's computational power.) Furthermore, he contends that in consciousness some kind of global quantum state must take place across large areas of the brain, and that it within microtubules that these collective quantum effects are most likely to reside.

For physics to accommodate something that is as foreign to our current physical picture as is the phenomenon of consciousness, we must expect a profound change--one that alters the very underpinnings of our philosophical viewpoint as to the nature of reality. *Shadows of the Mind* provides an illuminating look at where these profound changes may take place and what our future understanding of the world may be.

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Editorial Review

From Library Journal

This book asserts that human consciousness is not necessarily intelligible in terms of computational models. The brain's conscious activity essentially transcends the forms or possibilities of computation. Penrose (mathematics, Oxford) illustrates his thesis via mathematical logic, including detailed discussions of Godel's proposition of incompleteness, Turing's machines and computabilities, quantum mechanics, and microbiology. Eventually, Penrose argues that artificial intelligence and computer-controlled expert systems are capable of assisting local human expertise but will not be able to replace such expertise. Expanding on some of the ideas and concepts proposed in his controversial book, *The Emperor's New Mind* (Oxford Univ. Pr., 1989), Penrose challenges others to reconsider traditional concepts. Some familiarity with mathematical logic or processes will facilitate one's appreciation of this book. Recommended for scholars, specialists, and informed lay readers.

Donald G. Frank, Harvard Univ., Cambridge, Mass.

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From Kirkus Reviews

A leading critic of artificial intelligence research returns to the attack, attempting to lay the groundwork for an analysis of the true nature of intelligence. Building on his arguments in *The Emperor's New Mind* (not reviewed), Penrose (Mathematics/Oxford) begins by refuting the assertion that true intelligence can be attained--or even adequately simulated--by the strictly computational means to which current computers are ultimately limited. Much of his argument depends closely on the application of Godel's Undecidability Theorem to Turing machines--deep waters for laypeople, although the fundamentals of his argument are accessible to readers without sophisticated mathematical training. Having disposed of the central tenets of current AI research, Penrose then turns to an even more fundamental question: the actual foundations in modern physics (i.e., relativity and quantum theory) of the phenomenon of consciousness. Here much of his summary depends on fairly complex mathematical reasoning, although the key points are summarized for the general reader who has been willing to follow him so far. Penrose feels that a new physical synthesis, reconciling the paradoxes of quantum theory and bringing them into harmony with Einstein's gravitational theories, is ultimately necessary to explain the noncomputational elements of consciousness and intelligence. He speculates on the possible role of cellular structures called microtubules in creating a quantum phenomenon on a macroscopic scale within the brain, but grants that more research is needed to establish any connection between physical and mental phenomena. His conclusion steps back to a philosophical overview of the subject, paying homage to Plato, among others. A challenging examination of a central problem of modern philosophy, with no final answers but plenty of food for thought. (76 line drawings) (First printing of 50,000; \$50,000 ad/promo) -- *Copyright ©1994, Kirkus Associates, LP. All rights reserved.*

Review

"[Roger Penrose is] one of the greatest mathematical physicists alive....A work of breathtaking scope and richness....One certainly comes away from the book exhilarated by new metaphysical vistas."--*The Wall Street Journal*

"Provocative."--*American Scientist*

"Penrose reveals several worlds that are normally very hard to see but that thanks to his guidance are thrilling to imagine."--*The New York Times*

Users Review

From reader reviews:

Heather Jones:

Have you spare time to get a day? What do you do when you have considerably more or little spare time? Yes, you can choose the suitable activity intended for spend your time. Any person spent their own spare time to take a move, shopping, or went to the particular Mall. How about open or even read a book eligible Shadows of the Mind: A Search for the Missing Science of Consciousness? Maybe it is to get best activity for you. You know beside you can spend your time using your favorite's book, you can better than before. Do you agree with it has the opinion or you have various other opinion?

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Santos Conrad:

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