**Sir Roger Penrose**
**Evidence of the Soul**

Sir Roger Penrose, OM, FRS is an English mathematical physicist and Emeritus Rouse Ball Professor of Mathematics at the Mathematical Institute, University of Oxford and Emeritus Fellow of Wadham College. He is renowned for his work in mathematical physics, in particular his contributions to general relativity and cosmology. He is also a recreational mathematician and philosopher. He is also on the trail of the soul.

In 1955, while still a student at University College London, Penrose reinvented the generalized matrix inverse (also known as Moore-Penrose inverse, see Penrose, R. "A Generalized Inverse for Matrices." Proc. Cambridge Phil. Soc. 51, 406-413, 1955.) Penrose earned his Ph.D. at Cambridge (St John's College) in 1958, writing a thesis on tensor methods in algebraic geometry. In 1965 at Cambridge, Penrose proved that singularities (such as black holes) could be formed from the gravitational collapse of dying immense stars. (Ferguson, 1991: 66).

In 1967, Penrose invented the twister theory which maps geometric objects in Minkowski space into the 4-dimensional complex space with the metric signature. In 1969 he conjectured the cosmic censorship hypothesis. This proposes that the universe protects us from the inherent unpredictability of singularities (such as the one in the centre of a black hole) by hiding them from our view behind an event horizon. This form is now known as the weak censorship hypothesis; in 1979, Penrose formulated a stronger version called the strong censorship hypothesis. Together with the BKL conjecture and issues of nonlinear stability, settling the censorship conjectures is one of the most important outstanding problems in general relativity.

Another noteworthy contribution is his 1971 invention of spin networks, which later came to form the geometry of space-time in loop quantum gravity. He was influential in popularizing what are commonly known as Penrose diagrams (causal diagrams). In 2004 Penrose released The Road to Reality: A Complete Guide to the Laws of the Universe, a 1,099-page book aimed at giving a comprehensive guide to the laws of physics. In the June 2005 issue of Discover magazine, Penrose outlined his interpretation of quantum mechanics. Penrose is currently the Francis and Helen Pentz Distinguished (visiting) Professor of Physics and Mathematics at Penn State University.

Penrose has written controversial books on the connection between fundamental physics and human consciousness. In The Emperor's New Mind (1989), he argues that known laws of physics are inadequate to explain the phenomenon of human consciousness. Penrose hints at the characteristics this new physics may have and specifies the requirements for a bridge between classical and quantum mechanics (what he terms correct quantum gravity, CQG). He claims that the

present computer is unable to have intelligence because it is a deterministic system that for the most part simply executes algorithms, as a billiard table where billiard balls act as message carriers and their interactions act as logical decisions. He argues against the viewpoint that the rational processes of the human mind are completely algorithmic and can thus be duplicated by a sufficiently complex computer -- this is in contrast to views, e.g., Biological Naturalism, that human behavior but not consciousness might be simulated. This is based on claims that human consciousness transcends formal logic systems because things such as the insolubility of the halting problem and Gödel's incompleteness theorem restrict an algorithmically based logic from traits such as mathematical insight. These claims were originally made by the philosopher John Lucas of Merton College, Oxford.

In 1994, Penrose followed up The Emperor's New Mind with Shadows of the Mind and in 1997 with The Large, the Small and the Human Mind, further updating and expanding his theories. Penrose's views on the human thought process are not widely accepted in scientific circles. According to Marvin Minsky, because people can construe false ideas to be factual, the process of thinking is not limited to formal logic. Furthermore, he says that Artificial Intelligence programs can also conclude that false statements are true, so error is not unique to humans.

Penrose and Stuart Hameroff have constructed a theory in which human consciousness is the result of quantum gravity effects in microtubules, which they dubbed Orch-OR (orchestrated object reduction). But Max Tegmark, in a paper in Physical Review E, calculated that the time scale of neuron firing and excitations in microtubules is slower than the decoherence time by a factor of at least 10,000,000,000. The reception of the paper is summed up by this statement in his support: "Physicists outside the fray, such as IBM's John Smolin, say the calculations confirm what they had suspected all along. 'We're not working with a brain that's near absolute zero. It's reasonably unlikely that the brain evolved quantum behavior', he says." The Tegmark paper has been widely cited by critics of the Penrose-Hameroff proposal. It has been claimed by Hameroff to be based on a number of incorrect assumptions, but Tegmark in turn has argued that the critique is invalid. In particular, Hameroff points out the peculiarity that Tegmark's formula for the decoherence time includes a factor of the square root of T in the numerator, meaning that higher temperatures would lead to longer decoherence times. Tegmark's rejoinder keeps the factor of the square root of T for the decoherence time.

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Soul Search
Will natural science pin down our supernatural essence?
by Jane Bosveld

At the center of many near-death experiences is the sensation of the mind having left the body. Philosopher Thomas Metzinger of the Johannes Gutenberg University of Mainz in Germany hypothesizes that out-of-body experiences, or OBEs, may have actually spawned the idea of the soul. Early humans, he says, probably had such experiences and may have interpreted them as evidence that their minds separated from their bodies. This idea then could have evolved into the concept of a soul. Metzinger calls this his “soul hypothesis” and suggests that once the human brain had experienced out-of-body events, “it was a highly rational belief to assume the possibility of disembodied existence.”

Although Hameroff does not talk overtly about the soul, he invokes a similar idea.The question is, what causes out-of-body experiences? Olaf Blanke, a neuroscientist at the Swiss Federal Institute of Technology in Lausanne, actually induced an OBE in a patient by stimulating the temporal-parietal junction (a part of the brain important in body orientation). “Each time we stimulated that area, the patient, who had never had an out-of-body experience before, experienced one,” he says. “While we were stimulating it, she was awake and not impaired in any sense, and she told us that she saw the world, including us three investigators and herself lying on the bed, from this elevated perspective.”

If, as Blanke suggests, out-of-body experiences may be a product of a temporary brain stimulus, why do they leave such a deep and lasting impression? The effects of a near-death experience (often involving an OBE) literally change people’s behavior. “As a psychiatrist,” Greyson says, “what was most impressive to me was how people changed as a result of a near-death experience. It’s just one experience that takes place in maybe a fraction of a second, and it changes their lives. Psychiatrists spend years and years trying to help people make fairly small changes in their lives, and here comes this experience which in a blink of an eye totally transforms reality. If we can figure out what’s going on there and tap into that power, it would be an important tool for us to use. Basically, they come back believing that the golden rule is the way the universe works, just like gravity. What you do to other people gets done to you, so they come back with a different attitude toward almost everything. Some people change their careers, their relationships, how they do things. Some become more spiritual or more altruistic.”

Greyson has followed individuals for 20 years after they experienced an NDE. “For the most part,” he says, “the changes they made after having an NDE have persisted.”

Perhaps the most surprising scientific evidence for the soul comes from quantum mechanics—specifically, from investigations of the subatomic phenomena that produce consciousness. Stuart Hameroff, an anesthesiologist who has spent many years studying brain functions, has collaborated with renowned Oxford University polymath Roger Penrose on a model that explains consciousness as

the result of quantum processes occurring in tiny structures called microtubules in brain cells. “I think consciousness under normal circumstances occurs at the level of space-time geometry in the brain, in the microtubules,” Hameroff says. “But the fluctuations extend down to the Planck scale [far smaller than an atom] because the microtubules are driven bioenergetically to be in a coherent state. When the blood supply and the oxygen stops, things go bad and the coherence stops, but quantum information at the Planck scale isn’t lost. It may dissipate into the universe but remain somehow entangled in some kind of functional unit, maybe indefinitely. If the patient is revived, the information gets picked back up again.”

Although Hameroff does not talk overtly about the soul, he invokes a similar idea—consciousness that exists separate from the body. The Planck scale is the unimaginably small distance at which current theories of gravity and quantum physics break down. Events at the Planck scale, according to some theorists, may fundamentally establish the nature of reality. For Hameroff and Penrose, the idea goes even further, into the mystery of consciousness itself.

“Penrose came up with a specific threshold that is conscious. He made the connection between the quantum possibilities in the universe and the quantum processes in the brain,” Hameroff says.

Penrose speculated that there must be structures in the brain that process these fragments of quantum consciousness, but he didn’t know what they were. Meanwhile, Hameroff had found computer-like components in the brain but couldn’t figure out how they worked. “I needed a mechanism, and he needed a structure, so we teamed up,” Hameroff says.

Penrose theorizes that there exists at the Planck scale a realm of Platonic ideals that influence the workings of our mind. “It’s the tiniest scale imaginable,” Hameroff says. “The universe is, after all, mostly empty space. If you go down in scale 25 orders of magnitude below the size of an atom, on the way down it would appear smooth and featureless. Then you begin to see structure or coarseness or irregularity, which is the Planck scale, the basement level of the universe. You get patterns at the Planck scale that are constantly evolving and changing. This is where Penrose says the noncomputable influences are embedded. Even though they’re very, very tiny, they repeat everywhere.”

Even if that idea answers where consciousness comes from, it raises the question: Where did the Planck-scale processes that cause it come from Penrose’s answer: They came from the Big Bang. In this view, consciousness—all consciousness—was created at the same moment when the universe was created. If the soul exists, it, too, might be anchored to our moment of cosmic origin. This is what Italian astrophysicist Paola Zizzi terms the “Big Wow,” shorthand for her description of the connection between “the very early quantum computing universe and our mind.”

Penrose's ideas hint at a physical mechanism for consciousness that persists after death. "If a patient isn't revived," Hameroff says, "it enters the universe at large, and maybe it gets picked back up again by someone someday, who knows?" At the Division of Perceptual Studies, there are file cabinets bulging with case studies of people who think they know. Most of them are children who remember past lives: who they were, where they lived, what they looked like, what work they did, all sorts of details of a life.

Psychiatrist and physician Ian Stevenson, who founded DOPS, began gathering stories of past lives in 1960. He also made personal trips to verify and document the details, including reports of children with birthmarks corresponding to wounds the "previous personality" received and phobias related to the cause of death. Stevenson died early this year, but child psychiatrist Jim B. Tucker, author of Life Before Life: A Scientific Investigation of Children's Memories of Previous Lives, is continuing his work. Tucker has helped build a database of 1,400 cases of possible reincarnation. At his office at DOPS, Tucker explains that with the stronger cases "kids tend to start talking about these memories at an earlier age. They talk about them with more emotion. They give a lot of details, including specific names about the previous life."

Investigating reincarnation is an even thornier research problem than studying NDEs. Although almost every culture has stories of people whose souls returned after death, the evidence for that return consists mostly of recollections and anecdotes. Tucker does his best to examine as many of the memories in each case as possible. Sometimes he locates family members and consults local historians to confirm information. Nevertheless, Tucker says, "We would never say that we have proved that reincarnation occurs. I think we can only say that we've produced evidence for it."

The question comes back: What kind of evidence counts? For science, case studies like Tucker's are never going to be enough to prove that a human soul survives death and is reborn. Like the rainbow body, they will remain as nothing more than folklore for those who require empirical proof. As the Buddhist holy man Lama A-chos told Father Tiso, "This is not a matter for the eyes; it is a matter for the heart." The ongoing search for the soul may require both.

## Conclusion

It is my belief that each conscious moment is a quantum event. I am not alone in this line of thought. It just makes sense to me that a joining of unconscious quantum possibilities into definite values emerges as a reality from the collapse of the wave function, or quantum state reduction. The particular values created in each reduction will define the conscious experience and influence behavior.

And as Roger Penrose suggested, these events are reconfigurations at the most basic level of Einstein's space-time continuum, or the Planck scale. Way smaller than atoms or quarks, the Planck scale is quantized and nonrandom. It has specific geometry, information and logic. This leads us to:

1) Interconnectedness among living beings can be accounted for by nonlocal quantum entanglement.
2) Interaction with cosmic intelligence may be influence by Penrose noncomputable Platonic wisdom embedded in Planck scale geometry.
3) Existence outside the body: According to Orch OR, consciousness occurs at the fundamental level of Planck scale geometry, normally in and around microtubules between our ears. But when brain coherence is lost, quantum information related to consciousness and the unconscious mind remain in the universe, distributed but still entangled.

Science will indeed be able to find proof of the soul through the application of quantum mechanics to neuroscience. Steps are already being taken in this direction.