

NAME**STUART R. HAMEROFF, MD****POSITION TITLE**

EMERITUS PROFESSOR, ANESTHESIOLOGY

EMERITUS PROFESSOR, PSYCHOLOGY

DIRECTOR, CO-FOUNDER, CENTER FOR CONSCIOUSNESS STUDIES

EDUCATION/TRAINING

Institution and Location	Degree	Years	Field of Study
University of Pittsburgh Pittsburgh, PA	B.S.	1965-69	Chemistry, Physics Mathematics
Hahnemann Medical College Philadelphia, PA	M.D.	1969-73	Medicine
Internship, Tucson Medical Center Tucson, AZ		1973-74	

1977-Present**Attending Physician/Anesthesiologist, Department of Anesthesiology****University Hospital, University Medical Center, University Physicians Inc., University of Arizona, Health Sciences Center, UAHN, Banner-University Medical Center, The University of Arizona, Tucson, Arizona**

1977-1978

Instructor, Anesthesiology, University of Arizona, College of Medicine, Tucson, AZ

1978-1984

Assistant Professor, Anesthesiology

1979

Certified by the American Board of Anesthesiology

1979-1985

Director, Pain Clinic/Pain Service, University Medical Center

1984 -1995

Associate Professor with Tenure, Anesthesiology

1994

Joint Appointment, Associate Professor, Department of Psychology

1995

Professor, Department of Anesthesiology, College of Medicine

1995

Professor, Department of Psychology, University of Arizona

1999

Associate Director, Center for Consciousness Studies, University of Arizona

1998 Co-Founder

2003-Present

Emeritus Professor, Anesthesiology and Psychology

2004-Present

Director, Center for Consciousness Studies

Stuart Hameroff MD grew up in Cleveland, Ohio, working summers at Republic Steel and Cleveland Stadium. At the University of Pittsburgh in the late 1960s, he studied chemistry, physics, mathematics and philosophy of mind. In medical school in the early 1970s at Hahnemann Medical College in Philadelphia, Hameroff spent a summer in a cancer research lab. Studying mitosis, he became interested in mitotic spindles and centrioles, composed of microtubules, polymers of the protein 'tubulin', and major components of the cytoskeleton within all cells. Comparing their lattice structure to Boolean computer matrices, he proposed that microtubules were the source of biological intelligence, and perhaps consciousness. Choosing an academic career, Hameroff trained in anesthesiology at the new University of Arizona Medical Center in Tucson, mentored by the department of anesthesiology's founding chair, Dr Burnell Brown Jr, MD, PhD. After residency, Hameroff joined the anesthesiology faculty in 1977, a position he still holds as emeritus professor and practicing anesthesiologist.

Hameroff's research pursues theory - brain mechanisms of consciousness, memory, anesthetic action, quantum processing in microtubules, and clinical applications - transcranial ultrasound (TUS) for various brain disorders.

In the mid 1990s Hameroff teamed with famed British physicist Sir Roger Penrose to develop a quantum theory of consciousness ('orchestrated objective reduction', 'Orch OR') based on microtubule quantum computing. Highly controversial and harshly criticized, Orch OR is now supported by evidence, e.g. that anesthetics act in quantum channels in microtubules, and that microtubules have multi-scalar resonances, e.g. in megahertz. Hameroff and Penrose wrote a 20 year review of Orch OR in 2014.

Megahertz mechanical vibrations are ultrasound, clinically used in anesthesiology, and Hameroff proposed low intensity, non-invasive ultrasound could stimulate microtubule megahertz resonance and improve mental and neurological states in the brain. He and anesthesiology colleagues performed and published the first clinical trial of transcranial ultrasound ('TUS') on mental states in human volunteers, showing mood enhancement from brief, low intensity TUS. Collaborative studies with psychology professor John JB Allen and post-doc Jay Sanguinetti corroborated and elaborated TUS effects, and more TUS clinical studies are planned for Alzheimer's disease, depression, traumatic brain injury (with Dr. Lemole in neurosurgery), Parkinsons (Dr. Scott Sherman in Neurology) and pediatric developmental delay (with Dr. Sydney Rice in pediatrics). The group will test a state-of-the-art TUS headset from Berkeley Ultrasound, sponsored and organized through the Center for Consciousness Studies.

Beginning in 1994, with professor and former department head Al Kaszniak in Psychology, the late professor Alwyn Scott in mathematics, and subsequently philosophy (and Regents) professor David Chalmers, Hameroff started an interdisciplinary, international conference series 'Toward a Science of Consciousness' held in even-

numbered years in Tucson, and odd-numbered years elsewhere around the world. April 2014 marked the 20 year anniversary 'Tucson' conference, and the 2015 conference will be in Helsinki, Finland in June.

In 1998, with Kaszniak and Scott, and a 1.4 million dollar grant from the Fetzer Institute, Hameroff co-founded the University of Arizona Center for Consciousness Studies (CCS), served as associate director, and succeeded Kaszniak and then Chalmers, as director in 2004. With CCS moving administratively to anesthesiology, and Abi Behar-Montefiore as assistant director, CCS has subsisted since 2004 entirely on conference registration fees and small grants, and has supported relevant research.

Hameroff also collaborates with professors Jack Tuszynski at the University of Alberta, and Travis Craddock at Nova Southeastern on molecular modeling of microtubules, memory via CaMKII phosphorylation, and non-polar anesthetic and psychoactive drug actions in microtubule 'quantum channels'. Quantum non-locality implied for consciousness has attracted interaction with Deepak Chopra, and the inaugural 'Rustum Roy' award in 2011.

Hameroff has written or edited 5 books, over a hundred scientific articles and book chapters, lectured around the world, and appeared in the film 'WhattheBleep?' and numerous TV shows about consciousness on BBC, PBS, Discovery, OWN and History Channel. See http://en.wikipedia.org/wiki/Stuart_Hameroff, www.quantumconsciousness.org, and <http://www.consciousness.arizona.edu>.

BOOKS AUTHORED OR EDITED

1. Hameroff SR, Kaszniak AW & Chalmers D, (Eds), *Toward a Science of Consciousness III: The Third Tucson Discussions and Debates*, MIT Press/Bradford Books, Cambridge, MA (1999)
2. Hameroff SR, Kaszniak AW & Scott AC, (Eds), *Toward a Science of Consciousness II: The Second Tucson Discussions and Debates*, MIT Press/Bradford Books, Cambridge, MA, (1998)
3. Hameroff SR, Kaszniak AW & Scott AC, (Eds), *Toward a Science of Consciousness: The First Tucson Discussions and Debates*, MIT Press/Bradford Books, Cambridge, MA (1996)
4. Koruga DL, Hameroff SR, Withers J, Loutfy R, Sundareshan M. *C60 Fullerene--From Nanobiology to Nanotechnology*. Elsevier-North Holland, Amsterdam (1993)
5. Hameroff, SR, *Ultimate Computing: Biomolecular Consciousness and NanoTechnology*, Elsevier-North Holland, Amsterdam (1987)

PEER-REVIEWED ARTICLES

1. Craddock JA, Hameroff SR, Ayoub AT, Klobukowski M, Tuszynski JA. Anesthetics act in quantum channels in brain microtubules to prevent consciousness. *Current Topics in Medicinal Chemistry*, 2015/3/1, Vol 15:6, 523-533.
2. Craddock J.A. Travis, Friesen D, Mane J, Hameroff SR, Tuszynski JA. The Feasibility of Coherent Energy Transfer in Microtubules. *Journal of the Royal Society Interface*. 2014 Nov 6; 11(100).

3. Hameroff SR, Craddock TJ, Tuszynski JA. Quantum effects in the understanding of consciousness. *J Integr Neurosci*. 2014 Apr; 13(2):229-52.
4. Hameroff S, Penrose R. Consciousness in the universe: A review of the 'Orch OR' theory. *Phys Life Rev*, 2014; Mar 11(1):39-78.
5. Hameroff S, Penrose R. Reply to Seven Commentaries on "Consciousness in the Universe: Review of the 'Orch OR' theory". *Physics of Life Reviews*, 2014; 11:94–100.
6. Hameroff S, Penrose R. Reply to Criticism of the 'Orch OR qubit' - Orchestrated objective reduction is scientifically justified. *Physics of Life Reviews*, 2014; 11(1):104-112.
7. Hameroff S. Quantum walks in brain microtubules-a biomolecular basis for quantum cognition? *Top Cogn Sci*, 2014; Jan; 6(1):91-7.
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9. Hameroff SR. Quantum mathematical cognition requires quantum brain biology: the "Orch OR" theory. *Behav Brain Sci*, 2013; Jun; 36(3):287-90.
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11. Hameroff S. A tale of two fields: comment on "Dissipation of 'dark energy' by cortex in knowledge retrieval" by Capolupo, Freeman and Vitiello. *Phys Life Rev*. 2013 Mar;10(1):95-6; discussion 112-6.
12. Hameroff S. How quantum brain biology can rescue conscious free will. *Front Integr Neurosci*, 2012; 6:93, Oct 12.
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16. Craddock TJ, St George M, Freedman H, Barakat KH, Damaraju S, Hameroff S, Tuszynski JA. Computational predictions of volatile anesthetic interactions with the microtubule cytoskeleton: implications for side effects of general anesthesia. *PLoS One*. 2012;7(6).
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56. Hameroff SR, Simic-Krstic Y, Vernetti L, Lee YC, Sarid D, Wiedmann J, Elings V, Kjoller K, McCuskey R. STM of cytoskeletal proteins: Microtubules and intermediate filaments. *J Vac Sci A*, 1990; 8(1):687-691.
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60. Hameroff SR, Navabi MJ, Watt RC, Mylrea KC. Smart Alarms In Anesthesia Heart Rate And ECG Monitoring And Event Recognition Using Neural Network And Algorithmic Methods. Engineering in Medicine and Biology Society. *Proceedings of the Twelfth Annual International Conference of the IEEE*. 1-4 Nov 1990.
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microtubule stabilization *Journal of Vacuum Science & Technology A: Vacuum, Surfaces, and Films*, July 1989.

63. Rasmussen S, Karampurwala H, Vaidyanath R, Hameroff S. Emergent computation in microtubule model networks. Engineering in Medicine and Biology Society. Images of the Twenty-First Century. *Proceedings of the Annual International Conference of the IEEE Engineering in 9-12 Nov 1989*.
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BOOK CHAPTERS

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COMMENTARIES

1. Hameroff S. Quantum vitalism. *Advances: The Journal of Mind-Body Health* 1997; 13(4):13-22.
2. Hameroff S. To the brink of enlightenment? (Review of “The quantum brain” by Jeffrey Satinover) *Cerebrum – The Dana Forum on Brain Science* 3(2), Spring 2001.
3. Hameroff SR, Roger Penrose - The man who fell to earth in *Science and Spirit* March April (2003).

GRANTS/AWARDS

- | | |
|---------|---|
| 2014 | Bhaumik Foundation - Toward a Science of Consciousness TSC-20th Anniversary Conference |
| 2011 | Rustum Roy Award, Chopra Foundation |
| 2011 | Institute of Noetic Sciences, TUS Pilot Study |
| 2011 | USAF-AFOSR - Toward a Science of Consciousness, 2011 TSC-Stockholm Conference, European Office - Aerospace R-D; Asian Office of Aerospace R&D |
| 2005 | YeTaDeL Foundation Award for Quantum Approaches to Consciousness |
| 2003 | Samueli Foundation Award for 2003 Quantum Mind conference |
| 1998-01 | Fetzer Institute Award to establish the Center for Consciousness Studies at the University of Arizona |
| 1990-91 | National Science Foundation (NSF) studies of nonlinear dynamics in biomolecular systems; Solitons in biomolecules (Co-PI with Alwyn Scott, PhD) |
| 1982 | Pfizer-Roerig Pharmaceuticals for the study of Effects of the antidepressant doxepin in chronic pain |

states, and various clinical drug and equipment studies in anesthesiology.
1996-2014 Woodward White Independent Survey, US Pacific Region, Best Doctors in America,
(Neuroanesthesia)

EDITORIAL BOARDS

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PROFESSIONAL MEMBERSHIPS

American Society of Anesthesiologists
Association of University Anesthesiologists
Society for Neuroscience
Association for the Scientific Study of Consciousness

RESEARCH INTERESTS

Consciousness, microtubules, memory, quantum biology, anesthetic mechanisms, origin and evolution of life,
transcranial ultrasound (TUS)

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