TOWARD A SCIENTIFIC BASIS FOR CONSCIOUSNESS

PROGRAM AND ABSTRACTS

The University of Arizona
Tucson, Arizona
April 12–17, 1994

Sponsored by The University of Arizona
✦ Departments of Psychology and Anesthesiology
✦ Program in Applied Mathematics
✦ Cognitive Neuroscience Center
Arizona Health Sciences Center
Mabel St.
Parking (Permit Required)

Arizona Inn
Poster Session II
Friday, April 15th
6:30-9:00 pm

Plaza Hotel Conference Center
Poster Session I
Wed., April 13th
6:30-9:00 pm
Toward A Scientific Basis for Consciousness
An Interdisciplinary Conference

ACKNOWLEDGMENTS

In the planning stages, this meeting benefited from the ideas, inspirations and work of many. We offer our deepest thanks to these people.

In addition, we offer our gratitude to those who have made a financial contribution. They include:
The University of Arizona Department of Anesthesiology
The University of Arizona Cognitive Neuroscience Center
and
Gordon E. Olson, M.D., Sierra Vista, Arizona
Toward A Scientific Basis for Consciousness

Consciousness
What is consciousness? Ignored, denied, and mystified in the past, consciousness is now recognized as one of the greatest scientific frontiers facing humanity. It is being approached across a spectrum ranging from reductionism (the mind is the brain) to dualism (the mind is distinct and merely interacts with the brain). Between these extremes lie ample evidence, theory, and tools to begin to unravel the mind/brain "problem." Representatives from psychology, neuroscience, computer science, physics, mathematics, medicine, philosophy, and other fields will gather to discuss these issues at an international, interdisciplinary scientific conference on consciousness.

Communication across disciplinary lines isn't always easy; each field has jargon and biases that get in the way. We hope to promote understanding through an atmosphere of open discussion and festive challenge. While focusing on objective scientific approaches to consciousness, we also recognize the importance of subjective experiences and hope to provide avenues for discussing them. Join us in finding a common synergy among different fields, and help us move toward a new understanding of what "consciousness" really means.

Details
When: The conference begins Tuesday, April 12 with a welcoming reception starting at 6:30 p.m. Sessions continue through Sunday afternoon, April 17.

Where: Duval Auditorium in The University of Arizona Health Sciences Center.

Parking: Parking is available at the conference parking lot just south of the Arizona Health Sciences Center. Parking permits cost $6 for the entire conference, and will be available at the registration table.

Organizers
Stuart Hameroff, M.D., Department of Anesthesiology, The University of Arizona
Alfred Kaszniak, Ph.D., Department of Psychology, The University of Arizona
Alwyn Scott, Ph.D., Department of Mathematics, The University of Arizona
Gordon Olson, M.D., Internal Medicine, Sierra Vista, Arizona
Jim Laukes, M.A., Extended University, The University of Arizona
TOWARD A SCIENTIFIC BASIS FOR CONSCIOUSNESS
AN INTERDISCIPLINARY CONFERENCE
APRIL 12-17, 1994

TUESDAY, APRIL 12
6:30-8:30 PM Welcoming Reception, Arizona Inn

WEDNESDAY, APRIL 13
DuVal Auditorium, The University of Arizona Health Sciences Center
8:00-8:30 AM Continental Breakfast

PHILOSOPHY OF MIND
8:30-9:15 AM Owen Flanagan, PhD, Department of Philosophy, Duke University
"Constructive naturalism and consciousness: philosophic perspectives"
9:15-9:45 AM Alvin Goldman, PhD, Department of Philosophy, University of Arizona
"Philosophy of mind: defining consciousness"
9:45-10:15 AM David Chalmers, PhD, Department of Philosophy, Washington University, St. Louis, Missouri
"On explaining consciousness scientifically: choices and challenges"
10:15-10:45 AM Break

COGNITIVE APPROACHES
10:45-11:30 AM Bernard Baars, PhD, Wright Institute, Berkeley, California
"Cognitive theory of consciousness"
11:30-12:00 PM John Kihlstrom, PhD, Department of Psychology, University of Arizona
"The unconscious in social interaction"
12:00-12:30 PM David Galin, MD, Department of Psychiatry, University of California, San Francisco
"The structure of subjective experience"
12:30-2:00 PM Lunch on Your Own
OBSERVATIONS OF CONSCIOUSNESS

2:00-2:45 PM  EM Reiman, MD, RD Lane, PhD, GL Ahern, PhD, GE Schwartz, PhD, RJ Davidson, Departments of Psychiatry, Neurology, and Psychology, University of Arizona; Department of Computer Science, Arizona State University; Department of Psychology, University of Wisconsin; and the Samaritan PET Center, Good Samaritan Regional Medical Center, Phoenix, Arizona
  "Positron emission tomography and the conscious experience of emotion"

2:45-3:15 PM  LR Talbot, PhD, HA Whitaker, PhD, Centre de Recherche du Centre Hospitalier Côte-des-Neiges, Montreal, Quebec, Canada
  "Brain injured persons in an altered state of consciousness: measures and intervention strategies"

3:15-3:45 PM  James Whinnery, PhD, MD, Chief Aeromedical Scientist, Naval Air Warfare Center, Warminster, Pennsylvania
  "Induction of consciousness in the ischemic brain"

3:45-4:15 PM  Break

PERSPECTIVES FROM PATHOLOGY

4:15-5:00 PM  Alfred Kaszniak, PhD, Departments of Psychology, Neurology and Psychiatry, University of Arizona
  "Self-awareness in patients with Alzheimer's Disease"

5:00-5:30 PM  Victor Mark, MD, Department of Neuroscience, University of North Dakota, North Dakota
  "Diagnostic communicative behavior in a splitbrain subject"

5:30-6:00 PM  Polly Henninger, PhD, California Institute of Technology
  "Out of left-hemisphere awareness: what the commissurotomy subjects show us about consciousness"

POSTER SESSION I

6:30-9:00 PM- Poster Session I, with Dinner Buffet and Cash Bar
Poster Presenters with Last Names A-N
At the Plaza Hotel Conference Center
THURSDAY, APRIL 14
DuVal Auditorium, The University of Arizona Health Sciences Center

8:00-8:30 AM  Continental Breakfast

NEUROBIOLOGY OF CONSCIOUSNESS

8:30-9:15 AM  Christof Koch, PhD, Division of Biology, California Institute of Technology
"Towards a neurobiological theory of consciousness"

9:15-9:45 AM  Bruce McNaughton, PhD, Matthew Wilson, PhD, Department of Psychology, University of Arizona
"Ensemble neural codes for spatial experience, and their reactivation during sleep"

9:45-10:15 AM Valerie Gray Hardcastle, Department of Philosophy, Virginia Polytechnic Institute and State University, Virginia
"The binding problem and neurophysiological oscillations"

10:15-10:45  Break

EXPERIMENTAL FACTORS IN CONSCIOUSNESS

10:45-11:30 AM  Benjamin Libet, PhD, Department of Physiology, University of California, San Francisco
"Neural time factor in conscious and unconscious functions"

11:30-12:00 PM  Gary Schwartz, PhD, Department of Psychology, University of Arizona
"Olfaction, consciousness and the brain"

12:00-12:30 PM  Randall Cork, MD, PhD, Department of Anesthesiology, Louisiana State University, New Orleans, Louisiana
"The effect of surgical sedation on implicit memory"

12:30-2:00 PM  Lunch on Your Own
SUB-NEURAL MECHANISMS OF CONSCIOUSNESS I

2:00-2:45 PM  Karl Pribram, MD, Brain Research Center, Radford University, Radford, Virginia
                "Dendritic microprocessing and consciousness"

2:45-3:15 PM  Stuart Hameroff, MD, Department of Anesthesiology, University of Arizona
                "Anesthesia, quantum coherence in microtubules, and consciousness"

3:15-3:45 PM  Djuro Koruga, PhD, Faculty of Engineering, University of Belgrade, Belgrade, Serbia, Yugoslavia
                "Information physics, neuromolecular computing and consciousness"

3:45-4:15 PM  Break

SUB-NEURAL MECHANISMS OF CONSCIOUSNESS II

4:15-5:00 PM  Michael Conrad, PhD, Department of Computer Science, Wayne State University, Detroit, Michigan
                "Biomolecular quantum computing and consciousness"

5:00-5:30 PM  John Watterson, PhD, Faculty of Engineering and Applied Science, Griffith University Gold Coast, Australia
                "Pixels of consciousness: organized clusters at protein-water interface"

5:30-6:00 PM  Jack Tuszyński, PhD, University of Alberta, Edmonton, Canada
                "Microtubular self-organization and information processing capabilities"
FRIDAY, APRIL 15
DuVal Auditorium, The University of Arizona Health Sciences Center

8:00-8:30 AM  Continental Breakfast

QUANTUM THEORY AND CONSCIOUSNESS I

8:30-9:15 AM  Roger Penrose, PhD, Mathematical Institute, Oxford University, UK
"Quantum coherence and consciousness"

9:15-9:45 AM  Mari Jibu, MD, Kunio Yasue, PhD, Notre Dame Seishin University, Okayama, Japan
"Quantum optical coherence in microtubules: implications for consciousness"

9:45-10:15 AM  Walter Schempp, PhD, Department of Mathematics, University of Siegen, Germany
"Quantum neural holography"

10:15-10:45 AM  Break

QUANTUM THEORY AND CONSCIOUSNESS II

10:45-11:30 AM  Danah Zohar, B.Sc., Oxford Brookes University, United Kingdom
"Consciousness and Bose-Einstein condensates"

11:30-12:00 PM  Ezio Insinna, PhD, Schoeller Elektronik, Lyon, France
"Synchronicity Regularities in Quantum Systems"

12:00-12:30 PM  Fred Wolf, PhD, La Conner, Washington
"On the quantum mechanics of dreams and the arising of the self-concept"

12:30-2:00 PM  Lunch on Your Own

POSTER SESSION II

6:30-9:00 PM  Poster Session II, with Snacks and Cash Bar
Poster Presenters with Last Names O-Z
At the Arizona Inn
SATURDAY, APRIL 16
DuVal Auditorium, The University of Arizona Health Sciences Center

8:00-8:30 AM  Continental Breakfast

EMERGENT PHENOMENA

8:30-9:15 AM  Chris Barrett, PhD, Los Alamos National Laboratories, Los Alamos, New Mexico
   "Functionalism, emergence, and mental process"

9:15-9:45 AM  Steen Rasmussen, PhD, Los Alamos National Laboratories, Santa Fe Institute
   "The emergence of life - and consciousness? - through self-organization of matter"

9:45-10:15 AM  Arthur J. Deikman, MD, University of California, San Francisco
   "The role of intention and self as determinants of consciousness: a functional approach to a spiritual experience"

10:15-10:45 AM  Break

HIERARCHICAL ORGANIZATION

10:45-11:30 AM  Eric Harth, PhD, Department of Physics, Syracuse University, New York
   "The creative loop: how the brain makes a mind"

11:30-12:00 PM  Nils Baas, PhD, Department of Mathematical Sciences, University of Trondheim, Norway
   "Higher order cognitive processes"

12:00-12:30 PM  Alwyn Scott, PhD, Department of Mathematics, University of Arizona
   "Hierarchical organization in the brain--emergence of consciousness"

12:30-2:00 PM  Lunch on Your Own

NEURAL NETWORKS

2:00-2:45 PM  John Taylor, PhD, Centre for Neural Networks, Department of Mathematics, King’s College, London, United Kingdom
   "Toward a neural network model of the mind"
2:45-3:15 PM  Judith Dayhoff, PhD, Systems Research Center, University of Maryland
   "Artificial neural networks: biological plausibility"

3:15-3:45 PM  Andrew Wuensche, School of Cognitive and Computer Science, University of Sussex, UK -- Santa Fe Institute
   "The ghost in the machine"

3:45-4:15 PM  Break

**PHENOMENOLOGY**

4:15-5:00 PM  Andrew Weil, MD, Division of Social Perspective, College of Medicine, University of Arizona
   "Pharmacology of consciousness"

5:00-5:30 PM  Dharma Singh Khalsa, MD, Department of Anesthesiology, Maricopa Medical Center
   "Eastern philosophy, meditation and consciousness"

5:30-6:00 PM  Brian Josephson, PhD, Department of Physics, University of Cambridge, United Kingdom and Tethys Carpenter, PhD, Royal Holloway and Bedford New College, United Kingdom
   "Music, Meaning and Design"

6:30-9:00 PM  Western BBQ -- at Old Tucson Studios
   (Optional ticket may be purchased; transportation will be arranged.)
SUNDAY, APRIL 17
DuVal Auditorium, The University of Arizona Health Sciences Center

8:00-8:30 AM  Continental Breakfast

OVERVIEW

8:30-9:15 AM  Walter Freeman, PhD, Neurobiology, University of California, Berkeley
               "Some category confusions in studies of the biology of consciousness"

9:15-9:45 AM  I.N. Marshall, MA, MBBS, Oxford Brookes University, United Kingdom
               "Three kinds of thinking"

9:45-10:15 AM  Arthur Winfree, PhD, Ecology and Evolutionary Biology, University of Arizona
                 "Is it impossible to ‘measure’ consciousness?"

10:15-10:45 AM  Break

10:45-11:15 AM  Willis W. Harman, PhD, Institute of Noetic Sciences, Sausalito, California
                 "A comparison of three approaches to reconciling science and consciousness"

11:15-12:30 PM  Wrap-up Discussion
Field Trips

All trips will leave from the north entrance of the Plaza Hotel, 1900 East Speedway, Tucson, Arizona. Reservations will be on a first-come, first-served basis.

Ethnobotany or the Desert as Supermarket  April 12
Hike in Catalina State Park and enjoy a tasting session of native plant foods. Explore desert plants and learn how desert peoples relied on these plants for food, fiber, fuel, and building materials. Conducted by the staff of Tucson Botanical Gardens.
When: 8:00 a.m.-2:30 p.m., Tuesday, April 12
Cost: $55; includes transportation and a box lunch

Kitt Peak, Casa Grande, and Picacho Peak  April 12
Visit a world-class observatory, experience the wide expanse of an Indian reservation, look back in time at a national monument, and see the site of Arizona's only Civil War battle.
Begin with Kitt Peak, whose collection of telescopes sits high above the desert at an elevation of 6,882 feet. The grouping includes the McMath solar telescope with its unique triangular shape and the four-meter Mayall telescope. Continue on to the Casa Grande Ruins National Monument, an archeological site where today a giant steel "umbrella" protects the main four-story ruin. On the way back to Tucson, visit Picacho Peak State Park, the site of Arizona's only Civil War battle. The vistas are breathtaking, especially if you hike up this natural landmark.
When: 8:00 a.m.-5:00 p.m., Tuesday, April 12; Cost: $70; includes transportation and a box lunch

Sabino Canyon: A Desert Oasis  April 15
Sabino Creek originates more than 6,000 feet above the desert in the Santa Catalina Mountains. This rare perennial stream and its canyon watershed support a lush riparian community, wildlife, and native fish. You'll tour the canyon in an open-air tram, with a presentation by an interpretive specialist and opportunities for exploration of the riparian and stream communities.
When: 1:00-5:00 p.m., Friday, April 15; Cost: $40; includes transportation and beverages

Arizona-Sonora Desert Museum  April 15
This outdoor "living museum" features plants, animals, and earth sciences individually and in their relationships to each other. A few hours exploring trails and exhibits will give you a better understanding and appreciation of the desert, as well as an opportunity to experience many of its most unusual sights and sounds.
When: 1:00-5:00 p.m., Friday, April 15; Cost: $40; includes transportation and beverages

Dawn Bird Watching  April 13 or 15
Get an early start at one of the many prime birding spots in Tucson. Small groups will go to select locations. Vans will depart at 5:30 a.m. and return at 8:00 a.m.
When: Wednesday, April 13 and/or Friday, April 15; Cost: $15/session; includes transportation.
POSTER PRESENTATIONS
Toward a Scientific Basis for Consciousness
An Interdisciplinary Conference
April 12-17, 1994

Poster Presentations

1. Richard Amoroso, Director of the Noetic Institute, Orinda, California
   "Consciousness: A radical definition"

2. Britt Anderson, MD, Thomas Head, MD, Department of Neurology and the Alzheimer's Disease Center, University of Alabama at Birmingham, Birmingham, Alabama
   "Evidence for covert language comprehension in a severe 'sensory' aphasic"

3. Adam Atkin, PhD, Briarcliff Manor, New York
   "Mind is more than mechanism: A new-old consciousness paradigm"

4. Richard P. Atkinson, PhD, Heath Earl, Weber State University
   "Enhanced vigilance in guided meditation: Perceptual implications of altered consciousness"

5. Parthasarathi Banerjee, PhD, National Institute of Science, Technology and Development Studies, New Delhi, India
   "The four spaces of consciousness"

6. J. Baribeau, PhD, Director of Neurophysiology and Neuropsychology Laboratory, Department of Psychology, Concordia University, Montreal, Canada
   "Neurophysiological correlates of levels of consciousness and anesthesia"

7. John Barnden, PhD, Computing Research Laboratory and Computer Science Department, New Mexico State University, Las Cruces, New Mexico
   "Consciousness and folk-psychological metaphors of mind"

8. Mikael Bergenheim, PhD, Håkan Johansson, Brittmarie Granlund, Jonas Pedersen, Division of Work Physiology, National Institute of Occupational Health, Sweden; and the Department of Physiology, University of Umeå, Umeå, Sweden
   "Synchronization of sensory information to conscious experience"

9. John Boitano, PhD, Department of Psychology, Fairfield University, Fairfield, Connecticut
   "Edelman's biological theory of consciousness"
10. Greg Brack, PhD, Catherine Brack, PhD, Mary Kate Bagwell, MS, Georgia State University
   "Exploring the underlying mechanisms of dissociation as a modification of consciousness"

   "Self-learning, memory-controlled machines: Nonliving beings"

12. Dwight Bulkley, PhD, Seattle Institute for the Life Sciences, Seattle, Washington
   "Electromagnetic micromechanisms: a necessary prelude to understanding consciousness."

13. Jean Burns, PhD, San Leandro, California
   "The possibility of empirical test of hypotheses about the relationship between consciousness and the physical world"

14. William H. Calvin, PhD, University of Washington, Seattle, Washington
   "Islands in the mind: Dynamic subdivisions of association cortex and the emergence of a Darwin Machine"

15. Joseph P. Cammarota, Aerial Combat Maneuvering Enhancement Laboratory, Naval Air Warfare Center, Aircraft Division, Warminster, Pennsylvania
   "A dynamic model of the induction of unconsciousness due to acceleration (+Gz) induced ischemia"

16. Allan Combs, PhD, Department of Psychology, University of North Carolina at Asheville
   "Consciousness as a system near the edge of chaos"

17. Deborah Conrad, PhD, Department of Philosophy, Wayne State University, Detroit, Michigan
   "Consciousness and rule following"

18. Ellis D. Cooper, PhD, EC Consulting Company, New York, New York
   "Toward a mathematical theory of virtuality over neural machines"

19. Thaddeus M. Cowan, PhD, Department of Psychology, Kansas State University, Manhattan, Kansas
   "Sensation, perception, and the theory of conscious extent"
"Cerebral function, Jungian typology and language style: Toward a new theory"

21. Vinod Deshmukh, MD, PhD, Department of Neurology, University of Florida, Jacksonville, Florida
"The quiescent brain and consciousness"

22. José-Luis Díaz, PhD, Centro de Neurobiología, Universidad Nacional Autónoma de México and Instituto Mexicano de Psiquiatría, Mexico City, Mexico
"The stream revisited: A process model of phenomenological consciousness"

23. Avshalom C. Elitzur, Department of Chemical Physics, The Weizmann Institute of Science, Rehovot, Israel
"Can relativity shed a new light on consciousness?"

24. Glenn Ennis, Boulder, Colorado
"Expanding the energy-momentum equation to model awareness"

25. B. Raymond Fink, MD, Department of Anesthesiology, University of Washington
"Bioenergetic correlates of consciousness: An energy hub viewpoint"

26. Hans Flohr, Brain Research Institut, University of Bremen, Bremen, Germany
"Sensations and brain processes"

27. Gregg Franzwa, PhD, Department of Philosophy, Texas Christian University, Fort Worth, Texas
"Descartes, Searle and Edelman: The organic paradigm"

28. Michael Gilinsky, PhD, Institute of Physiology, Siberian Branch of Russian Academy of Medical Sciences, Novosibirsk
"Participation of consciousness and emotions in elaboration of cold adaptation strategies"

29. Güven Güzeldeş, Center for the Study of Language & Information, Stanford University, Stanford, California
"Consciousness and the functional link hypothesis"

30. Scott Hagan, BS, Department of Physics, McGill University, Montréal, Québec
"Coherent activity in microtubules and its implications for global brain function"
31. John S. Hagelin, PhD, Maharishi International University, Fairfield, Iowa
"Is consciousness the unified field? A field theorist’s perspective"

32. Christine Hardy, PhD, Laboratoire de Recherche sur les Interactions Psychophysiques, Morsang/Orge, France
"Meaning as interface between mind and matter"

33. Howard T. Herman, MD, John C. Kotelly, BS, Newtonville, Massachusetts
"A candidate architecture for characterizing consciousness"

34. Marco Iacoboni, Jan Rayman, Eran Zaidel, Department of Psychology, University of California, Los Angeles, California
"Left brain says yes, right brain says no: normative duality in the split brain"

35. Svetlana Jankovic, MD1, Djuro Koruga, PhD1,2, AKADEMIA NOVA-GMT, Division for Consciousness Research, Serbia, Yugoslavia; 2Advanced Biotechnology Laboratory, Department of Anesthesiology, University of Arizona, Tucson, Arizona
"Biomedical approach to consciousness research"

36. S. Jeffers, J. Sloan, Department of Physics and Astronomy, York University, Ontario, Canada
"Optical diffraction and interference phenomena as potential indicators of anomalous phenomena"

37. Alexander Jourjine, PhD, Analog Intelligence DA, Winchester, Massachusetts
"Consciousness as modeling of environment"

38. Stanley Klein, PhD, School of Optometry, University of California Berkeley, Berkeley, California
"The dual nature of consciousness"

39. George Kurian, PhD, Department of Psychology, Punjabi University, Patiala, India
"Microgenesis of consciousness"

40. R Lahoz-Beltra, PhD1, SR Hameroff, MD2, J Dayhoff, PhD3, 1Department of Applied Mathematics, Faculty of Biological Sciences, Complutense University of Madrid, Madrid, Spain; 2Advanced Biotechnology Laboratory, Department of Anesthesiology, University of Arizona, Tucson, Arizona; 3Systems Research Center, University of Maryland, College Park, Maryland
"Phase transitions in bound water and their role as cytoskeletal communication interface and medium for information representation"
41. Dyan Louria, Departments of Physiology and Anesthesiology, University of Arizona, Tucson, Arizona
"Computer simulation of anesthetic quantum effects in proteins"

42. Ljubomir J. Kljakic, AKADEMIA NOVA, Division for consciousness research, Novi Beograd, Serbia
"The Pelasgian creation myth as a starting point of new scientific paradigm of human consciousness?"

43. John Limber, Psychology Department, University of New Hampshire, Durham, New Hampshire
"'Traynes of Thought' in language and consciousness: past and present"

44. Paul Lovland, M.SC., Klofta, Norway
"Meaning, motivation, and disorder: Thermodynamic model and possible experiment"

45. Rollin McCraty, MA1, Mike Atkinson1, and William A. Tiller, PhD2, 1 Institute of HeartMath, Boulder Creek, California; 2 Department of Materials Science and Engineering, Stanford University, Stanford, California
"Heart rate variability as an indicator of highly ordered states of consciousness"

"Awareness of colours"

47. Peter J. Marcer, DPhil, FBCS, CEng., Aikido Enterprises, United Kingdom
"Self-organization by means of quantum holographic adaptive resonance"

48. Donald Mathis, Michael Mozer, Computer Science Department, University of Colorado, Boulder, Colorado
"On the computational utility of consciousness"

49. Douglas Matzke, Texas Instruments Incorporated, Dallas, Texas
"Consciousness: A new computational paradigm"

50. Jefffrey Mishlove, PhD, Saul-Paul Sirag, Eugene, Oregon; Global Intuition Network, Institute of Noetic Sciences, Sausalito, California
"Saul-Paul Sirag's model of consciousness"

51. Peter L. Nelson, PhD, Centre for Humanities and Human Sciences, Southern Cross University, Lismore, Australia
"Consciousness as reflexive shadow: An operational, ontologically neutral, non-epistemic model"
52. J. Hulse Neufeld, Department of Anesthesiology, VA Medical Center, San Diego, California  
"A rat model of chronic pain and hypercortisolism for the study of attention"

53. Seán Ó Nuallián, PhD, Dublin City University and National Research Council, Ottawa, Ontario, Canada  
"An integrated theory of consciousness and cognitive development"

54. C.M.H. Nunn, PhD, C.J.S. Clarke, B.H. Blott, Department of Psychiatry, Royal South Hants Hospital, and I.N. Marshall, MA, MBBS, Southampton, United Kingdom  
"Collapse of a quantum field may affect brain function"

55. Michio Okuma, Isao Todo, Department of Mechanical Engineering, Yokohama National University, Yokohama, Japan  
"Restricted emergent process as a simulation method for image generation"

56. Ayub Ommaya, MD, FRCS, FACS, Neurological Surgery, Center for Interdisciplinary Brain Research Foundation, and George Washington University Medical Center, Bethesda, Maryland  
"Emotion as consciousness: A thermodynamic approach"

57. David C. Osmon and Yana Suchy, University of Wisconsin, Milwaukee, Wisconsin  
"A neural network model of dissociative disorder"

58. Donald Perlis, Department of Computer Science and Institute for Advanced Computer Studies, University of Maryland, College Park, Maryland  
"An error-theory of consciousness"

59. Willis Pitkin, Jr., PhD, Department of English, Utah State University, Logan, Utah  
"Discourse, dreams, and the dawn of modern consciousness"

60. Paavo Pylkkänen, Academy of Finland Researcher in Cognitive Science, Department of Philosophy, University of Helsinki; and Research Fellow Department of Physics, Birbeck College University of London, England  
"Mind, consciousness and the quantum theory"

61. Ellen Questel, PhD, Arlington, Vermont  
"Elementary metaphors of everyday speech and their implications for a theory of consciousness"
62. Miloje M. Rakocevic, Department of Chemistry, University of Nis, Nis, Serbia, Yugoslavia
   "Does universal consciousness exist?"

63. Dejan Rakovic, Faculty of Electrical Engineering, University of Belgrade, Belgrade, Serbia, Yugoslavia
   "Neural networks, brainwaves and ionic structures; biophysical model for states of consciousness?"

64. Peter A. Raynolds, PhD, Gennie H. Raynolds, Management and Organizational Behavior, Northern Arizona University, Flagstaff, Arizona
   "The projective differential (PD) response phenomenon: New tool for consciousness research?"

65. Antti Revonsuo, Department of Philosophy and Center for Cognitive Neuroscience, University of Turku, Finland
   "Semantic processing without conscious understanding in global aphasia"

66. William S. Robinson, Philosophy Department, Iowa State University, Ames, Iowa
   "Intrinsic consciousness"

67. Steven K. Rogers, Matthew Kabrisky, Department of Electrical and Computer Engineering, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio
   "Consciousness, just another computation!"

68. Gershom Zvi Rosenstein, The Hebrew University-Hadassah Medical School, Jerusalem
   "Processing of single potentials elicited from a working human brain can become the technique for studying consciousness-linked phenomenon"

69. Alexei Samsonovich, Applied Mathematics Program, University of Arizona, Tucson, Arizona
   "Quantum Neural Networks: Implications for Consciousness Modeling"

70. Alexei Samsonovich, Applied Mathematics Program, University of Arizona, Tucson, Arizona
    "Superattractor neural networks and self-awareness"

71. Marya Schechtman, Department of Philosophy, University of Illinois at Chicago
    "Psychopharmaceuticals and the philosophy of mind"
72. Conrad Schneiker, AthenaTech, Tucson, Arizona
"The second scientific revolution"

73. Matthew C. Scott, Indiana University
"Antichaos unbound: The antiquation of the human mind"

74. A.M. Selvam, Indian Institute of Tropical Meteorology, India

75. Ron Shaffer, PhD, and Greg Dootson, Western Washington University
"Phenomenimagery"

76. Shahid S. Siddiqui, Laboratory of molecular Biology, Department of Ecological Engineering, Toyohashi University of Technology, Toyohashi, Japan
"Conservation of the C-terminal sequence EEEGEEY in the brain specific Alpha tubulins across the nematodes and humans"

77. Eric S. Silverman, MD, Richard Watt, MSEE, Eugene Maslana, BSME, Stuart R. Hameroff, MD, Department of Anesthesiology, University of Arizona Health Sciences Center, Tucson, Arizona
"VARS - Visual/Auditory Relaxation and Sedation"

78. Stuart Silvers, Department of Philosophy and Religion, Clemson University
"Consciousness and it's proper place in cognitive theory"

79. Douglas M. Snyder, PhD, Los Angeles, California
"On the relationship of consciousness to the physical world in the theory of quantum mechanics"

80. Gordana Stanojevic-Vitaliano, MD, Boston, Massachusetts
"A new relativistic model for dualistic nature of consciousness"

81. David Steinberg, The Sàa Institute, Fiddletown, California
"Phylogenetic mental evolution and the emergence of consciousness"

82. Philip L. Stocklin, PhD, Consulting Physicist, Florida
"Evidence for endogenous standing microwaves as a substrate for consciousness"

83. Leopold Stubenberg, PhD, Department of Philosophy, University of Notre Dame, Notre Dame, Indiana
"Consciousness and qualia"
84. Euan J. Squires, PhD, Department of Mathematical Science, University, Durham City, England
   "Towards a quantum theoretic understanding of consciousness"

85. Jeff Tollaksen, Department of Physics, Boston University, Boston, Massachusetts
   "The two-vector formulation of quantum mechanics and implications for consciousness"

86. L.S. Turkstra, PhD, National Center for Neurogenic Communication Disorders, Tucson, Arizona
   "Processing of meaningful environmental stimuli in vegetative state after severe brain injury"

87. Mario Varvoglis, PhD, Director, LRIP, Morsang/Orge, France
   "Nonlocality on a human scale: PSI and consciousness research"

88. Laurence J. Victor, PhD, Pima Community College, Tucson, Arizona
   "Experiential and functional aspects of human consciousness"

89. Giuseppe Vitiello, PhD, Department of Physics, University of Salerno, Salerno, Italy
   "Quantum coherence and brain"

90. Ron Wallace, PhD, Department of Sociology and Anthropology, University of Central Florida
   "A microscopic model of phase transitions in neuronal membranes: implications for the evolution of mind"

91. Kurt Wallen, PhD, Department of Behavioral Science, Neumann College, Aston, Pennsylvania
   "Processing natural cues without awareness: What does the conscious know?"

92. Eric Wallich, MD, Paris, France
   "A biophysical approach to consciousness"

93. Richard C. Watt, Advanced Biotechnology Laboratory, Department of Anesthesiology, University of Arizona Health Sciences Center
   "EEG dimensionality and depth of anesthesia"

94. Tokiko Yamanoue, PhD, Faculty of Engineering, Kyushu Institute of Technology, Kitakyushu, Japan
   "Artificial ‘attention’ in an oscillatory neural network"
95. Yong Yan, Department of Physics, University of Nevada, Reno
   "A quantum physics theory of thinking process: Toward a quantitative understanding of consciousness"

96. George K. York, MD, David A. Steinberg, MD, Kaiser Stockton Medical Center and the Såa Institute, Fiddletown, California
   "Clinical neurology and the study of consciousness"

97. Fred Zaman, Hill Air Force Base, Utah
   "Consciousness: A psychobiomagnetic dynamo"
CONSCIOUSNESS: A RADICAL DEFINITION

1. Contemporary nomenclature surrounding the term consciousness (c) has provided an inadequate description, referring mainly to the abstract content of the mind, psychological processes, and sensory phenomenology. This is incomplete - remiss in delineating the Noumenon of Consciousness (C).

2. C is a universal principle.

3. C has substantive qualities.
   A. C is not an abstract concept but has a physical basis.
   B. C is not a brain state, epiphenomenon, nor does it originate in brain processes.
   C. C is not a heuristic algorithm.

4. C is a multiphasic complimentary continuum.
   A. The brain is a classical mechanism acting as a buffer for somatic and sensory phenomenology.
   B. The primal substrate C both activates and mirrors neurological and metabolic processes, operating in dynamic complimentarity.
   C. Although C permeates the atom, sentience does not occur without the noumenal compliment of elemental intelligence.

5. C is a power or force.
   A. The foundation of natural law governing the structure of energy (matter) and the translation of gravitational spacetime in the eternal organization of the universe.
   B. The basis and organizer of life.
   C. There is a physical force C operationally a dynamic unity integrating all forces, wave-particles, geometries, and energies.

6. C has field properties which subsumes mediation by psychons.
   A. There is a boson of C which will be predicted by the putative Noetic Field Theory.
   B. The singularity of C is subquantum, residing in the K - K tower, prespace, or twister space as determined.
   C. C is quantified as the unified field.

7. Thought is a local quantization of conscious energy. This cognitive field's complimentary qualities are coupled to the nonlocal or holotropic noumenon of Consciousness.

8. The unitary aspect of this atemporal noumenon provides the foundation for complimentarity in the temporal translation of perceived reality; for example-certainty - uncertainty, causal - acausal, unity - separation.
Fig 1: Conceptual representation of the Noumenon of Consciousness illustrating the domain of the Noetic Effect - a psychotaxic response of the Noumenon of Consciousness on quantum biological processes. Scale and dimensionality suppressed.
Title: Evidence for Covert Language Comprehension in a Severe 'Sensory' Aphasic

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Covert/overt behavioral disassociations have been demonstrated in a number of domains, e.g. visual perception. Language represents a special case technically and theoretically. How does one test for covert language awareness in someone who, by definition, cannot understand language? Additionally, some theorize a privileged role for language in the development of conscious self-awareness. Thus, covert/overt disassociations might not exist in the domain of language.

Our approach hypothesized that normal subjects show measurable changes in skin potential to humorous stimuli. Thus, a subject with severe language comprehension problems could be assessed for alterations in skin potential (to indicate covert awareness) to humorous material he overtly could not understand.

A Humor Assessment (HA) was constructed with 22 items. The first two items were "blanks" used to fatigue the increase in skin potential that occurs to novel stimuli. The 20 following items consisted of 10 children's riddles (Why do cows wear bells? Because their horns don't work.) and 10 similarly formatted nonfunny phrases (How do you tell time? By looking at a clock.) intermingled. Preliminary assessments showed that normal subjects reliably discriminated between the two types of items. Funny and nonfunny items also differed in their skin potential responses in normal subjects.

A subject with severe chronic sensory aphasia (Brief Token Test Score = 1) was read the humor instrument while skin potentials were measured. Most skin potential responses above the mean occurred to funny items (7/9) while most skin potential responses below the mean (8/11) were to nonfunny items (0.1 >p>0.05 Fisher's Exact Test). Comparing the magnitude of the skin potential responses to funny and nonfunny items revealed a significant difference (Mann-Whitney U = 14, p<0.01).

Our study suggests a method to approach covert language comprehension and provides preliminary evidence that individuals may be able to comprehend language that overtly appears "incomprehensible."

¹Presenting Author
Just how are we conscious? Are attempts to relate particular conscious experiences to particular patterns of neural activity bound to fail, being phenomena at different categorical levels? Brain is ‘machine’ of unprecedented complexity; our methods for analyzing machines were developed for those designed by external agents — engineers. But brain is its own designer — the epitome of self-organizing systems (Prigogine & Stengers 1984). Thus our study methods may not be adequate for brain.

Neuroscience has been seeking mechanisms of consciousness (Dennett 1991; Churchland 1986). What are they? It will be suggested that there are none — that neuroscientists who have been looking for them have not had appropriate conceptual tools to study relations of consciousness to brain. It may be time to rehabilitate an old but much-neglected approach, which asserts that: Consciousness is ongoing emergent change, the continuing creation of unprecedented pattern.

The idea offered here is that while both unconscious and conscious actions are the play of mechanisms, consciousness enters when the activated mechanisms are at that moment undergoing essential structural modifications which are altering their laws of operation (Atkin 1992). In short, "consciousness is creation" — it is the continual birth of meaning. Thus, if this is correct the essence of consciousness is entirely foreign to what I, and other neuroscientists, have been looking for. To encompass it, our frame of reference must enlarge (Bohm 1983; Elitzur 1989; Watzlawick et al., 1974).

It is further proposed that the inner structure that is thus re-organizing itself is the organism's dynamic (predictive) internal model of itself-in-its-world (Atkin 1992; Craik 1943; Kawato et al. 1987) — an evolving virtual machine (Dennett 1991) that is the ongoing product of the brain's neural networks (Edelman 1989; Flohr 1991; Hebb 1949; Kawato et al. 1987). The model's predictions are continually being tested, and the model then readjusts, modifying its structure to compensate for discrepancies, so that its subsequent predictions will be more accurate. That is, it "accommodates" by actively incorporating these adaptive structural modifications. It is the ongoing accommodative changes in the organism's "Self-world model" that generate conscious awareness (Atkin 1992).

This perspective on brain-mind puzzles, which can be related to certain recent explorations in science and technology (e.g. — Bohm 1983; Elitzur 1989; Kawato et al. 1987; Prigogine & Stengers 1984), is not on the same explanatory level as most other brain-mind theories, but entails the inclusion of a meta-level (Watzlawick et al. 1974). Recent work by Elitzur (1989) and Flohr (1991) is further support for this thesis.

References

Enhanced Vigilance in Guided Meditation: Perceptual Implications of Altered Consciousness

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This study investigated the pre-post signal detection task (SDT) performance of 52 student volunteers (25 women, 27 men) who were randomly assigned to either chamber restricted environmental stimulation (REST) or guided meditation for a one-hour duration. Each subject was exposed to 12 practice SDT trials, as well as 36 pretest and 36 posttest trials. A block of 36 SDT trials consisted of 12 strong signals, 12 weak signals, and 12 no signals. No significant differences were observed between the chamber REST and guided meditation conditions on the pretest strong (M = 8.62, SD = 1.50; M = 8.69, SD = 1.62), weak, and no signal trials (M = .12, SD = .45; M = .12, SD = .45). The chamber REST and guided meditation conditions scored a significantly greater number of weak signal hits (F(1,50) = 5.19, p < .05; F(1,50) = 35.87, p < .001) from the pretest (M = 5.65, SD = 2.06; M = 5.58, SD = 1.72) to the posttest trials (M = 6.38, SD = 1.90; M = 7.50, SD = 1.17), while the number of strong signal hits and no signal false alarms remained constant for both conditions. The guided meditation condition (M = 7.50) scored a significantly greater number of weak signal hits (F(1,50) = 6.50, p < .025) on the posttest than did the chamber REST condition (M = 6.38). The chamber REST and guided meditation conditions did not differ in number of strong signal hits (M = 8.27, SD = 1.80; M = 8.23, SD = 2.07) and no signal false alarms (M = .12, SD = .45; M = .04, SD = .20) on the posttest trials.
Consciousness is often assumed to be incomprehensible by ordinary means. A contrastive analysis comparing similar conscious and unconscious mental processes shows, however, that conscious experience shows a clear, distinct, and empirically solid pattern of evidence. These empirical constraints can be understood in terms of a Global Workspace architecture, in which consciousness corresponds to the contents of a system-wide interactive medium. Brain structures whose lesioning lead to a loss of consciousness resemble such a global capability.
In the first part of the talk we will introduce a framework for studying emergence. This will then be used to define a notion of higher order structures called hyperstructures--consisting of lower level interacting structures. We will also indicate a taxonomy of emergence with a basic distinction between algorithmic and non-algorithmic emergence. This will be related to Gödel's incompleteness theorem.

In our definition of emergence the notion of observer plays an important role. We will use this to suggest a connection with cognitive structures and processes. Viewing cognitive processes as emergent structures we may build up higher order structures according to our hyperstructure design in order to create genuinely new properties. We will illustrate this with mathematical constructions from category theory.

Finally, we will suggest the possibility of viewing and understanding consciousness as a property of a higher order hyperstructure. This will support and extend the point of view that consciousness is a non-algorithmic structure--as suggested by R. Penrose.
BARIBEAU, Jacinthe, (Psychology Professor, Concordia University) & Plourde, Gilles (Anaesthesiology, Royal Victoria Hospital)

**Neurophysiological correlates of levels of consciousness and anesthetia.**

This study examines the effects of general anaesthesia on 2 components of the auditory electrical cortical activity. Anaesthetic agents cause reproducible dose-dependent changes of the auditory evoked potentials (AEP), especially its late positive component P300, and its middle-latency component the 40Hz response.

The mechanism by which general anaesthetics produce unconsciousness are not yet understood at the sub-cellular (molecular, axonal, synaptic) and macroscopic levels (electroencephalogram-eeg). Theories involving cell membranes are increasingly challenged by the postulates of direct effects on proteins (1). Inhalated anaesthetic sometimes enhance, sometimes depress neuronal excitability and post-synaptic neurotransmission and response, while axonal conduction is not affected by varying dosages of anaesthetics. Different anaesthetic agents differentially affect the EEG, usually increasing its amplitude and reducing its frequency, but with many unexplained exceptions and no uniform measure. The same clinical state of unconsciousness with different anaesthetic agents will have different EEG patterns and conversely, similar EEG patterns caused by different agents will be associated with different clinical states of consciousness. (2)

Auditory evoked potentials provide a better chance of identifying unitary changes with anaesthesia and with levels of consciousness. AEPs were recorded with the standard EEG montage (10-20 system) in human surgical patients. The anaesthetic agent was isoflurane, an inhaled agent (3) which reliably produces unconsciousness. It was studied at 3 end-tidal concentrations (1.0, 1.5, 2.0%) covering the range of common use. Ten patients were tested for each concentration. The AEP were recorded before anaesthesia (control), and during anaesthesia and surgery at the desired concentration. To obtain an independent measure of auditory processing, verbal information was presented during anaesthesia immediately before and after the recordings. Implicit memory (4) for this information was assessed post-operatively to measure intra-operative sub-liminal cognitive functions. AEPs were recorded in 2 paradigms. For the 40 Hz response, fast sequences of tones were presented at frequency of 40 Hz. In order to record the P300, an oddball sequence of standard 500Hz tones was presented with irregular random targets differing in pitch (at 1000 Hz) from the standard tones.

The results showed that the 40Hz response is modified by the anaesthetic agent. The changes are showed to be dose dependent. Other studies demonstrated that this effect is similar across agents. Its latency is increased and its amplitude decreased with dosage increment. The 40Hz response disappears from recordings with a short lag after autonomic and behavioral signs of consciousness during anesthesia while the P300 disappears earlier than the behavioral signs. The P300 is correlated with implicit memory and is thus an index of higher level processing, possibly at a semantic level, while the 40Hz indexes pre-attentional primary sensory processing. The relative value of the 40Hz and the P300, respectively as functional indices of 2 different levels of awareness is discussed in relation to the problem of translating the changes of scalp-recorded waveforms in terms of neuroanatomy and neurophysiology. Our results do not support the theory of a unitary mechanism of anaesthesia and contribute evidence in favor of a modular and multi-functional multi-layered model of consciousness.
"The four spaces of consciousness"
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We begin by defining akasa - a space defined in a particular way. Akasa is that power or that unmanifest which is pervasive over and binds together the past-present-future feelings or meanings on the one hand with that on the other, which intervenes from the sensible matter to that stage of matter which is beyond sensible. Anything that is felt or meant, is therefore held onto this akasa. The feeling or meaning of consciousness is thus akasa, the latter being a designator or feature of consciousness.

The felt or meant designator of consciousness, the akasa, is not unique however; it can designate in four ways. The first mode which as it were the cause, is pervasive over all the feelings or meanings that appear. The second is that on which all the matters reside. In the third all the lives (formo) appear and grow, while the fourth akasa is that which is inactive and which remains unaffected through all the changes of the residents (i.e., matters).

Consciousness is that indestructible which can be apprehended through these four designator akasa. The meaning or feeling of 'I' is therefore fourfold.

A brief critical tour around some recent attempts, such as neurobiology, folk psychology or sensations, (may be quantum approaches), is taken up in particular to examine the issue of inter-theoretic reductions, in the light of the above discussion.

The felt or meant spaces that are through the auditory, through the speech or the tactile (say) as through the absence of touch and the visual - are not all the same. The decisional is not the same as that of the space of actions. Neuronal, group selections, say through re-entry, cannot be conceived ultimately (without truncating out an operational problem) if the akasa of life-forms is absent and is substituted by a population-competition paradigm. Similarly epistemology in inter-theoretic reductions cannot be limited to historically/continentally available, in order to chart out a research agenda. Finally, can we reduce questions of knowledge to questions of epistemology!
When they speak or write, people often describe mental states (and processes) using various conceptual metaphors of mind. For instance, someone might say: Part of Sally thought that John was untrustworthy, using a metaphor of MIND PARTS AS PERSONS; or: Sally said to herself that John was untrustworthy, using a metaphor of IDEAS AS INTERNAL UTTERANCES. Other common metaphors are MIND AS CONTAINER (George put the idea into her head) and BELIEVING AS SEEING (Sally could see that John was untrustworthy). Such metaphors form an important though relatively neglected part of folk psychology. Since metaphor in general is a cognitive rather than purely linguistic phenomenon, the metaphorical views of mind are used by people in their thought processes about mental states, not just in their utterances. Also, the metaphors can be used in people's utterances and thoughts about their own mental states. The metaphors, through the inferences they support, can have a profound impact on the interpretation of natural language discourse. We have developed a prototype implementation of an AI system, ATT-Meta, that represents and reasons about mental states in a way that is sensitive to common-sense metaphors of mind used in inputed discourse segments. However, the present paper concentrates on some implications for the scientific study of consciousness.

Some of the metaphors we have studied convey that the described mental state is or is not conscious, or provide some detail about the nature of the state. For instance, IDEAS AS INTERNAL UTTERANCES and BELIEVING AS SEEING generally convey that the agent's thought is conscious and mentally central; and the former metaphor always conveys that the thought is an occurrent event, not an ongoing belief state. On the other hand, mention of the "back" of the mind (in a manifestation of MIND AS CONTAINER) generally conveys a low level of awareness and possibly non-consciousness. MIND PARTS AS PERSONS conveys a divided mental state, either at the conscious level or the non-conscious; but mind-parts are often portrayed as speaking (One part of Sally was insisting that ...), in which case consciousness is implied.

Thus, by looking at metaphorical talk about mental states, we can obtain insight into people's commonsense views of such states. These views can be used by the speaker either consciously or unconsciously (independently of whether the described mental states are conscious or unconscious). Of course, commonsense views of any subject matter can depart widely from scientific fact. Nevertheless, the metaphorical views of mind do reflect something of the real nature of mental states to the extent that they are useful in people's understanding/predictions of people's behavior. Also, the use of the metaphors by someone, X, says something about how X thinks; and in the special case where X is applying a metaphorical view to him/herself, X's use of the view is an important topic in the study of the introspective quality of mind. In short, the study of metaphors of mind in natural language discourse should be an important aspect of heterophenomenology.

The paper therefore advocates the study of such metaphor as part of the methodology of consciousness studies. We intend also to present the results of some psychological experiments on discourse comprehension that we are just embarking on. The experiments should illuminate people's understanding of the metaphors.

Our ATT-Meta system is unique in combining its metaphor-based reasoning with simulative reasoning, which is a computational technique closely allied to the Simulation Theory of mental state ascription in philosophy. (See special issue of Mind and Language, 7(3), 1992, and Davies & Stone, in press.) The study of whether people really use simulation of each other's thought processes is an important topic in the study of consciousness. Our work emphasizes this, and extends it by the fruitful link to metaphor of mind.

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Synchronization of sensory information to conscious experience.
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For the understanding of consciousness, it is essential to increase our knowledge about the representation of time in the brain. This matter has been subject to extensive theoretical discussions. Recently, in their article "Time and the observer, the where and when of consciousness in the brain", Dennet and Kinsbourne (Dennett & Kinsbourne, 1992) pose the question "How...does the brain ensure central simultaneity of representation for distally simultaneous stimuli?". They present a model (Multiple Drafts model) that provides a reasonable answer to this question. However, to date no experimental evidence is available showing that the brain actually does ensure central simultaneity.

When two stimuli are delivered simultaneously to skin areas with different distances to the somatosensory cortex, there are two major perspectives on the subjective experience of temporal order.

One perspective, assuming that the brain ensures central simultaneity, is represented by the Multiple Drafts model (Dennett & Kinsbourne, 1992). Another perspective could be named the "order of arrival" theory. Here the order in which different stimuli arrives to the brain will be the subjectively experienced order. Hence, according to this theory, central simultaneity is not ensured. It seems that Libet and his coworkers would support this view, when they state that the subjective conscious experience of a sensory stimulus is "referred backwards in time" to the occurrence of an early evoked potential in the somatosensory cortex (Libet et al, 1979). This implies that the order of arrival alone, would determine the subjectively experienced temporal order of two stimuli.

The aim of the present study was to investigate to what extent subjects could judge the order of two nearly simultaneous stimuli, delivered at different distances from the brain, and if one of the above described theories satisfactorily could explain the obtained results. The study included two experiments: (1) Subjective judgement of the temporal order of two tactile stimuli, delivered to skin areas with different distances to the somatosensory cortex, and (2) Measurement of reaction times for the above mentioned tactile stimuli.

Ten healthy subjects without any history of neurological diseases (6 women and 4 men), 14 to 40 years old, were tested. The sensory stimulus was delivered by a mechanical square-wave tapper, with an amplitude of 0.5 mm and a duration of 2 ms. The tapperhead was blunt and had a circular shape with an area of 0.008 mm². The stimulus was experienced as a non painful distinct tap. The tapper was triggered by a computer. This stimulus was used in both experiments. In the reaction-time experiment the subjects pulled a handle which was connected to an electromagnetic strain gauge. The force was sampled on a PC-486 with a frequency of 10 kHz and the reaction times were measured manually using the sampling software. For each trial in the first experiment, the number of "arm" and "foot" responses were registered and plotted separately in the same diagram. A line was fitted to each plot by means of a non-linear regression analysis, using a least-square algorithm. At the intersection of the two fitted lines, the subjects could not determine the actual temporal order more accurately than on a chance level (i.e., 50%). Around this point of intersection, a 95% confidence interval was fitted. The confidence interval was calculated by plotting a confidence interval of 68.4% around the two fitted regression lines.

In the second experiment, comparisons between the mean reaction times for tactile stimuli delivered to the arm and the foot respectively, were conducted using the Mann-Whitney two-tailed test and also by a paired t-test.

In the first experiment, it was found that the two fitted lines intersected at a point where the foot stimulus was delivered 11.5 ms before the arm stimulus. In the second experiment, the mean difference in reaction time between the foot and the arm stimuli, was 13.5 ms. This indicates that for experienced simultaneity, the foot stimulus had to be delivered 11.5 and 13.5 ms respectively before the arm stimulus.

Interestingly, the mean difference in conduction time between the sites used for stimulation has been shown to be 24 ms. Thus, the results from both experiments indicate that sensory information arriving to the brain with different latencies, is indeed synchronised to conscious experience, but not to the extent hypothesised by Dennet & Kinsbourne. Instead, the synchronisation seems to be only partial.

REFERENCES
Title: Edelman's Biological Theory of Consciousness
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Edelman’s (1989) theory is a biological account of the different psychological functions necessary for the development of consciousness and is based on the principles of Darwin’s evolution and those of population dynamics as they apply to enormous collections of neurons interacting with each other. These evolutionary principles are basic to his Theory of Neuronal Group Selection (TNGS) upon which rests his theory of consciousness. His TNGS is really a progression of three stages (developmental selection, experiential selection, and reentrant mapping) resulting in global mapping of neuronal populations connecting sensory and motor functions that are able to interact with non-mapped brain areas as the hippocampus, the basal ganglia, and the cerebellum. From this anatomical substrate, primary consciousness (PC) originates.

PC is immediate, ongoing, present-time consciousness. It is an awareness of objects and events in the world; a mental scene depicting the here and now. PC consists of two neural systems subserving different functions; viz., the brain stem/limbic system is the hedonic system mediating internal values while the thalamocortical system evolved to receive external sensory inputs and to transcript these signals into movement. Both systems are connected through learning. Emerging as a result of the increasingly fine tuning between these 2 systems is value-category memory designed to recategorize and store the interactions between the simple perceptual categorization system and the internal value system. PC is the development of reentrant signalling in each sensory modality between value-category memory and ongoing exteroceptive global mappings before these new perceptual signals enter or are stored in memory. The reentrant circuitry provides a feedback mechanism allowing conceptual categorization of current perceptions permitting the construction of a complex scene or mental image.

Higher-Order Consciousness (HOC) is then imposed on PC with the addition of two new cortical areas; viz., Broca’s area and Wernicke’s area having to do with the acquisition of language. Since words serve as symbols for concepts, the specialization of linguistic capabilities leads to the development of new memory for concepts and imagery. This permits a direct awareness of mental episodes having past and future characteristics, a concept of the personal self, and being conscious of one’s own consciousness.

Three types of neuropsychological disorders (hippocampal deficiencies, blindsight, and the contralateral neglect syndrome) affecting consciousness will be discussed within the Edelman framework. Evaluative comments will follow.
Dissociation is a disturbance or alteration in the normally integrative functions of identity, memory, or consciousness (DSM-III-R). Investigating dissociation can assist scientists to understand more about consciousness. While scientific interest in dissociation is more than 100 years old, there are few integrative models of the underlying mechanisms of the dissociative response. Braun's BASK (Behavior, Affect, Sensation, and Knowledge/thought) model provides a mechanism for dissociation based on Pribram and associates TOTE (Test-Operate-Test-Exit) model of human behavior. Pribram's model can be conceptualized using Bateson's framing theory. The "tests" in Pribram's model involve matching templates (frames) against experience. Frames define, classify, and/or delimit one set of events (messages) in relation to other possible messages and the frames that might be used. If the template matches perfectly, it stays active. The matching of the frame to emerging environmental information is more than a difference analyzer and/or a set of mismatch criteria. Framing theory suggests that individuals essentially engage in a constant match of their active frames of events, the information from the event itself, and all available frames for that event. The frame's underlying components (called frame slots in this paper) serve to compare the environmental information being experienced with the expected values of the frame slots. The greater the difference between the current frame and the world, the greater the pressure to alter the current frame (or reframe). Within the TOTE model, this mismatch is defined as "error." An "operation" or strategy to correct the mismatch occurs until a balance between the template and the environment is established (exit). Thus, as the incongruence of the expected frame slot values and actual information grows, the move to find new frames with more accurate frame slots occurs. According to Braun, as the error signal increases, dissociation occurs with the concomitant loss of "encoded information." The goal of the present paper then is to examine in much greater detail Braun's insight into the trigger of dissociation and the template mismatches that seem to be involved. Framing theory may provide an important new insight into the role of the BASK and TOTE models in dissociation. Because a mismatch between the frame and incoming information can lead to anxiety, it may be an important trigger for dissociation. It also may explain the role of anxiety in consciousness management.
Self-Learning, Memory-Controlled Machines: Nonliving Beings

Robert Alan Brown (45 minutes)

A scientific study is carried out on self-learning, memory-controlled machines having sensors, actuators, and memory matrices that operate in discontinuous transition cycles leading to a line of behavior. A memory-controlled machine can use four different types of memory cells: absolute predetermined, conditional predetermined, absolute empirical, and conditional empirical.

An absolute predetermined scalar memory can be programmed to produce a single value of a single actuator variable for each value of a single sensor variable in each transition cycle. A sensor machine can be combined with an actuator machine to produce a vector machine with multiple sensor and actuator variables. The number of memory cells in any memory matrix can be reduced by digitizing the sensor and actuator variables. More memory cells can be eliminated by connecting a sensor unit to an actuator unit by means of a symbolic intermediate variable, forming a duplex network. The predetermined duplex network can be programmed to produce unitary or synchronous diverse behavior. Asynchronous diverse behavior can be produced by using multiple intermediate variables. The organization of the network is based upon answering the question: What variables operate together and what variable operate separate? In a system with many variables, sensor units can be connected to actuator units by intermediate units to minimize the number of interconnections, forming a nodal network.

Large absolute predetermined machines may be hard to program. Conditional predetermined memories may be easier to program over time (incremental), but require a voltage ramp signal, voltage-sensitive switches (gates), and a logarithmic subtraction mechanism in each cell to keep track of the number of times each cell receives a write-maximum or write-minimum programming signal. An absolute empirical memory-controlled machine can establish its own behavior automatically (empirically) using a memory-write feedback system, but remembers the results of the last action only, and cannot be used in a duplex network. A conditional empirical machine can establish its own behavior automatically over time (incremental), can be connected into networks, and uses the voltage ramp signal, voltage-sensitive switches (gates), and logarithmic subtraction mechanisms to keep track of the number of times each cell selects its output vs. the number of times it receives a feedback signal. A duplex empirical machine requires a bidirectional actuator unit containing bidirectional conditional empirical memory cells. Feedback to the sensor unit is back-selected through the bidirectional actuator unit by the even more symbolic intermediate co-variable. An empirical network can organization itself into a unitary or asynchronous diverse system.

Results: Conditional empirical memories can be used in sensor/sensor machines, actuator/sensor units, and actuator/actuator units. Unlike the sensor/actuator machine, these other machines can operate without an environment. They act as if they can see and hear things, like an hallucinating or dreaming individual. In a single machine, absolute predetermined memory cells can be used to maintain essential functions since their programming can evolve, the programming of conditional predetermined memory cells can evolve and be used as fall-back (instinctive) behavior in competition with conditional empirical memory cells that establish learned behavior.

Conclusion: Memory-controlled machines require two types of brain waves: 1. Transition cycle timing signals, which may be spikes or square waves. 2. Ramp signals, which are saw-tooth. The loss of transition cycle signals would lead to death of a living being. Loss of the ramp signal would lead to the loss of consciousness and responsive physical activity in living and nonliving beings. If we could find the source of the ramp signals, we might be able to suspend or restart consciousness and responsive physical activity.

Other questions remain: Is a neuron a value of a variable like a memory cell, or is a neuron a complete variable like a scalar memory matrix? Can empirical machines work together, forming a behavioral bond? Empirical machines have a will to exist, and are capable of acquiring unique behavior and knowledge. Does this make them special?
Electromagnetic Micromechanisms:  
A Necessary Prelude to Understanding Consciousness  

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Our 300 Year-old biochemical model of life has been crippled from the start by being unable to see its electromagnetic microstructure.

Despite several decades of electron microscope views of dense circuits and coils, the life-as-chemistry paradigm has been so rigidified that the mandate for an Electromagnetic biology has gone undeeded. A list of 250 serious problems, warning signs and "impossible" contradictions to the Life-as-Chemistry paradigm has also been ignored.

As a result, speculations on the physical nature of consciousness have suffered because of the severe limitations of the chemical bias and its denial of three fundamental distance-spanning properties of consciousness:

1) its cosmic dimensions and unlimited geographics (implicit in the physics of its electromagnet structures), i.e., omnipresence;

2) its cosmic awareness and unlimited inclusiveness (implicit in global migrations of terns, eels and monarch butterflies, and the performance of idiot savants), i.e., omniscience,

3) its near-instant self-ordering structural integrity (implicit in the extreme homeostasis of terminal cancers and extreme wound healing) i.e., cellular omnipotence.

To encompass these features, one can make a generic paradigm shift to an Electromagnetic Biology, in which all the structures of life are treated as energetic components of circuits (rather than reactive ingredients in a chemical soup). Consciousness can then be understood as the manifestation of the unitive resonances, so far seen mostly in the infrared, that connect all life to the matter of the universe (Mach’s Principle of Inertia).
Hypotheses about the relationship between consciousness and the physical world usually involve some or all of the following four issues, each of which is independent of the others:

1. What physical characteristics are associated with the mind/brain interface?

2. What is the ontological relationship between consciousness and the brain/physical world (physicalism, dualism, etc.)?

3. Is all of the information content of conscious experience encoded in the brain?

4. Can consciousness act on the brain independently of brain processes?

Recent models of consciousness have given a variety of answers to the above questions, and models which agree on one issue frequently disagree on others.¹,² This paper describes various hypotheses which are made in current models, and discusses the possibility of empirical test, for each issue.

A variety of hypotheses have been made about the physical nature of the mind/brain interface,¹ and physical representations of many models could be constructed now or within the next few decades. (Computers for which the number of interconnections rival that of the brain are expected to be built within the next forty years, so even a representation of the complexity hypothesis could be made.) However, to test whether a given set of physical conditions produces consciousness, it is necessary to have an independent test which could definitively show that consciousness is present. Although the Turing test is often described as a test for the presence of consciousness, it is based on a number of assumptions and is not definitive. In fact, no such test exists, and there is no present way to confirm or prove invalid any model of the physical characteristics of the mind-brain interface.

There is no known empirical test of hypotheses about the second issue. An extensive understanding of the way the brain encodes information could shed light on the third and fourth issues; however, we do not presently have such understanding. Thus, while discussion of the above issues may be useful, it does not appear that any of them will be resolved empirically in the foreseeable future.

Islands in the Mind: Dynamic Subdivisions of Association Cortex and the Emergence of a Darwin Machine

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To model cognitive processing, language construction and 'intelligence' at a neurophysiological level using darwinian evolutionary mechanisms requires more than a survival-of-the-fittest principle. Darwinism is about the copying success of patterns, typically DNA strings; here I outline a seconds-to-minutes competition between different spatiotemporal firing patterns in a multifunctional cortical workspace. The proposed mechanism for recall from a passive distributed memory into an active working memory is analogous to genotypes and phenotypes. The evolution of ephemeral working patterns is accelerated by cortical equivalents of the roles played by climate change and lowered sea level in island biogeography. Chimeric islands containing a pastiche of patterns are judged against episodic memories in a way that bears some correspondence to the known organization of human language cortex.
A DYNAMIC MODEL OF THE INDUCTION OF UNCONSCIOUSNESS DUE TO ACCELERATION (+Gz) INDUCED ISCHEMIA
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INTRODUCTION. There are two groups of otherwise healthy individuals who are routinely subjected to acute ischemic insults of the central nervous system: pilots of high performance aircraft engaged in high G maneuvering, and volunteers in high-G research projects being carried out on human centrifuges. The ischemia is a result of the cardiovascular (CV) systems’ inability to overcome the effects of the acceleration stress. The symptoms produced by this ischemia range from dimming of peripheral vision (greyout), loss of peripheral and central vision (blackout), alteration of the content of consciousness, and the loss of consciousness (G-LOC). While there has been much research on the CV aspect of the high-G environment, the mechanism behind the G-LOC induction remains unknown. There is much evidence to support the assertion that G-LOC is not simply a power failure. The Neurophysiologic theory of G-LOC that has been proposed by J.E. Whinnery falls in line with the reasoning of others looking at the mechanism of unconsciousness and holds that the induction of unconsciousness is an active protective mechanism that has evolved to enhance to survivability of an organism by reducing energy demands in the face of a metabolic threat. This hypothesis is investigated through the use of a computer model based on the role of the Ascending Reticular Activating System (RAS) in the control of consciousness in the human.

METHODS. The model of the RAS was constructed utilizing the tenets of Complexity Theory. This theory holds that global behavior of a complex systems is governed only by the local interactions among a network of interconnected local dynamical systems. The global behavior in this case is G-LOC. The model does not attempt to relate the occurrence of G-LOC directly to the acceleration Time History nor such parameters as Blood Pressure/Flow etc. The input to the model is acceleration as a function of time. This stress reduces the blood flow to the central nervous system. The acceleration induced ischemia differentially affects local regions of the cerebral cortex. When the oxygen in these localized areas of the cortex becomes depleted, these regions are no longer able to participate in the RAS communications loop. This communication pathway is modeled using a percolation network. This network is a two dimensional grid with bonds between the nearest neighbors in the grid. The network is said to percolate if there is a continuous path from one edge of the lattice (Reticular Formation) to the other (higher cortical centers). Sites in the lattice are deactivated and their corresponding bonds removed when the local oxygen saturation falls below a preset threshold. The rate of oxygen use in ischemic neural tissue is modeled from in vivo studies of an ischemic retina in the rat. When the critical topology of sites are deactivated, pathways through the network are broken, the network no longer percolates thus breaking the communications loop of the RAS. The hypothesis is that the induction of unconsciousness occurs when this communications loop is broken.

RESULTS. The output of the model is the Time to Unconsciousness. The numbers predicted by the model are first compared to the human unconsciousness study “Acute Arrest of Cerebral Circulation” by Rosen, Kabat, & Anderson(1947). In this study, unconsciousness was induced in an average of six seconds by complete arrest of carotid circulation. The model is then exercised using the acceleration profiles from numerous centrifuge studies.

CONCLUSIONS. This exercise illustrates the use of a non-linear dynamical model with many degrees of freedom, constructed within the framework of Complexity Theory, to simulate loss of consciousness in humans due to an acute ischemic / hypoxic insult.

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What can scientific investigation of consciousness achieve? Quite a lot, I think, but we have to be very clear about what we can and cannot expect of different strategies. It would be convenient if methods that have been successful in other domains could be straightforwardly adapted, but things may not be so simple. Consciousness is perplexing for good reasons, and we cannot expect to get something for nothing.

Much scientific work on consciousness tries to explain it entirely in terms of more basic processes — witness Crick and Koch’s theory based on cortical oscillations, and Baar’s theory based on processing in a global workspace. These theories certainly promise to explain *something*. They seem well-suited to explain such cognitive functions as the integration of information, verbal report, and explicit memory, for instance. But when it comes to the most baffling aspect of consciousness — the subjective experience of our mental states — these theories have little to say. Why? Because even after we have explain these cognitive functions, a further question remains unanswered: why does the performance of these functions give rise to conscious experience? This is the crucial mystery, and it is something about which these reductive theories are silent.

These theories can tell us much of interest about consciousness, but for a fully satisfactory theory we have to acknowledge the lacuna and try to fill it. Here, I will argue that no reductive account can be successful, and that at some point in a theory of consciousness we must acknowledge some new fundamental laws of nature. Consciousness almost certainly arises from physical processes, but it only does so in virtue of these fundamental laws that bridge the gap. This is what makes a theory of consciousness unlike a theory of life, and in some ways more akin to a theory of physics. There may well be a scientific theory of consciousness in the distance, but it will be a new kind of theory.

After developing these points through systematic argument, I will outline the shape that a non-reductive theory of consciousness must take, and I will sketch my own favored candidate for such a theory: a double-aspect theory based on the notion of information.
Consciousness as a System Near the Edge of Chaos

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Consciousness is viewed from an ecological perspective in which the ongoing events that structure it are seen as a rich complex of interacting cognitive, perceptual, and emotional processes, not unlike the complex interactive metabolism of a living cell. The result is an organic, self-generating, or autopoietic, system, constantly in the act of creating itself.

There is increasing evidence on many fronts that psychological processes such as memory, perception, and emotion, as well as the neurological events which undergird them, are at least partially chaotic. It is a short jump from this to suggest that such processes might usefully be depicted as systems which are characterized by chaotic attractors. Indeed, this paper will argue on the basis of the data and theories of psychology, as well as on the grounds of naturalistic observation, that cognitive, perceptual, and emotional processes tend to exhibit the properties of systems caught in chaotic, or near-chaotic, attractors, and which only with difficulty and often after experiencing chaotic perturbations are relocated to new attractor patterns.

Moreover, it will be argued that states of consciousness, such as dream and non-dream sleep, drug-induced states, various ecstatic states, etc., are appropriately modelled as autopoietic attractor states for the entire consciousness. That is to say, each represents a unique but optimal fit of the various psychological processes such as feelings, thoughts, memories, sensory experience, and body sense, to produce a stable pattern or gestalt which, though not static, exhibits the stabilizing properties of a system near the edge of chaos.
Consciousness and Rule-Following
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Consciousness, i.e. an individual's awareness of his surroundings and of himself, obviously provides human beings with an avenue of knowledge. Whether it is a sine qua non of cognition is not so clear, given the existence of subconscious knowledge such as linguistic competence, as well as apparently nonconscious machines that can learn. Both these phenomena have an intimate relationship to rules, in particular to syntactic rules. This paper addresses the question whether appeal to rule basedness is sufficient to explain human mentality, including consciousness, or whether conscious awareness is necessary for rule following in its fullest sense. An argument based on the nature of choice and intention is advanced that being conscious is a condition for the ability to follow rules in the way that human beings do, even though not every act of rule following is a conscious one.
A picture of life and mind is developed in which wave function collapse is mixed into the time evolution dynamics of the universe. Three theses are presented. The first is that sensitive transduction-amplification cascades provide vertical communication links between the classically picturable macrodynamics of biological organisms and the nonpicturable quantum dynamics that are operative in biomolecular interactions. Enzymatic recognition, self-assembly, and conformational dynamics of the cytoskeleton are examples. The second thesis is that the vertical links allow organisms to exploit the superposition of electronic states to achieve superclassical information processing capabilities. The effect is based on electronic-conformational interactions that speed up macromolecular recognition processes. The third thesis is that vertical links allow the control capabilities of organisms to draw in an essential way on self-regulatory (renormalizing) interactions between manifest particles and the unmanifest vacuum potentialities that mediate the forces between these particles. These interactions entail departures from linear superposition, and therefore a continual collapse of possibility into actuality that correlates with features of subjective experience.
Daniel Dennett declared that anything controlled by a certain kind of virtual machine is conscious, without explaining what a "virtual machine" is. There does not appear to be a mathematical definition of this fundamental concept in the computer science literature. Machines of various kinds have been formally defined (e.g., Turing machines) but I argue that none of them is appropriate for a theory of virtuality over neural machines. This presentation starts with a careful definition of abstract serial machine in terms of memory space, instructions, pointed states (programs), and self-maps of pointed states associated with instructions. Then connections between input and output locations of separate machines are defined and used to describe parallel machines, including neural networks. I prove that parallel machines in this sense form a mathematical category whose morphisms are of two types. The first type is standard in the theory of finite automata, and is essentially a homomorphism of machine structure. The second type is a compiler from a virtual machine to a simulator machine. Both types of morphism induce morphisms of machine behavior. Both types also figure in the formal definition of how one machine may include behavior which is an image of a virtual machine simulated by a third machine. An example would be the mental model in the mind of a computer user of a graphics application program which has buttons and other operating controls. What prevents this from being a good example is that the brain is not a parallel machine in the above sense.

The heart of the argument is that the units in neural networks are not adequately diverse nor individually complex enough to model the behavior of brains. The solution to the problem is to define a new mathematical category of neural machines. A neural machine is an object built up from elementary units of two kinds called triggers and timeouts. A trigger generalizes the summation of spikes arriving at a neuron. It has a buffer to collect arbitrary signals (which at the least could be identical spikes) over a period of time, and it has predicates which may "fire" depending on the contents of the buffer. If a predicate fires then a signal is emitted to a specified unit. A timeout is a unit with a timer which can be (re)started and emits signals when its time runs out. This can be used simply to model delays in a system, or it can be considered to be a top-down model of an as yet unspecified neural process which takes time for its completion. In other words, timeouts are used for "chunking": A timeout may be "compiled" in terms of a network of other units. Neural machines are built by object-oriented binary inheritance and derivation from the classes of triggers and timeouts. The category of neural machines has a rich structure, including generalizations of the above concepts of simulation, compilation, and virtuality.
As an application of the category of neural machines, I have made a detailed analysis and re-formulation of Benjamin Libet's experiments on the "subjective timings of reportable awarenesses." There is also a repertoire of neural models built within the category of neural machines, including the "autaptic neuron" of Arnold Trehub. (He has shown that this particular kind of neuron (in vast quantities) can "account for human cognitive competence on many basic tasks.")

Mathematical work continues with an indication that the category of neural machines may be subsumed by a theory of continuously distributed ordinary differential equations whose right-hand sides include impulse functions.

CITATIONS:


Title: THE EFFECT OF SURGICAL SEDATION ON IMPLICIT MEMORY
Authors: RC Cork, C Campbell, J Eyrich, S Viswanathan, J Heaton, J Kihlstrom
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Introduction. Recent interest in the area of implicit memory has focused on its preservation under general anesthesia. However, a sizeable proportion of surgical procedures are performed with conscious sedation. This involves the administration of a sedative and/or analgesic to the patient, while the procedure is carried out with local or regional anesthesia. The purpose of this study was to test for preservation of implicit memory during these procedures.

Methods. After approval of the LSU Medical IRB and informed consent, 31 patients scheduled to undergo a procedure involving conscious sedation were enrolled. No preoperative medication was given. Conscious sedation was with propofol 0.5 mg/kg and fentanyl 1 mcg/kg iv prior to local or regional anesthetic, followed by an infusion of propofol 50 mcg/kg/min iv until the last skin stitch. Repeat doses of propofol during the procedure were provided by one of two protocols randomly selected: (1) the anesthesiologist administered 30 mg propofol iv until he/she perceived the patient to be adequately sedated or (2) the patient utilized a PCA (Patient Controlled Analgesia) unit to self-administer propofol at 30 mg increments, with a lock-out period of 3 min. Four lists of paired associates were prepared. Each consisted of 15 stimulus terms and the most frequent response given to them, as indicated by standard word-association norms. For each patient, two of the lists served as targets, the other two as controls, and these were randomly determined. A tape containing one repetition of the targets was played near the end of the surgical procedure. After one hour of recovery, patients were questioned about intraoperative memories. Using both target word pairs and controls, we tested patients for free association, as an index of implicit memory, and cued recall and recognition, as indices of explicit memory.

Results. Of the 31 patients who finished the protocol, 4 reported explicit memory of words played on the tape. The remaining 27 patients were included in this analysis. This included 8 males and 19 females, age 45.8±3.0 yr (mean±SEM). Surgical procedures lasted 50±6 min. No effect of mode of sedation administration (PCA vs anesthesiologist) was found. Significant differences between the number of critical free associations (6.67±0.35) and the number of control free associations (5.44±0.38) were observed (p<0.05). There was no evidence of any improvement in cued recall or recognition of targets over lures.

Conclusions. Conscious sedation with propofol spares implicit memory. Thus, patients who have no explicit memory of their surgical procedures may still have implicit memory, which could affect future behavior. In general, the use of anesthetic agents in the clinical environment provides us with an excellent opportunity to test hypotheses involving differential effects of these agents on implicit and explicit memory. Results of such investigations may shed some light on the biological substrates of memory and consciousness.
ABSTRACT FOR CONFERENCE ON CONSCIOUSNESS

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4. Session: (Oral presentation) Perception, Cognition

5. Title: Sensation, Perception, and the Theory of Conscious Extent

6. Abstract:

   Terms like "sensation," "perception," and "image" are topics for psychologists, and the assumed basis for their existence varies from the neurophysiological to the cognitive. Most theories suggest a neurological substrate (m) triggered by some physical event (p) which creates the perceptual (conscious) event (m'). This paper will consider the perceived location or the conscious extent of m'. Briefly, taste and smell are localized internally; their experience resides in the mouth and the nose. The tactile senses, on the other hand, project experience to a distance of a half a meter or so, the loci of which is at the frontier between the body and the external world. The conscious extent of hearing and vision is projected fully outside the body; the redness of the rose is placed where the sun's rays were refracted from the flower. A careful analysis of this phenomenon has been avoided in the past partly because of the lack of any formal (testable) system of explanation. However, comparing cognitive-neurological approaches (sequentially, m p m') to this brief description of conscious extent (physical stimulus to mental substrate to physical location or p m p') we find the relation m p m' = p m p'. This relation appears in nature in various places and is well known to topologists as the defining relation of certain knot configurations. This may serve as the formal basis for a theory of conscious extent.
A Proposal for a Paper and/or a Poster Session

Cerebral Function, Jungian Typology and Language Style: Toward a New Theory

This paper proposes an innate relationship between the four Jungian cognitive styles identified by the Myers-Briggs Typology Indicator (MBTI) and four particular processing centers in the cerebral cortex. It further posits that the same four processing centers also mediate the four main modes of figurative expression identified by Vico (1744)—metaphor, synecdoche, metonymy and irony.

Empirical evidence suggests that each cognitive style exhibits a natural affinity for one particular trope and its various subtypes. My study of students' creative output, often spanning a period of several years, indicates that a writer's "dominant trope" reflects more than literary style: it appears to represent the writer's dominant outlook on life: idealistic (metaphor), realistic (synecdoche), symbolic (metonymy) or philosophic (irony).

Brain models illustrating the type/trope/brain link embody a cross of two pairs of polar-opposites with adjacently harmonious qualities. Neurolinguistic research findings, which have identified functionally separable subsystems (Allport) and multiple convergent zones (Damasio) for mediating language, lend support to the model.

In an extension of the type/trope/brain hypothesis, a series of additional models illustrate underlying symmetries among other common quaternities of polar opposites such as the four elements, four body fluids, four seasons, and the four mathematical functions. A final model, the Unus Mundus Mandala, structured on internally consistent correspondences among twenty quaternities of polar-opposite pairs in the brain, body and cosmos, posits the possibility that an invisible fourfold matrix undergirds all reality.

SHEILA DAVIS, author of The Craft of Lyric Writing teaches at The New School For Social Research from a Jungian perspective. She is an accredited administrator of the MBTI, a member of the Association for Psychological Type (APT) and has presented her theory of the language/type/brain relationship at APT Conferences. Her articles on metonymy and synecdoche will appear in The Encyclopedia of Rhetoric (Garland Books, 1995).
Neural network paradigms offer an expansive array of training rules and activation dynamics that include differing levels of complexity and sophistication in computational and perceptual capabilities. Whereas feed-forward networks can be trained to classify and recognize patterns, and static networks can complete and recall memories, dynamic networks have limit cycles, attractors, and chaotic modes, and can shift between these dynamic states during processing. We examine the biological plausibility of these paradigms and the possibilities for evolutionary transitions to have occurred from one to another as organisms developed greater awareness and cognitive abilities, expanding the experiences of consciousness.
The role of intention and self as determinants of consciousness—a functional approach to spiritual experience

Most spiritual traditions assert that a state of consciousness can be reached characterized by unity, positive meaning, freedom from fear, and the experience of a "higher" self. Not only do these traditions agree on the goal, they prescribe the same basic means for changing consciousness: contemplation and renunciation. The characteristics of spiritual consciousness—and the process of attaining it—can be understood as reflecting the organization of consciousness into two basic modes suitable for serving one of two basic intentions: to act on the world or to receive from it. The first is the instrumental mode which features focal attention; sharp perceptual and cognitive boundaries; logical thought; linear time; the dominance of formal qualities over sensual; and an object-like self, localized and, separate from others. In contrast, the intention to take in the environment produces a shift to the receptive mode featuring diffuse attention; blurred boundaries; paralogical thought, fantasy; sensual qualities dominating the formal; Now replacing time; communication through music, art, poetry rather than discursive language; and a self that is undifferentiated, non-localized, and merging with the environment.

The difference is functional. The instrumental mode is necessary for biological survival, it enables us to defend and attack, to acquire food and possessions. For that task it is necessary that we experience ourselves as object-like, separate from others, part of a world composed of distinct objects having a past and future. In contrast, the spiritual traditions seek to bring about a shift in the dominant intention in order to provide a different, more unified experience of reality. For this purpose they use contemplation and renunciation. Contemplation teaches allowing rather than doing; renunciation sets aside the goals of the survival self. As the survival self becomes less dominant, the receptive mode deepens. Subjectively, the external world acquires a "presence," it "speaks," seeming to become more vividly alive. Past and Future give way to Now and the world is experienced with a richness, fullness, and unity not known in the instrumental mode. Whereas instrumental consciousness features separation, receptive consciousness features connection. Both are needed. In order to survive we must have a form of consciousness suitable for manipulating objects, but in order to experience a larger context for the self, to find meaning, satisfaction and relief from fear, we must experience connection to others and the world. For that task, we need to concentrate on a form of consciousness—the receptive—that accesses dimensions of reality other than those featured in the instrumental mode, dimensions that provide a different experience of self and time. This bimodal model integrates the spiritual traditions with Western psychology.
The Quiescent Brain and Consciousness

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The human brain-mind is capable of voluntarily activating as well as inhibiting various higher cortical functions such as movements, speech, head-eyes-body orientation, sensory perception, remembering the past and anticipating the future, facing and reacting to the current environment cognitively, emotionally as well as physically. The activation of a specific cortical area manifests in a specific conscious activity, whereas the inhibition of a specific cortical area manifests in a specific conscious quiescence. There are specific excitatory (glutamic acid, Aspartic acid, acetyl choline) and inhibitory (GABA, Serotonin, Dopamine, Norepinephrine) neurotransmitter systems in the brainstem and the cerebral cortex. The present paper proposes a neuroscientific description of the quiescent conscious brain states. The following categories of quiescent conscious brain states are within the range of human conscious experience.

1) Voluntary motor quiescence: This includes voluntary inhibition of various muscles innervated by the cortico-spinal system. Such learned quiescence of certain groups of muscles is crucial in all skilled, purposeful activities, for examples all sports and artistic activities.

2) Voluntary verbal quiescence: This includes voluntary inhibition of external as well as internal speech for more effective and efficient cognition and communication. Without adequate training, the voluntary inhibition of internal speech is difficult for example in children.

3) Voluntary executive quiescence: This implies voluntary inhibition of the executive cortical functions. Whenever a specific task or a project is completed, there is logically no need for an executive to continue brooding on that project. One should be able to let go of that executive stance or activity until the beginning of the next task, which results in a period of quiescence between two tasks. This provides for executive efficiency and effectiveness.

4) Voluntary sensory quiescence: This implies voluntary inhibition of sensory processing e.g. audio-visual stimulation. This is crucial for an undistracted attention to task and to minimize unnecessary sensory flooding of consciousness. This would also reduce wasteful and reactive internal monologues.

5) Voluntary mnemonic quiescence: This implies voluntary inhibition of remembering the irrelevant past events or anticipating and worrying about the future. The functions of memory and anticipation when intentionally performed, are important for problem solving, pain avoiding, and pleasure seeking; but many times they become automatic and can clutter the consciousness and impair cognition.

6) Voluntary emotional quiescence: This implies voluntary dissipation and normalization of emotions like anger, fear, hatred, or excitation etc. This results in a natural sense of wellbeing and mental composure.

Thus, voluntary activation as well as quiescence of higher cortical functions can help to achieve excellence in cognition and conscious processing.
The scientific approach to consciousness requires a theory which makes the relationship between consciousness and brain more transparent. In order to accomplish this it is necessary to develop models of the several aspects of phenomenological consciousness which, in turn, can be correlated to specific neural events and processes.

In the present paper I present a dynamic process Petri diagram which incorporates the seven main phenomenological characteristics of consciousness. The first is temporality, the irreversible arrow of unfolding events which actualizes in a "window" of 1-3 seconds duration some aspects of the vital process of an individual. The second is activity, the working, dynamic aspect of specific contents which arise, undergo complex processing and disappear or generate new contents. The third is the intentionality, "aboutness" or specific content (sensations, emotions, thoughts, images, intentions and so on) which must be processed in different parts of the brain provided with local awareness systems. The meaningful coordination of the several classes of contents constitutes the fourth characteristic of conscious experience; its unity or totality, the amalgam of contents which requires a functional binding of separate brain processes. The fifth property of consciousness is its strong qualitative flavour, the notorious differences between visual, auditory, tactile, pain, motor or, within one modality, between colors, sounds, or flavours. Such qualia defy the known functional uniformity of brain activities and would require minute but definite differences among specific patterns of brain activity involving particular receptors and neural architectures. In the present process model these five properties are represented in a Petri flow diagram of contents arising, getting processed and transformed in a bidimensional surface of a "stream". There are two more characteristics of phenomenological consciousness which can be incorporated in the diagram. One is attention, the system which allows for the selection of specific stimuli requiring further processing in the field of awareness. The properties of zooming, searching, shadowing, intensity, and direction of attention constitute the shape of the stream margins whereas the last property, the levels of consciousness (dream, wakefulness, self-consciousness, ecstatic), would need several vertical layers of transparency. Besides from helping in theorizing about its neural correlates, the dynamic process model of consciousness could be applied to the naturalization of conscious experience in several other ways. Thus, it permits functional hypothesis of consciousness (the retrospective, "noetic", and prospective functions) to be drawn; it raises the possibility of using trans-subjective third person accounts to empirically study the properties of the stream and, finally, it does not require the stipulation of an agent or "I" as a crucial element in either consciousness or individuals.
The issue of how quantum effects can have an influence at the level of molecular assembly and ion channel flow control is discussed. A hypothesis is made that a quantum potential similar in principle to that advanced by Bohm and Hiley may operate at macroscopic scales and that this potential could have a controlling or in-forming influence upon the growth of intracellular signalling pathways, similar to models discussed by Bray, Mikulecky, and others. Methods for investigating this hypothesis by simulation and experimentation are presented. Finally, the question of how this model could be integrated with theoretical and experimental work on cytoskeletal networks and holographic models of learning, memory, and consciousness is considered.
The old dispute concerning the nature of consciousness seems to have been discussed by now from every possible viewpoint, with no decisive argument in favor of one view or another found so far. This is the reason why, for some people, the issue is uninteresting. Yet, a new way of posing the problem may give it an unexpected twist.

This new approach concerns the special and general theories of relativity, hitherto seldom considered relevant to the issues of consciousness. Long ago it has been noticed that, by banishing the notion of simultaneity from our physical picture of the world, relativity has thereby rendered the very notion of “Now” arbitrary and observer-dependent. The bearing of this “objectivization” on the phenomena of conscious experience leads to some awkward consequence. Our mind sharply distinguishes between past events, which we remember but cannot change, present events which we experience with the fullest conscious intensity, and future events which are unknown to us and which we can only infer, hope for or worry about. In sharp contrast with this common-sense distinction, relativistic invariance obliges assigning equal ontological status to all these times. From this requirement it follows that relativity, at least in its present Minkowskian framework, is more compatible with theories of mind that have long ago been out of favor in modern science and philosophy, such as eliminative materialism, identity theory, and epiphenomenalism. Indeed, it has been noted earlier (Elitzur, 1992a) that the relativistic dismissal of the apparent passage of time as illusion entails dismissing the unity of consciousness as illusion as well: One’s “self,” in the relativistic framework, constitute in fact of myriad momentary selves, each having the illusion of being identical with the others. This view follows rigorously from relativity theory, as some of Einstein’s own conversations with Besso and Carnap testify.

This unnoticed affinity between physics’ most celebrated theory and philosophical propositions which are for a long time considered outdated calls for a closer examination of relativity theory, especially in relation to the question, Does relativity necessarily negate the objectivity of the privileged “Now”? Contrary to a widespread belief, it turns out that relativity theory’s implications for the nature of time are not accepted today by all physicists (see, e.g. Rosen, 1980, 1991). During the last decade some ideas in the spirit of Bergson and Whitehead, concerning an intrinsic, objective “flow” of time, have become the focus of attention by leading theorists of time (e.g. Stapp, 1982, 1986). A novel theory of spacetime, developed during the last decade by Horwitz et al. (1983, 1988), is presented, which explains why consciousness has some intrinsic qualities that are irreducible and inexplicable in the present framework of physics. It is shown that this new formalism, besides its novel bearings on quantum mechanics, has also far-reaching consequences for the scientific understanding of consciousness and for bridging the persistent gap between the various disciplines dealing with matter and mind.
Expanding the Energy-Momentum Equation to Model Awareness
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Keywords: intelligence, energy, physics, equation, momentum, awareness.

The energy-momentum equation, the parent of \( E=mc^2 \), describes the equivalence of energy, momentum, and mass. The act of "knowing", of "understanding", must be linked to these universal constituents of energy, mass, and momentum in a fundamentally meaningful way if we hope to be able to model awareness. But our present descriptions of nature do not adequately describe "the act of knowing". In the words of Penrose,

One can argue that a universe governed by laws that do not allow consciousness is no universe at all. I would even say that all the mathematical descriptions that have been given so far must fail this criterion. It is only the phenomenon of consciousness that can conjure a putative 'theoretical' universe into actual existence!

If, as I propose, "knowing" is an aspect of energy, a dimension of activity that is different from mass and momentum, then a new term is required to expand the energy-momentum equation to a more general form, the energy-awareness equation. The alternative, that we are wholly described in terms of mass and momentum, is to show that although we may be wondrous creatures, we are not fundamentally different from any other set of complex reactions that self-sustain under the proper conditions.

The accepted energy-momentum equation (after Serway\(^2\)) is:

\[
E^2=(pc)^2+(mc^2)^3
\]

The proposed expanded form, the energy-awareness equation, is:

\[
E^2=I+(pc)^2+(mc^2)^2
\]

where \( E=\) the total energy, \( p= \) the relativistic momentum, \( m= \) the rest mass, and \( c= \) the speed of light. Note that inclusion of the term \( I, \) to signify intelligence, is the only suggested change. And by intelligence I mean knowing, understanding, real intelligence, which is distinct and different from the "artificial" variety.

As with any theoretical proposal, verification will come only at the hands of experiment. However, the proposed expansion is advantageous in that it sets up a dichotomy for experimental verification or refutation because "knowing" will eventually be demonstrated to be, or not be, a form of energy.

References
The evolution of consciousness was driven by redox energy. Early invertebrates, obtaining oxygen by simple diffusion, would use a nervous system (NS) to corral reductant (R) food into a mouth, and, later, additional oxidant (O) through variously situated gills. Chordate NSs, however, take O & R into a common hub, the pharynx (fig. 1). A land chordate's NS breathes air through an open hub extension, the larynx, but swallows food past that closed extension. The swallow closure (denied by some) is real (cineradiographed human adult, human infant, cat, ferret, pig) and crucial. Swallowing food past the closed hub extension safely fulfills the aim of corraling it and seemingly necessitates an "awake" or "conscious" NS. Successive grades of land vertebrates add pieces to the hub extension, cumulatively enlarging its cavity and functions, (birds add a syrinx), and add neurons to the brain, (table & fig. 2), enough to suggest a direct connection between potential energy supply, information supply, and complexity of movements, subjectively integrated in wakefulness or consciousness. In humans, the energy-information-action link finds expression in speech and self-consciousness and at least partly explains why these deteriorate together during inebriation and slow induction of inhalation anesthesia.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Additions to hub-extension</th>
<th>Functional effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urodele</td>
<td>arytenoid cartilages (cart.s)</td>
<td>enlarged passage (e.p.)</td>
</tr>
<tr>
<td>Reptile and bird</td>
<td>cricoid cart., [bird syrinx]</td>
<td>e.p., [bird song]</td>
</tr>
<tr>
<td>Monotreme</td>
<td>thyroid &amp; epiglottic cart.s, thyroarytenoid fold</td>
<td>e.p.</td>
</tr>
<tr>
<td>Marsupial</td>
<td>fused thyroid cart., corniculate cart.s.</td>
<td>e.p.</td>
</tr>
<tr>
<td>Placental</td>
<td>cuneiform cart.s, vestibular folds, vocal folds</td>
<td>e.p., voice</td>
</tr>
<tr>
<td>Simian</td>
<td>subhyoid sac, vocal cusp</td>
<td>e.p., inlet closure, arbrobatics</td>
</tr>
<tr>
<td>Ape</td>
<td>preepiglottic body</td>
<td>e.p., inlet &amp; exit closure, part-time bipedality</td>
</tr>
<tr>
<td>Human</td>
<td>no subhyoid sac</td>
<td>e.p., exit closure, erect bipedality, speech voice</td>
</tr>
</tbody>
</table>

Footnote to table. Successive enlargements of the passage help "finance" the oxygen cost of brain expansion and novel energy niches (fig. 3). Human laryngeal endowment includes *inter alia* (1) reinforced protective closure against invasion by food; (2) low resistance throughput of air; (3) specialized folded closure that seals the trachea and enhances efficiency of: (a) major effort by arm or leg, (b) expulsive effort by hollow viscera; (4) independent adjustability of: (a) amplitude of vocal fold vibration (VFV), (b) frequency of VFV (including whisper), (c) resonance of voice cavity above glottis; (5) small size, low-inertia arytenoids and attached muscles; (6) elasticity, for well-timed and economic use of energy. (4), (5), & (6) are exploited in speech; so is (7) concave paramedian axis of low pitch vocal fold vibration (fig. 4), enabling the glottal Bernoulli effect to lower the energy cost of conversational tones by up to 75%.

Summary. Maintenance of energy flow is the primary aim of a nervous system. The land vertebrate NS assures the energy supply by sorting air and food at an energy "hub", and uses wakefulness both to corral and swallow the food. In humans, serial phylogenetic accretions at the hub: 1. protect larynx from food, 2. enlarge the air supply, 3. serve efficiency of work effort and 4. foster the versatile vocalization which underlay emergence of *Homo sapiens sapiens* language and self-consciousness.
Constructive naturalism is the view that consciousness is a natural phenomenon and that we can construct a theory of it by application of "the natural method"—the method of drawing simultaneously on phenomenological, psychological, neuroscientific, evolutionary, and anthropological data and theory. 'Consciousness' is a superordinate term that names heterogeneous kinds of states that share the property of "there being something it is like" to be in any one of these states. In Consciousness Reconsidered, I argue against epiphenomenalism. But it is a mistake to assume that because, for example, an adaptationist account can be given for phenomenal consciousness in the sensory modalities that all the types of conscious mentation have an evolutionary proper function. In this paper, I use the example of dreams to show how the application of the natural method, leads to a plausible argument that although sleep and sleep-cycling have evolutionary proper functions, the mentation associated with both NREM and REM sleep has no evolutionary proper function. Dreaming is, in one sense of the term, epiphenomenal.
(1.) States of consciousness causally depend on the representational activity of the CNS, i.e. the number and complexity of representational states that can be generated per time; a high representational activity is the necessary and sufficient condition for awareness.

(2.) In a neural net a high representational activity induces the generation of higher-order, self-referential representations, i.e. representations of the system’s internal states, and of the system as an actually representing system. The system develops concepts and beliefs on its internal state. Phenomenal states are identical with complex self-referential representational states.

(3.) The various disturbances of consciousness have a common denominator: they occur if the representational activity falls below a certain threshold level.

(4.) Hebbian cell assemblies are the instantiation of mental representations; hence, consciousness depends on the rate at which active assemblies are formed.
ABSTRACT

Descartes, Searle and Edelman: The Organic Paradigm

The primary text in modern Philosophy on the nature of human uniqueness is Descartes' Discourse on Method. There Descartes claims that human beings are unique by virtue of the characteristics of speech and reason. He argues this distinction against both robots and other animals. It leads him to the conclusion that human beings are metaphysically different in kind from robots and animals.

As a consequence of the Darwinian revolution the distinction in kind between human beings and other animals has been largely abandoned. Yet the distinction between actual humans and robot humans has been maintained to our own day. Gerald Edelman, for example, has made the argument once again in his recent book, Bright Air, Brilliant Fire. Edelman argues that an explanation of human language and reason must incorporate evolutionary neurophysiology. Thus a mere combination of silicon chips could not be said to reason or speak in the human way.

One of Edelman's arguments rehearses John Searle's objection to what the latter termed "strong artificial intelligence." In his intuitively convincing thought experiment about the Chinese Room Searle grounds a distinction between syntactic and semantic processing. But no such distinction characterizes the arguments about other animals. If a chimp could follow syntactic rules as well as even a small computer it would be news. What would a computer have to do to demonstrate semantic competence? Several alternatives will be considered, all of which reveal problems for the Searle/Edelman distinction.

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Some Category Confusions in Studies of the Biology of Consciousness

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Neuroscientists have drawn heavily on the physical sciences to provide a theoretical framework in which to interpret their results from experiments and clinical observations. In the process, there has been a strong tendency among investigators to attribute the properties of physical variables to neural activity. Examples are found in the works of Prochaska, J. Hughlings Jackson, Freud, and Koehler, each of whom confused nerve activity with electric current, with more or less disastrous results.

One can also trace a direct lineage from “nerve force” (vis nervorum) through “nerve energy” to “information” with its “source” in the environment and its “flows” through neural “channels” conceived as subject to the 1st and 2nd laws of thermodynamics. In this approach concepts of “information storage and processing” are metaphorical and lacking in measurability. Much of the failure of computational neuroscience and artificial intelligence to achieve their goals of simulating the performances of biological intelligence can be attributed to the confusion of neural activity with information. The problem remains: how to define neural activity. It is not directly observable, and it is not a force, a chemical concentration, an electric current, or a flow of information. Just as “force” in physics is defined as a relation (mass to acceleration), neural activity must be defined by the relations between its electrochemical signs and overt behavior.
Another kind of experience presents information about aspects not selected for feature-awareness. For example, our sense of an object's meaning can be thought of as a condensation or summary over a relatively large part of its multidimensional property space, in contrast to its few most topic-relevant dimensions. It is this, in addition to the feature-awareness, that fleshes out our experience of an object as more than an assemblage of parts. It is this which is missing in patients with associative agnosia following brain injuries.

A third very important type of information in subjective experience is not related to current input, current feature-awareness, or the immediate topic. Rather, it concerns non-conscious knowledge related to other topics or goals further in the background of goal hierarchies.

The scheme proposed is quite different from the dominant current models explicitly or implicitly based on the "moving spotlight" metaphor for consciousness, in which the concept "attention" is used to indicate adjustments of the beam. The contrast will be discussed.
A complete theory of awareness will have to include accounts of subjective phenomena as well as the neurological and cognitive-behavioral levels. Although awareness has been reclaimed as a major topic of study, most research and theory has focused on the supporting processes and apparatus rather than on subjective experience itself. This paper examines ideas on the fine structure of subjective experience and proposes a more precisely characterized set of variables, useful to all psychologists whether their focus is on computer simulation, neuroscience, or clinical interventions.

When we examine our subjective experience, we find a great variety of qualitatively different components: e.g., sensory feelings; feelings of intention; feelings of expectancy; the feeling of rightness or "on-trackness"; and the feeling of knowing. Modern psychology has not yet addressed this plurality. We have not yet developed a taxonomy for the varieties of elements that make up our subjective experience, or even a consensus on the constructs or terminology with which to characterize its richness.

As first steps toward a complete theory, this paper identifies key descriptive aspects of subjective experience which have been rather neglected, and proposes a taxonomy for the components based on the type of information they carry. The descriptive analysis is then set in the framework of self monitoring functions. Examples are given in the domains of emotion, action, and metacognition.

In brief, based on introspection and functional considerations, I argue that our experience of an object, event, or idea is a complex of many parts. One component presents the few distinct features that are most relevant to our current topic or goal. I call this "feature-awareness". But there is much more in subjective experience than just the most topic-relevant features. Space permits only a few examples.

One group of components provides evaluation or metacognitive information, explicating the items in feature-awareness. For example, the feeling of on-the-right-track-ness and the feeling of knowing concern the relation of feature awareness to the current topic; they guide and sustain search operations. Such information could not be given by just adding more features. Other examples of this type are the feelings of source that tell us vividly whether feature-awareness is coming from current perception or from memory, or the feelings of agency that tell us whether a proprioceptive image of movement was self-initiated, autonomous, or passive.
There exist two main strategies of adaptation to cold. First strategy consists in metabolic compensation of heat loss. Second one suggests body temperature decrease, and increase of the thresholds of cold shivering with the broadening of the comfort zone. Depending on several factors the subject chooses personal way to survive in the cold environment. The principal interest in this problem consists in possible participating of consciousness and emotions in elaboration of the adaptation strategy. Two assumptions were made that make it possible to re-examine problem of cold adaptation in terms of consciousness, emotions and higher nervous activity. 1) Within some limits animals are able to manifest the signs of consciousness. 2) Emotion is an attribute of consciousness, and a signal could elicit emotions only in conscious state.

Cold tolerance in rats was estimated as a value of body temperature decrease after 45 min exposition of slightly restricted rats to moderate cold (+4 C). Several manipulations with the emitiogenic brain mechanisms were used including amygdalectomy, treatment with the benzodiazepine agent, alcohol injection or preexposition of stressors. It was shown that animal resistance to cold stress increased significantly after preexposition of contingent (i.e. cold) stressor. In contrast, preexposition of non-contingent stressor (i.e. immobilization) decreased animal tolerance to cold. Amygdalectomized animals conventially used as a model of the deficit of emotional memory, manifested high resistance to cold during first chilling. Their capability to acquire adaptive thermoregulatory experience was inhibited. Chlordiazepoxide and ethyl alcohol applied as protectors against emotional stress, lowered the temperature drop during the period of drug action (chlordiazepoxide significantly, alcohol as a pronounced tendency). A repeated cold test in 48 hr. showed a lack of increase in cold resistance in animals trained under these substances.

Taking together the above mentioned, the excitation of emotional brain mechanisms lead to the preference of metabolic adaptation strategy. The other more economic way of adaptation needs in the participation of habituation processes. Possible propagation of the principles of two strategies of adaptation to the behavioral models with more clear cut role of consciousness is discussed.
Various attempts to define consciousness are critically examined, e.g., in terms of verbal reportability, informational access, or self-monitoring. Phenomenal consciousness cannot be defined adequately in any of these ways. Implications of this for a theory of consciousness are considered.
Consciousness and the Functional Link Hypothesis  
(Abstract for the Tucson TSB Conference)  
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Among the things that fall within the scope of the predicate “conscious”, the two most important kinds are individual beings and mental states that belong to, or occur in these individuals. There is a difference in my being conscious (as opposed to, say, being in a coma) and my having a mental state which is conscious, (as opposed to, say, its being subconscious, or perhaps, unconscious).

One can be conscious in the sense of being awake and alert, and with one’s consciousness being directed upon something, e.g. the tune coming from the radio, or a lingering thought about a past conversation. This, I will call the individual sense of consciousness.

On the other hand, it makes sense to talk about a mental state’s being conscious (or not). This is not quite the same as someone’s being conscious (or, conscious of something). The first sense of consciousness denotes an overall state one is in; the second classifies one’s (mental) states as of one type or another. I will call this sense of consciousness, state consciousness.

Traditionally, these two senses have been taken to systematically go together. For instance, Locke took being conscious of a mental state or process as equivalent to that mental state or process’ being conscious, when he claimed that “thinking consists is being conscious that one thinks”. A great many contemporary philosophers who write on consciousness today (e.g., D. Armstrong, P. Churchland, D. Rosenthal, W. Lycan) follow Locke’s footsteps.

Implicit in this received view is the employment of a meta-level mental state, which is responsible for the consciousness of the lower-level states. X’s (individual-)consciousness of S is itself a mental state, $S^*$, in X, presumably directed upon S. $S^*$, then, endows S with state-consciousness, in virtue of being a mental state in X itself, directed upon S. I will call this view the Higher Order Representation thesis of consciousness (in short, HOR).

HOR could be seen as a useful way to link the two notions of consciousness, even if it doesn’t say anything specific about the nature of consciousness. But is a person’s having a mental state which is state conscious nothing over and above as that person’s being individual conscious (of something)? Or does it make sense to talk about these as separate events always occurring together (thus replacing identity with co-occurrence), or even causing one another?

In this essay, I investigate the relation between these two senses of consciousness, and propose that not only is it not an analytical truth that one’s mental states are of the (state-)conscious type when and only when one is (individual-)conscious, or (individual-)conscious of something, but also that the HOR thesis does not mesh well with the relevant empirical data, and hence it is not psychologically plausible.

In place of HOR, I propose a different way of joining the two sense of consciousness, and call it the Functional Link Hypothesis: A (state-)conscious state is an internal state that one has (or, one is in), which makes one (individual-)conscious of a thing or fact. That is, the causal-functional role a (representational) state plays in a human being determines the categorization of that state as conscious or non-conscious. If by means of some state S one becomes individual conscious of some object, fact, or state of affairs, S can be said to be a conscious state. (A somewhat similar thesis is currently being defended by F. Dretske.)

In other words, such mental states as visual perceptions or beliefs deserve to be called conscious states only when they make us conscious of their contents. This is not a trivial tautology, since these states are not always conscious. Visual presentations of certain brief durations never make us conscious of what is presented, or even that something is presented, though studies on “subliminal perception” show that they nevertheless provide some information to our nervous systems which gets processed and even affect behavior. Thus, a visual state which is caused by subliminally presented stimuli may count as a genuine representational state which is nonetheless not conscious, since it doesn’t make one conscious of anything.

Naturally, what will ultimately determine the superiority of an account of consciousness along these lines over one involving a HOR thesis is the explanatory power it is supposed to provide for answering empirical questions regarding consciousness. In conclusion, I draw upon a number of empirical studies on implicit memory and subliminal perception to substantiate my thesis.
It is suggested that the mode of operation invoked by connectionism is inappropriate to the description of unified consciousness. Locality considerations further require that the solution to the binding problem have a quantum mechanical character. A specific model of the subcellular quantum dynamics of neurons is formulated in terms of superadiance and self-induced transparency. In the environment of a spontaneously broken symmetry, these mechanisms may allow quantum level dynamics to interact with the classical neurophysiological level and thereby account for global aspects of the functioning of the brain.
Is Consciousness the Unified Field?
A Field Theorist’s Perspective

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Abstract

Progress in theoretical physics during the past decade has led to a progressively more unified understanding of the laws of nature, culminating in the recent discovery of completely unified field theories. The parallel discovery of a unified field of consciousness raises fundamental questions concerning the relationship between the two. Following a general introduction to unified quantum field theories, we consider the proposal due to Maharishi Mahesh Yogi that the unified field of modern theoretical physics and the field of “pure consciousness” are identical. We show that the proposed identity between consciousness and the unified field is consistent with all known physical principles, but requires an expanded physical framework for the understanding of consciousness. Such a framework may indeed be required to account for experimentally observed field effects of consciousness and phenomenological aspects of higher states of consciousness.
Anesthesia, Quantum Coherence in Microtubules, and Consciousness

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General anesthesia causes reversible cessation of consciousness (sparing other brain functions) by inhibiting conformational dynamics (functional nanosecond movements in response to appropriate stimuli) of certain brain proteins (receptors, ion channels, second messengers, enzymes, cytoskeletal subunits, etc.). Anesthetics do so by weakly binding in hydrophobic (water excluding) pockets within these proteins where they apparently inhibit quantum-level movements (electrons, dipoles, phonons, bosons) which couple to the protein's net functional conformational movements (Hameroff & Watt, 1983).

Properties of consciousness which suggest a role for quantum effects include 1) unitary sense of "self", 2) non-deterministic "free will", 3) non-algorithmic computation (Penrose, 1989). Quantum coherence among neural proteins (and associated water) can help explain these properties. Cytoskeletal networks (microtubules, filaments, connecting proteins etc.) dynamically organize activities within each neuron; microtubules are particularly good candidates for quantum coherence due to their paracrystalline, cylindrical structure and ubiquitous, essential functions.

Consciousness may therefore be viewed as a macroscopic quantum state driven/selected by neural networks, attentional scanning circuits, and/or coherent neural firing. Two inter-related mechanisms can provide such a state via quantum coherence in microtubules: 1) Bose-Einstein condensates stemming from a "Frohlich pumped phonon" mechanism (Marshall, 1989) in hydrophobic pockets of microtubule subunit proteins, and 2) quantum dynamics and quantized electromagnetic field involving ordered water inside the hollow microtubule core (Jibu et al, 1994).

A macroscopic quantum state approaching brain-wide dimension can provide a unitary sense of "self" and other properties of consciousness. Coupling of this quantum state to "classical" microtubule subunit conformation and cytoskeletal function can account for cellular control, adaptive behavior, synaptic regulation and cognition by propagating signals and information processing in cytoskeletal networks (Hameroff, 1987).

Anesthetics, whether acting directly on microtubules or indirectly via membrane proteins or membrane-cytoskeletal connections, can reversibly erase consciousness by inhibiting quantum mobility and coherence in and among protein hydrophobic regions. Thus, anesthesia collapses the quantum wave function of consciousness.

The "binding problem" in modern psychology arises in the construction of visual percepts. Generally speaking, in order for us to interpret incoming stimuli semantically, our brains first must extract constant features from an incoming array of light patterns, then construct temporary (pre-) representations from the patterns, before it begins to associate the object representation with its meaning. However, it is well documented that the brain processes visual data in segregated specialized cortical areas. Nevertheless, the features computed separately must somehow become united after processing in these initial distinct areas, since our conscious experiences reflect the various features and sub-contents as joined together in a single interpretative unit or as a single percept.

However, given what we know about the segregated nature of the brain and the relative absence of multi-modal association areas in the cortex, how conscious percepts become unified into single perceptual units is not clear. If we lack true association areas, then the more popular (and intuitive) neurophysiological solutions to psychological binding, such as "grandmother" neurons and convergence zones, cannot be correct. But, if we could figure out how and where the brain joins together segregated outputs, we would have a start in localizing the neuronal processes that correlate with perceptual experiences.

In this essay, I critically examine some data apparently relevant for understanding the neurophysiological underpinnings of perception. In particular, I examine the possibility that 40 Hz oscillatory firing patterns in cortex are important lower level neuronal events related to perceptual experiences. Although the phase-locked oscillations may yet turn out to be an artifact of some other, more fundamental, process, it may be that "[stimulus-evoked] resonances are a general phenomena, forming the basis of a correlation code which is used within and between different sensory systems and perhaps even throughout the entire brain" (Eckhorn, et al., 1988, p. 129). And as modelers in artificial intelligence pick up on the mechanism of phase-locked oscillations and explore the principles underlying this sort of binding solution, it does appear that this hypothesis provides the ideal sort of answer to psychology's binding problem.

However, the neurophysiologists who suggest that synchronized oscillations are the key to solving the binding problem are guilty of confusions about stages in processing. The sort of underlying model of mental function which neuroscientists assume divides visual perception into three different stages: segmentation, binding, and association, each of which the brain actively pursues using some computational means or other. Early stages in the visual system must be dedicated to parsing the incoming two-dimensional pattern of retinal stimulation into cohesive features. And only after the brain determines which features are present can it begin to bind them into unified objects (though top-down expectations most likely do play some role in determining which features the brain decides are there). Finally, only after this initial processing can the brain assign meanings to the bundles of features through associating the temporary object hypotheses with previously encountered stimuli and their related associations.

I argue that what the oscillation studies have indexed is segmentation, not binding. Without additional converging evidence that the brain uses phase-locked oscillations to tie together disparate features into a single object, it is premature to conclude that these oscillations form a binding mechanism. I must conclude that those who see phase-locked oscillations in individual neurons as the additional temporal process which overcomes superposition woes celebrate prematurely. Though oscillations may be the correct answer, we do not have anything near conclusive evidence linking phase-locked oscillations with the psychological phenomena of binding.
MEANING AS INTERFACE BETWEEN MIND AND MATTER

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Whether seen as a product of symbolic operations or as a neural-network emergent, meaning is largely conceived as an internally generated epiphenomenal process. Little attention is given to the active role of meaning. The basic hypothesis presented here is that the generation of meaning is, in itself, an organizing process shaping reality, while the mind is, in its turn, shaped by a reality endowed with meaning.

Extending a basic connectionist premise, we might view the mind as a network organized in semantic constellations, generated by the interplay of experience, genetic constraints and cultural context. This network, which we will call the noo-semantic field, reflects an ongoing conceptualization and valuing process; it constitutes the totality of a person's cognitive/affective dynamics, and serves as the basic interpretational framework.

It is postulated, however, that the noo-semantic field is also the source of a projective process imprinting information and order upon the outer world. The effects of this process range from the everyday creation of "world-three" objects, to an ongoing, but far subtler "impregnation" of the environment with meaning. This dynamic generates a semantic dimension in objects themselves - an eco-semantic field of an allopoietic nature.

The two facets of global semantic interaction are engaged in a circular dynamic. Perception of a novel object activates and reorganizes internal constellations, while, simultaneously, the emergent meaning-clusters are injected into the eco-semantic field of the external object, thus changing its organization and status in consensual reality. The modified eco-semantic field, in turn, will be "retrojected" into the psyche, starting a new loop, until eventually this mind/object interaction stabilizes.

It is proposed that this semantic synergy primarily implicates events or objects relevant to the noo-semantic field - especially those of our immediate environment. This leads to the concept of "local universe", as being, for an individual, that part of phenomenal reality imprinted and shaped by his/her noo-semantic field; thus, the way in which the local universe is organized tends to reflect the person's own worldview and set of values.

The model hypothesizes that the semantic structure of the local universe will tend to allow for the occurrence of specific events while diminishing the likelihood of other ones. This could be seen as the dynamic underlying synchronicities or "chance" series. Several parameters relevant to this informing and "bending" of reality can be identified, including the psychological and cognitive traits correlated to psi performance in laboratory research, as well as the depth-psychological dynamics observed in psychoanalytical studies.
A Comparison of Three Approaches to Reconciling Science and Consciousness

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Abstract

The inability of modern science to give an adequate account of mind or consciousness, even in its ordinary everyday manifestations, is by now a glaring flaw. The problem is accentuated by the many anomalous phenomena and experiences associated with consciousness, which "don't fit" with the scientific worldview.

There appear to be three contemporary approaches to this dilemma. One is to push the envelope of science as we presently know it. (For example, several quantum physicists have attempted to show the compatibility of quantum theory with philosophical idealism.) A second is to re-examine the basic epistemological assumptions of Western science, from the standpoints of modifications which could better accommodate subjective experience, volition, intuition, the role of the mind in immunity and healing, psi phenomena, and so on. A third, more radical approach, involves a proposal to restructure science on the basis of a different set of ontological assumptions, namely those which are implied by taking seriously the data from the meditative and esoteric traditions.

Probably all three of these approaches should be supported. The first is the most obvious, but it may in the end prove to be inadequate. The second appears to stand a good chance of gradually achieving acceptance within the scientific community, and is probably the best next step. The third may be where the consciousness issue ends up eventually, but for the time being seems to have little likelihood of gaining very widespread acceptance.
A Candidate Architecture for Characterizing Consciousness
Howard T. Herman, M.D., John C. Kotelly, B.S.

1. What Are We Doing?
1.1. From a small set of concepts, which we formally characterize, we propose a mechanism that can explain the binding problem, namely, how distributed representations of the world in the brain can be bound by consciousness. We start from the premise that the brain manifests the principles of physics of organizing systems; that the mechanism of consciousness is a natural and necessary manifestation and show that the visual symbols we create in our mind called mathematics, arising from the self-referential mechanism that couples our brain to the world, can mirror and predict phenomena in the world independent of the particular manifestation of consciousness.

2. Objectives
2.1. The process by which consciousness is created has been beyond direct experimental access. We discuss a variety of clinical psychiatric disorders, ranging from major psychotic states to attention disorders, positing that they derive from specific disruptions of normal operations of the conscious states.

3. Approach
3.1. We Present and Explicate Our Organizing Principles
3.1.1. Our studies have led us to believe that the following are the minimal set of operating principles necessary for characterizing consciousness: Observer, Modeling, Context operators, Reconstitution, Self-Reference, Time/Clock, Questioning/Answering, Elaboration, Information.
3.2. We Define Consciousness.
3.2.1. We use definition to show it is a unifying principle for all discussions of consciousness.
3.2.2. We suggest a mechanism for how mathematics arises through consciousness.
3.2.3. We propose a system for binding.
3.3. Application to Clinical Psychiatric Phenomena

4. Conclusion
4.1. Studies of consciousness will lead to a science of psychiatry.
4.2. Avenues of further study.
Left brain says yes, right brain says no: normative duality in the split brain
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We investigated the capacity of a split brain patient to coordinate decisions about the lexical status (word or nonword) of cued letter strings flashed to either visual hemifield alone or simultaneously with another string flashed to the opposite visual hemifield. The patient was NG, a 60 year old woman operated on 1963. The completeness of callosotomy was confirmed by MRI in 1987.

NG's performance was significantly above chance only when the target was flashed in the right visual hemifield (RVF) and the patient responded with the right hand (Rh). There was no difference between unilateral and bilateral presentations either in accuracy or in latency. Words (724 ms) were recognized significantly faster than nonwords (964 ms) (p<.003). The patient exhibited an unusually strong bias for word decisions when a stimulus (whether target or distractor) occurred in the RVF (unilateral, RVF target; bilateral, RVF target; bilateral, LVF target) and responses were made with the right hand. Conversely, the patient exhibited an unusually strong bias for nonword decisions when a stimulus (whether target or distractor) occurred in the LVF (unilateral, LVF target; bilateral, LVF target; bilateral, RVF target) and responses were made with the left hand. This pattern of responses is unlikely to be due to perseverative behavior because of the random order of unilateral and bilateral trials in the two VFs.

Our data suggest a dissociation between the lexical processing and the decision mechanisms in the two hemispheres of NG. Her RVF-Rh performance is reliably above chance despite the strong bias for words. During both unilateral and bilateral RVF-Rh presentations collapsed, the patient said "nonword" only twenty times out of 96 trials, and of those twenty trials, 19 had nonword targets. Thus, performance in the unilateral RVF-Rh condition reflects some balance between lexical access and decision bias (word) in the LH, whereas the contralateral RVF-Lh condition reflects complete dominance by the decision bias in the LH. Similarly, NG's LVF-Lh performance, though not different from chance in overall accuracy, does not show a random distribution of "word" and "nonword" responses, but rather a nonword bias. The opposite bias occurred not only for the "pure unilateral" conditions, LVF-Lh and RVF-Rh, but also for bilateral trials, where identical pairs of letter strings can produce opposite bias depending on the response hand. The decision processes in NG's two disconnected hemispheres are in direct conflict during the same bilateral presentations and then the response hand determines which hemisphere will be in control. Certainly, decision bias can change from trial to trial, as between LVF-Lh and RVF-Lh trials in the same block.

We posit that any stimulus in a VF (even unattended) will trigger automatic lexical access and a subsequent decision in the contralateral hemisphere, and that there is some competition for dominance between the lexical access and decision processes in the same hemisphere, as well as between the decision processes in the two hemispheres. In lexical decision by normal subjects, there is often a small but statistically significant difference in hemispheric response criteria, due to a more stringent criterion (nonword bias) in the LVF, and a more lax criterion (word bias) in the RVF. In NG, on the other hand, we have observed a most radical separation of response criteria, where the LH "says" "word" and the RH says "nonword" almost whenever they "see" a stimulus and control the response hand.

These findings are inconsistent with the hypothesis that NG has one undivided control system for supervisory evaluation of alternative choices, and they suggest instead the existence of two independent, parallel, and sometimes opposing "decision makers" in the two disconnected hemispheres.
Synchronistic Regularities in Quantum Systems?
E.M. Insinna

C.G. Jung's theory of synchronicity has been regarded until now as a purely theoretical approach for psycho-physical interactions. The application of synchronicity in the field of scientific research might now become possible on the basis of W. Pauli's personal interpretation of both quantum mechanics and Jungian synchronicity. The recently published correspondence between Pauli and Jung sheds a new light not only on the unsolved question of the role of the observer's consciousness in quantum measurement but also on the mind-body problem.

"Modern physics reintroduces the observer as a small god of creation in his microcosm, with the ability of (at least partial) free choice and mostly uncontrollable effects on the observed object. However, if such phenomena depend on how (the experimental condition) they are observed, why couldn't there exist also phenomena (extra corpus) [i.e. in quantum systems] which depend on the person who observes them (i.e. on the psychic quality [the unconscious] of the observer)?" [Inserted by the author]

Pauli's suggestion of a complementary irrational interaction between the observer's unconscious and the observed quantum system has remained neglected for almost forty years and this attempt needs now to be rehabilitated. His interpretation of the measurement problem implies an extension of both Bohr's original concept of complementarity and Jung's concept of archetype. It suggests further to view archetypes as factors similar to mathematical attractors whose range of manifestations (viewed from the observer's ego consciousness) spans from the physical to the psychic domain.

In other words, following Pauli, we may say that the collapse of the wave function becomes a spontaneous process in which the observed system is correlated with the psychic attitude of the observer. The system's answer stays in a complementary relationship not only with the observer's ego consciousness (as suggested by Wheeler and Wigner) but mainly with his unconscious psyche. Thus, individual (random) quantum events, which quantum physics tries to eliminate with the help of statistical calculations, become the open door to Synchronistic events.

Jung's theory of synchronicity and Pauli's interpretation of quantum mechanics allow us to view quantum systems and dynamical systems in general as the place for the manifestation of archetypes in the form of coherent sequences of individual quantum events. Jungian synchronicity implies the abolition of the Cartesian dichotomy between psyche and matter. In Synchronistic events the complementarity between the unconscious and the ego conscious, between psyche and matter become evident and may be interpreted as manifestations of an intrinsic wholeness underlying the reality of being.

An experimental set-up has been designed to search for the emergence of such coherent regularities in two independent quantum systems.

The author presents his preliminary results in order to draw the attention of specialists of other disciplines to the possibility of an experimental approach of synchronicity. The data obtained should be thoroughly analysed with more sophisticated equipment and further experiments should be carried out to either confirm or refute the present hypothesis.

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There are a lot of hypothesizes of the origin of consciousness both philosophical and scientific. However, there is not yet a satisfied theory about consciousness. Because, we are not conscious of what is going on in our brains (bodies), at the first, we need to consider current both theoretical and experimental results in biology and medicine which are relevant to establish a scientific theory of human consciousness. The most relevant field in biomedicine to consciousness is general anesthesiology, particularly its cellular and molecular mechanism.

In this paper short history of molecular anesthetic mechanisms is presented. Focus of our consideration is synapso-dendritic molecular mechanism. Experimental results of the effect of anesthetic on the secondary structure of Poly (L-lysine) [Shibata A. et al., J. of Pharmaceutical Sciences, 80(11): 1037-1041, 1991] and effect of ethanol on secondary structure of firefly luciferase, as model system of anesthetics effects [unpublished result Hameroff/Koruga research group] indicate that dynamics of secondary structure of some protein(s) on synapse and cooperative action of many synapso-dendritic processes through neuron nets could be relevant to consciousness. We postulate that microtubule-clathrin interaction on synapse, and dynamics of secondary structure of their proteins, may have important role to formation of spatio-temporal information field. Based on structure-energy properties of these proteins it was fined by Koruga/Jankovic that their spatio-temporal law is based on Golden Mean (GM) properties [Koruga et. al. Fullerene C-60: History, Physics, Nanobiology, Nanotechnology, pp. 144-153, North-Holland, Amsterdam, 1993]. This indicate that GM could be link between brain (GM+ as law of 3-dimensional structures) and mind (GM- as a law of 5-dimensional spatio-temporal field -"shadow of mind"), as N(3)xN(-2)=N(0).

Based on these considerations we can proposed that the lifting point of human consciousness is unity of wave functions based on GM+ (clathrin-tubulin ) and GM- (microtubule-tubulin), as a spatio-temporal field around N=0 dimension. This model predict that consciousness, as state of N=0, can exist itself and forself as |N(0)|=1. Also this model predict that another beings with consciousness can exist, but Being as N(5)xN(-4)=N(0) is optimal. In near future we plan investigate dynamics of secondary structure of some proteins, and experimentally both identified and measure wave functions of clathrin and microtubules in vitro by STM under influence of anesthetics.
Optical Diffraction and Interference Phenomena as Potential Indicators of Anomalous Phenomena

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There have been several reports in the scientific literature (1,2,3) of claims that some humans have the ability to affect in a marginal but statistically highly significant manner phenomena which are ostensibly governed by Poissonian or Gaussian statistics e.g. the decay of radioactive sources or the pulse count from a diode source. The general nature of these claims is that human intentionality can affect the mean value of a statistical distribution in a manner consistent with the intentionality. The proponents of these claims have attempted to model the claimed effects by invoking quantum mechanics. We have devised some simple optical experiments predicated on these claims e.g. a single slit diffraction experiment wherein the diffraction pattern is detected using a computer controlled linear photodiode array at high data rates (4). The intensity distribution in the diffraction pattern is interpreted as a probability distribution as in quantum mechanics. We have tested the ability of over 80 human operators to shift this pattern in a manner consistent with their intentionality. These results of these experiments have not yielded strong support for the claims. Currently we are conducting double slit interference experiments wherein very high contrast interference fringes are recorded using linear photodiode array. Given the complementarity between path information and high contrast fringes as in some interpretations of quantum mechanics, we are proposing to invite human operators to attempt to intuit the nature of the energy flow in the interferometer. If such information is successfully abstracted it should be indicated by a reduction in fringe contrast.

References
Quantum Optical Coherence in Microtubules: Implications for Consciousness

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A detailed quantum field theoretical investigation on the system of water molecules confined within the hollow core of a cytoskeletal microtubule reveals that the microtubule may play the roles of not only a coherent photon generator but also a perfect dielectric wave guide along which coherent photons are transmitted as if it were transparent. This result may force us to change our practical point of view of brain processing drastically from the conventional "electronic" processing regime to a new "photonic" one. The cytoskeletal network of microtubules in and among brain cells such as neurons and astrocytes may be considered as a subneuronal quantum optical network essential in brain processing.
Abstract of paper to be presented at the Conference
Toward a Scientific Basis for Consciousness
Tucson, Arizona, Arizona, April 12-17, 1994

Music, Meaning and Design

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The phenomenon of music, and in particular its apparent specificity, presents an intriguing challenge to science, which seems to have no satisfactory explanation for it. The approach utilised here takes into account not only the objective surface structure of music but also its deeper structure (which could be considered to be its meaning) perceived subjectively by the listener. Such studies reveal logical concatenations of principles and mechanisms (such as the fact that particular forms create tension whilst others create feelings of closure) that are in themselves seemingly arbitrary and inexplicable. It is instructive to compare this situation with that of biology, where logical explanations of significant processes are underpinned by details that are subject to the laws of chemistry and so are not derivable from logic alone.

An important part of the logic of biology is the principle of natural selection, which explains logically why biological processes tend to have functional value. In the cultural context music can itself be seen to have functional value, consisting in its powerful ability to generate emotional states regarded as having high value. It seems implausible, however, that biological evolution alone could have created a mechanism of such high specificity. We propose therefore that music is an aspect of a self-organising process of a much more universal kind, and discuss some of the requirements and implications of such a hypothesis.
Consciousness as Modeling of Environment

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Abstract

Taking the defining property of a "conscious" system to be its ability to learn modeling of its environment in real time and with limited resources, we attempt to define "consciousness" quantitatively within the framework of the dynamical systems theory. Our goal is to find the minimal setup to capture the major characteristics of a "conscious" system by following an analogy with biology, namely:

i) its ability to build internal models of possible environments, including that of itself;

ii) two evolution time scales, the fast scale for "perception" of the environment, and the slow scale for learning optimal modeling;

iii) its ability to modify its interaction with the environment to ensure "optimization" of the interaction.

To this end we consider two interacting dynamical systems, the larger E - the environment and, the smaller L = V ⊕ M - the learning system composed of a non-dynamical representation space V and of a memory space M, M = Mm ⊕ Mp, Mm - the model space, Mp - the model parameter space, with evolution equations d/dt x(t) = φx(t), x(0) ∈ E and μd/dt ν(t) = φν(t), ν(t) ∈ M, μ > μp, where E is a functional space over a domain U ∈ Rn. V and M are defined as domains in Rk, Rm, m > k. L and E interact through the imbedding of boundary S of a closed bounded subset Rp, p < n. Given an imbedding i: S → SE = i(S) ⊂ E, E parametrizes evolution of L through the values of x(t) on SE = i(S): x(t) = x(t)|S, the sensory input of L, while L affects the evolution in E through i. Evolution in M is determined by the extrema of a "pleasure" functional P[y(t), ν(t)], under evolution resource constraints C[y(t)], while evolution in M is determined by minima of computational resource functional Q[y(t)] under constraint of a given accuracy of representation of E. The relationship between S, V, and M can be described by three maps: sensory representation map Fs: S → V, memory representation map Fm: M → V, and memory reconstruction map R: V → M, such that || R · Fm - I ||M < ε, FmR = Ip, where Ip - identity maps on M, V, ||.||M is a norm on M, and ε is an accuracy parameter. Let m(E) be the space of all dynamical systems in X = E, M, and U ⊂ m(E), a neighborhood of 0 in m(E). An element φ ∈ U of accuracy ε on scale T if there exists ϕ ∈ U and trajectories x(t), ν(t) such that || Fx(ν) - Fxν(0)||ν < ε for t ∈ [0,T], provided Fx(0) = Fx(0). We call L "conscious" of E with respect to U if M contains a model for any ϕ ∈ U, such that there exist at least one solution of δP = 0, C = const. In other words L will be "conscious" of its environment if it can model E accurately enough to adapt and ensure its own most pleasurable existence.
Consciousness is not a matter for the intellect. Discussing it with hundreds of tongues for thousands of years will bring you no closer to it.

What allows an individual to be carefree: totally healthy, happy, holy and at peace?

What can bring an ordinary person to the state of ecstasy in the infinity of consciousness; what the Yogi would call Wha He Guru.

To that point where God is in all, big or small. Where God is within you, dwelling within you. Where God and you, you and God are one.

There is indeed a technology, a series of steps you can make and actions you can take to bring you closer to that state. That state of pure awareness, past the intellect to your own true identity. That is consciousness and we will experience it.
Self-Awareness of Deficit in Patients with Alzheimer's Disease
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Impaired self-awareness of deficits has been reported to occur in a variety of neurologic disorders, including stroke, head injury, multiple sclerosis, and various dementing illnesses such as Alzheimer's, Pick's, and Huntington's diseases. Impaired self-awareness of deficits can be severe and striking, as in anosognosia for hemiplegia, or mild and subtle, as when patients in the early stages of Alzheimer's disease (AD) admit to memory problems but underestimate the severity of their mnemonic deficits.

Research concerning self-awareness of deficit is of both practical and theoretical importance. Practically, the degree of self-awareness of deficits may both predict aspects of functional independence among neurologic patients, and significantly affect outcome of rehabilitation efforts. Theoretically, research on unawareness of deficits has implications for understanding the processes by which persons are normally aware of and monitor their own cognition (i.e., reflective consciousness). Impaired awareness of deficits is most frequently observed clinically as a feature of those dementias with predominant cortical degeneration, such as AD and Pick's disease, and some observers have suggested that loss of insight concerning symptoms occurs earlier in the course of illness for Pick's disease than for AD. Both of these kinds of dementia are typically associated with signs of frontal lobe pathology, but frontal involvement is generally more severe in the early stages of Pick's disease than AD. This is of interest, given the documented association between frontal lobe pathology and impaired self-awareness of deficits in a variety of neuropsychological syndromes, and speculations regarding the role of the frontal lobes in aspects of self-awareness. Recently, it has been shown that AD patients with less awareness of memory loss (as rated by clinicians) were those who had relative right dorsolateral frontal lobe diminished perfusion (by SPECT scan). However, given the unknown reliability and validity of clinician judgments of patient self-awareness of deficit, such observations require replication with more rigorous operational definitions of deficit self-awareness. Much of the literature concerning self-awareness of deficit in dementia patients employed clinical observation without explicit operational criteria for defining and measuring awareness. However, an increasing number of recent studies have applied systematic empirical methods.

It is the purpose of this presentation to review empirical research on self-awareness of deficit in AD patients, with a particular emphasis upon those employing operational definitions of awareness based on self-prediction of specific memory and other cognitive task performance. Both methodologic issues and theoretic implications will be illustrated with recent results from the author's own ongoing research in this area.
Recent research in cognitive psychology has given new life to the old idea of the psychological unconscious. Unconscious processes are implicated in social interaction as well. As examples, I will discuss the role of unconscious perception, memory, and thought in emotional life, in forming impressions of other people, and in stereotyping and prejudice.
The dual nature of consciousness
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Much of the confusion associated with discussions of consciousness stems from its dual nature. There are really two consciousness problems, one scientific and one philosophic. The scientific problem can be tackled with standard classical reductionist approaches and the philosophic problem requires, I believe, a new approach based on quantum mechanics. Both aspects will be the subject of my presentation.

The scientific aspects of consciousness are being actively explored by psychologists, biologists and other neuroscientists. They sometimes call it the "binding" problem, referring to the question of how the multiple representations of the world found in the brain are bound together to produce a unitary percept. One recent theory is that of Crick & Koch ("Towards a neurobiological theory of consciousness", Seminars in the Neurosciences, 2, 263-275, 1980) who propose that neural "oscillations" of around 40 Hz can provide the substrate of consciousness. Our own approach to this problem is to use the visual evoked potential (VEP) to localize the sources of neural activity in a variety of tasks involving selective attention and different states of awareness. Previous attempts at high quality source localization of the VEP have not been too successful. The special ingredient that we believe enables our approach to succeed is our combination of 61 simultaneous stimuli across the visual field (Sutter, "A deterministic approach to nonlinear systems analysis" in Nonlinear Vision, CRC Press, 1992) with 48 (or more) multiple electrodes. Continuity across the visual field in addition to continuity across the scalp provides a powerful new set of constraints that we believe will allow unambiguous localization of the underlying cortical sources. By manipulating the observer's attention and awareness we intend to uncover the dynamics of neural processing underlying these factors.

The philosophical aspects of consciousness involve the nature of qualia. Even after the scientific aspects of consciousness have been solved, there is still the problem of how to integrate the subjective aspects into normal science. This is the mind-body problem of Descartes. There have been many, many philosophical arguments about whether this is really a problem. See, for example, Searle's clear analysis in his recent book "Rediscovery of the Mind". I believe that much of the confusion stems from the outright rejection of duality by almost all investigators. In order to establish legitimacy, the first chapters of most mind-body books are devoted to Descartes bashing. Duality seems to be the enemy of science. In one sense that is correct. Reductionist science has been unbelievably successful in unifying phenomena that had previously seemed to belong to different realms. The laws of motion of heaven and earth were unified by Newton. Electricity, magnetism, light and radio waves were unified by Maxwell. The biochemistry of DNA and proteins unified life and non-life. Superstring theories may be getting close to unifying all the forces and particles of nature. The quest for unity is indeed a strong driving force of science. Seen in this light the duality of the subjective and objective worldviews seems anomalous, so it is not surprising that many scientists and philosophers consider dualistic thinking to be a product of sloppy thinking. The coming of quantum mechanics should have brought a change. Quantum mechanics offers a beautiful, self-consistent model for a duality. The quantum split divides the observer from the observed. In my talk I will argue that the quantum split should be considered not as an analogy for the mind-body split but rather IS the mind-body split. It solves the central paradox plaguing most mind-body dualities of where exactly is the dividing line between the two realms and what exactly is the connection between the two realms. Von Neumann showed that the quantum split can be moved arbitrarily to different positions! What an elegant solution!

In summary, there are two very different aspects of consciousness, one belonging to biology and psychology and one belonging to physics and philosophy. It is very easy to get them mixed up. We must be very clear in our discussions about which one we are talking about.
THE PELASGIAN CREATION MYTH AS A STARTING POINT OF NEW SCIENTIFIC PARADIGM OF HUMAN CONSCIOUSNESS

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Usually we confront science and myth. It is, because science today could not yet explain metaphors and symbols as a "mind machines" of human consciousness. It will be case until a "strong science" of consciousness will not be established. In this paper we consider conceptual relationship between the Pelasgian myth, as the oldest known one, and modern theory of physics based on the superstring theory. This can be a starting point to a new approach to consciousness research.

According to an ancient Greece documents, in Old Europe about 6,000 BC., the Pelasgian myth was the first "flash of lighting" of human consciousness. This myth comes from the North to Greece and was inspiration for the Homeric and the Olympian myths which become famous in literature. The Pelasgian Creation Myth says that: In the beginning, there was only Eurynome, the Goddess of All Things, who rose naked from the Chaos, but not finding anything solid to lay her feet on, she separated the Waters from the Heavens, dancing her celestial dance on the waves...The dance gave birth to the great snake Ophion, which not able to withstand the magic of Eurynom's dance, became one with her. Eurynome was then transformed into a pigeon, and, prostrate on the waves, laid the Universal Egg. At her bidding, Ophion coiled seven times about this egg, until it hatched and split in two. Out tumbled all things that exist: sun, moon, planets, stars, the earth with all living creatures (R. Graves, The Greek Myths, pp 27-30, Penguin Books Ltd., 1980, Middlesex, England).

About 8,000 years latter human consciousness "give birth" a scientific scenario of World creation (Big Bang) similar as the Pelasgian Creation Myth is. Big Bang, become more popular after A. Penzias and R. Wilson experimental result, so-called cosmic microwave radiation background. There are corresponding elements in human consciousness which represent myth and modern physics: Creation, Chaos, Superstring (Ophion as one-dimensional object), 4 + 7 space-time world (Egg as a four dimensional and Ophion as one-dimension object, superstring, which vibrate on water wave, giving seven-dimensionality unit sphere on the Plank's length). In both cases wave concept is dominant, what open new relationship between myth, as temporal structure of human consciousness, and quantum mechanics, as a human spatio-temporal picture of reality.

The one of the most challenge of science of consciousness is temporal unity (past-future) in similar way as modern physics has challenge of spatial unity (micro $10^{-33}$ cm and macro $10^{33}$ cm). Bearing in mind these facts, the science of consciousness we can define as both human method of investigation and cognition of space-time structures of reality.
Towards a Neurobiological Theory of Consciousness

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What is the neuronal substrate of awareness? In other words, what are the necessary conditions at the level of neurons and synapses in order for a sensory event in the environment to be "perceived" or reach "awareness"? At least three non-exclusive possibilities exist:

(i) a sensory event needs to excite a sufficiently large number of neurons within the cortical system (i.e. neocortex, paleocortex, thalamus),

(ii) a sensory event needs to activate certain "labeled" or "tagged" neuronal pathways or areas or

(iii) there exist at least two distinct forms of neuronal activity: non-oscillatory or non-synchronized neuronal firing activity that causes or influences behavior WITHOUT leading to awareness (as in blindsight, automatic processing, priming, implicit memory) while only synchronized neuronal firing activity among a subset of neurons in the cortical system gives rise to awareness.

I will discuss relevant experiments based on the framework Crick and I outlined several years ago (F. Crick and C. Koch, Seminars in the Neurosciences, Vol. 2, pp. 263–275, 1990). In particular, I will focus on the question to what event layer 5 pyramidal cells of the intrinsically bursting type that project outside of the cortico-thalamic system constitute a critical component of the neuronal substrate of awareness.
INFORMATION PHYSICS, NEUROMOLECULAR COMPUTING AND CONSCIOUSNESS

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There are many philosophers and scientists who have proposed a link between human consciousness and quantum mechanics. It is, because, both subjects are mysterious and confusion, which nobody really understand. We propose to overcome confusion about quantum theory to use its ontological rather than epistemological interpretation. To improve our explanation of the human consciousness based on quantum theory, we proposed to established a new scientific field which we named information physics. To do that we need to consider monades, based on the universal physical constants, and their coherence and self-organization as a link between classical physics, quantum mechanics and consciousness. Coherence and self-organization based on biomolecular computing generally, and neuromolecular computing particularly, are important for originate human consciousness.

As we know there are three main events for a human being. The first event is the uniting of a male gamete with a female gamete, on the molecular level, to form a single cell called a zygote. From that moment exist genetic code, cytoplasmic molecular network and ordered biological water as "intelligent solvent" of an unique unit of human genus. The second event is embryological development, from zygote, as a part, to body, as a whole. Zygote, as the molecular space-time scenario, and brain as manifest space-time pattern of that scenario, are electro-magnetic base to establish human consciousness as complex wave function. The third event begins after birth when a human being interacted with environment, specially with gravity waves. Preliminary theoretical research indicate that a sub-unconsciousness arise, as an interaction of electro-magnetic and gravity waves in water, centrioles and cytoskeleton network, in each cell. During the embryology some cells become temporarily extra active as energy-information network in body and generate unconsciousness state of human being. This energy-information field of microtubules (around dimension N=1) in body is known as Qi (Chinese) or "Ki" (Japanese). However, human sub-consciousness, is a wave function of water, microtubules and clathrins on synapses of neuron, and originate consciousness during the cooperative actions of about $10^{10}$ neurons.

According to information complementarily based on dimensions(N) and the symmetry of space-time unit spheres [1], information field of our Being consists of: $N(3) \times N(-2_{\text{w}})=N(0)$ around $[N(0)_{\text{w}}]$ (Consciousness with many its altered states), two $N(2) \times N(-1_{\text{w}})=N(0)$ around $N=1$ (Unconsciousness) and monad $[N(-4_{\text{w}})$ as a unit sphere with Plank length) which can become Self if $N(5) \times N(-4_{\text{w}})=[N(0)]$. Information physics we can define as a science of wave function unity of both space-time field around $[N(0)_{\text{w}}]$, which unit sphere has value equal one, and energy-information field around $N=1$, which unit sphere is equal two.

Neural Time Factor in Conscious and Unconscious Functions

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Our experimental evidence indicates there is a substantial cerebral delay in the production of a conscious experience, whether exogenously (sensory) or endogenously (volition) initiated. Evidence was largely obtained with intracranial studies in awake human subjects. A ‘time-on’ theory is proposed for a controlling mechanism in the cerebral distinction between conscious vs. unconscious functions. Widely significant implications of the ‘time-on’ theory are discussed.
The "Trayne of Thought" (ToT) is a common metaphor in traditional discussions of consciousness. This poster will review the history of this metaphor and speculatively evaluate recent ideas (Limber, 1982, 1990) on the origins and acquisition of human language in regard to consciousness.

Hobbes (1651), for example, explains "By the Trayne of Thoughts I understand that succession of one thought to another to distinguish it from Discourse in Words." The commonsense interpretation of this expression is that while consciousness and speech may occur together, the "train" is simply being reflected in the flow of speech and is not in any way causally driven by it. Similarly, Reid (1813/1969) observes "Such trains of thought discover themselves in children about two years of age." Again there is no suggestion that the ToT itself is in any way causally related to the appearance of speech in children.

By the nineteenth century, however, human language is viewed increasingly as an "organism" with a life and perhaps a consciousness of its own. Or more precisely, as Humboldt and others noted, LANGUAGES may have their own character, consciousness or genius that they impart to their users. Darwin (1871) saw the evolution of language driven by the role of language reacting "on the mind itself, by enabling it and encouraging it to carry on long trains of thought." But in what language!

Most recently Jaynes (1976/1990) explicitly stood the traditional view on its head: "I wish to be very clear that consciousness is chiefly a cultural introduction, learned on the basis of language and taught to others rather than any biological necessity." Again, what language? Or does it matter? I will argue there is no reason here to see biological necessity and culture as mutually exclusive options—especially in an evolutionary context.

It is evident that if there is anything to the linear ToT metaphor in fact being due to the linear quality of human speech, then questions about the universality of language have corresponding implications for the universality of human consciousness. While metaphors may attract historical interest in tracking the flow of ideas, in regard to consciousness they may take on a special role in that in some sense "metaphor" may be all there is!

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Computer Simulation of Anesthetic Quantum Effects in Proteins

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General anesthesia causes reversible cessation of consciousness while sparing other brain functions. Anesthetic gases include a wide variety of molecular structures—halogenated hydrocarbons, N₂O, ethers etc.—but share in common their solubility (by weak van der Waals forces) in hydrophobic (water excluding) regions found in both lipids (i.e. membranes) and specific pockets within certain proteins. The preponderance of evidence in the last decades (e.g. Franks and Lieb, 1982) show that anesthetics act directly on certain brain proteins (receptors, ion channels, second messengers, enzymes, cytoskeletal subunits, etc.), and exert their effects by inhibiting functional conformational responsiveness of these proteins. Fröhlich (1975), proposed that conformational responses of proteins were coupled to quantum events within hydrophobic regions of the protein. Thus quantum events such as electron, dipole, phonon, and/or boson movements in hydrophobic regions can control the ("classical") conformational states of proteins necessary for brain function and consciousness. Hameroff and Watt (1983), showed that anesthetic gases inhibited electron mobility and proposed that they erased consciousness by inhibiting electron mobility within protein hydrophobic regions.

In this study we describe computer simulation of hydrophobic regions in two anesthetic sensitive proteins (bacterial luciferase, papain) and one protein insensitive to anesthetics (acetylcholinesterase). We examine quantum level van der Waals energy and electrostatic potential within those proteins. We conclude that anesthetics can act by inhibiting quantum events at the level of intra-protein hydrophobic regions.

References


MEANING, MOTIVATION, AND DISORDER

Thermodynamic Model and Possible Experiment

By Paul Løvland*

Abstract
The present author assumes that basic physical and mental processes obey identical laws. In other words, the processes may be homologous.

Provided it is possible to find plausible mental analogues to physical quantities, there should at least qualitatively, or semi-quantitatively, be possible to suggest testable hypotheses for such an analogy/homology. Løvland in a previous paper has proposed analogues to thermodynamic quantities and explained how they can be applied to general mental processes.

Within psychology both S. Freud and C.G. Jung have applied thermodynamically inspired models and analogies. However, their thermodynamic basis was fairly simple, as they naturally were not aware of the latest discoveries of the second half of our century, i.e. especially those related to irreversible processes and processes far from equilibrium (e.g. Prigogine and Defay, and Glansdorff and Prigogine.)

The present hypothesis is developed from basic principles within classical thermodynamics and statistical mechanics and relates to affective meaning, motivation, and structural order-disorder changes of images. The fundamental formula and the analogues applied should make it feasible to test the hypothesis experimentally.

Affective meaning is related to motivation which is a kind of potential energy. The latter links physical quantities to mental analogues. This makes it possible to formulate the amount or intensity of affective meaning as a function of 1) initial motivation relevant to a particular image, and 2) motivation caused by the shift from one image to another.

Motivation is further related to "arousal", which may be measured experimentally by using Osgood's semantic differential. Thus we can determine a value for the amount of affective meaning under various conditions.

Preliminary tests hint that motivation caused by a shift of images is dependent on two variables. Firstly, the change itself which generally will increase the meaning of the final image; and secondly, the change of disorder (complexity) which will raise this meaning when the disorder decreases, and lower it when the disorder increases for a certain type of images. These tendencies comply with the thermodynamic model.

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HEART RATE VARIABILITY AS AN INDICATOR OF HIGHLY ORDERED STATES OF CONSCIOUSNESS

By

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ABSTRACT

This work utilizes the measurement of heart rate variability (HRV) as a vehicle to show that the practice of certain specific heart focus techniques produces such levels of mental and emotional self-management in the practitioners that a number of unique attainment plateaus in HRV order are automatically manifested. In particular, (1) enhanced balance between parasympathetic and sympathetic innervation, (2) entrainment of parasympathetic and sympathetic power spectra to the ~0.1Hz range, (3) frequency locking of multiple body oscillators (HRV, Pulse transit time and respiration - see figure) (4) shift of entrainment frequency to different frequencies and (5) the intentional generation of an internal coherence state (near zero HRV) have all been achieved. The achievement of the entrainment state plateau has been shown, in other studies, to produce a variety of beneficial chemical and hormonal changes inside the body plus a variety of structural changes to either pure water or to human DNA held in an aqueous solution outside the body. Thus, focused intentionality directed through the heart rather than the head yields great gains in inner self-management and brings into question our present concepts of human consciousness and its location relative to our physical bodies.

(a)

Three simultaneously recorded body information channels' responses to a "Freeze Frame"(FF) and shifting to a state of sincere appreciation at around 300 secs. a) real-time data for respiration, HRV and PTT, b) power spectra for the before FF condition and c) power spectra for the after FF condition.
How might the awareness that characterises seeing and knowing be conceived in experimentally-testable terms? The matter of how we name or otherwise identify colours provides a useful avenue of investigation into this problem. The analysis offered rests on drawing and maintaining a distinction between determinate colours, that is particular colours — yellow, blue, brown, and the like —, and colour as a visible property of material things.

Language is the vehicle for colour cognition. When someone sees a colour as being of a certain kind, this relation of seeing-as, which captures the problematic notion of acknowledged awareness, is mediated by language. The act of identification brings the colour into articulate focus and in so doing makes it the object of sight, meaning that of which one is momentarily aware. An analysis of the knowledge that enters into the visual experience when one says what one sees is provided. This conceives of acknowledged awareness as susceptible to the same logico-linguistic constraints that shape and restrict our naming behaviour.

How might the empirical worth of this conception be gauged? If, as claimed, how a colour looks to someone is conceptually linked to his naming behaviour in context, then, in case of a radical discrepancy in such behaviour, we might look for evidence of an accompanying difference in visual awareness. Comparative studies are called for, for example between subjects whose means of reference to colours makes use of distinct conceptual schemes, or between normal and cognitively-impaired speakers of English. These comparisons afford the opportunity to study colour identification under conditions where different category systems are at work, and under conditions where awareness of what one is seeing is either absent or fails. Thus we might compare normal subjects with subjects who have colour-naming disorders to find out if qualitative differences are discernible. Neuropsychological investigation has revealed several such disorders, the result of brain damage. Among these are cases where there is no colour deficit nor language deficit per se — that is the patient is neither colour-blind nor aphasic — yet names cannot be put consistently and correctly to colours seen. Findings suggest that certain patients do indeed suffer from an inability to see colours as determinate colours, and hence are unaware of them as colours of a definite kind. The neuroscientific implications of this are discussed.
Self-Organization by Means of Quantum Holographic Adaptive Resonance

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The Heisenberg group G, Lie algebra g and nilmanifold describe the quantum holographic processes to be considered. The description includes the classic beam splitter quantum (self) interference experiments by, for example, Hach-Zehner interferometry. It is a methodology applicable to all waves, i.e. electron waves, ion waves, x rays, acoustic waves etc. as well as optical waves - provided the wavelets are coherent enough to form the required stationary quantum inference patterns in the hologram plane, where wavelet mixing takes place.

When holography is performed by the excitation of stationary waves inside a wave propagating medium with reflecting boundaries, phase conjugation occurs spontaneously and both virtual and real images of the stationary quantum interference patterns formed between two waves with one acting as the reference wave, are elicited by wave diffraction. Such images are of geometric time varying behaviours which are spatio-temporal geodesics. For example in a cavity such adaptive resonance allows it to function as a square law detector, so that the closest pattern to the one newly input is incrementally amplified while the remaining stored patterns elicited in mode competition with it are simultaneously attenuated. The cavity thus functions as a parallel computer with a definite metric for pattern discrimination, where the nature of the information processed is not bits but holographic encoding. The mathematics of the Heisenberg group says exponentially complex time behaviours can not only be encoded as such patterns and decoded, but also transmitted as real signals, so overcoming the combination explosion of real world complexity which is the obstacle to efficient computation and information transmission in other processing models.

Furthermore the newly input pattern, a time varying piece of information will itself become stored without limit to the number of patterns or encoding holographically superimposed. Such superimpositions therefore constitute an historical record or memory corresponding to the Berry phase in a quantum system against which further self organization by adaptive resonance takes place. The historical record of the system as a whole therefore constitutes a unique self-reference frame for this further self-organization. It provides a model of evolution and for learning by adaptive resonance which is spontaneous or automatic, initiated from an empty self-reference frame or historical record/memory i.e. a mathematically specified and physically realizable model of genesis or something for nothing. Such genesis or evolution, which can be interpreted as taking place from the dynamic quantum vacuum, can be expected to be hierarchical since from the self-similarity properties of holography as found for example in holograms, the features of the evolution/learning on a lower/one level of scale, will be replicated by equivalent features on a higher/another level as further adaptive resonance proceeds.
Self-Organization by Means of Quantum Holographic Adaptive Resonance (continued)

It is proposed to investigate, the nature of the neuron and the brain, i.e., of intelligence defined as the genesis/perception of order/concepts or artefacts that never previously existed/perceived, and the nature of the cosmogenesis by means of this model of adaptive resonance. Such a cosmogenesis would constitute a free lunch or everything from nothing as a fully mathematically specified and physically realizable model of the holomovement advocated by Bohm, where the information metric for the adaptive resonance can be postulated to be entropy as proposed by Zurek and the self-adjoint Hamiltonian operator for the cosmic adaptive resonance is that advanced by Berry for the dynamical system without time reversal symmetry of which the phase space trajectories are chaotic. This Hamiltonian has eigenvalues which are the imaginary parts \( E_m, m=1,2, \ldots \) of the non-trivial zeros of the Riemann Zeta function \( \text{E}(z) \) and is appropriate to the fractal self-similarity properties that quantum holography would require.

If the above postulates can be validated, as my preliminary research in the form of published papers indicates strongly will be the case, then a strong possibility exists of a grand scientific unification spanning number theory through computation and chaos theory to quantum physics and cosmology, extending eventually to the neurosciences. In the final case, the preliminary work on the model of the neuron working by quantum holography, presented in preliminary form at the recent University of Liege COMETT symposium on the design of new intelligent machines, is indicative of a highly biologically neuromorphic model. This for example requires the synaptic button to be a resonant cavity predicting the existence of the presynaptic vesicular grid of hexagonal hololattices as found in mammals. It is the principal part of the synaptic mechanism for the provision of a standardized metric for synaptic gain, that an assembly of such neurons would require if they are to function as a neural net or brain, and it is truly remarkable that the model should predict the hexagonal structure found, as well as the probabilistic release of a single synaptic vesicle from the grid so as to provide the synaptic gain across the synaptic cleft—a mechanism in biological systems which is truly amazing in itself.

Such an assembly of neurons working as a neural net or brain is appropriate to a model of the mind/brain system which can be interpreted as Descartian. In this interpretation the brain behaves classically, the mind quantum mechanically and consciousness concerns the dynamics of the quantum vacuum. That is, such a brain is a prepared classical wavefield apparatus capable of making quantum mechanical measurements in the sense of an experimental apparatus in high energy particle physics.
Diagnistic Communicative Behavior in a Splitbrain Subject
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Patients with injury to the corpus callosum (the major fiber bundle directly linking the cerebral hemispheres) may experience inability to control the movements of one limb, such that the limb appears to perform seemingly purposeful, coordinated movements (such as closing a drawer) that oppose the patient’s declared intent and actions of the other limb. The patient denies understanding why the limb behaves in this manner. Such "diagnistic" behavior1 has suggested to some observers that one hemisphere has a "will" of its own, isolated from conscious awareness. However, alternate explanations have been proposed, such as epileptic seizures; psychiatric disorder; or disinhibited reflexes.

Additional insight into the source of this disturbance may be gained from the patient presented here, who showed not only oppositional behavior of the limbs on one side, but also interference with her communication. The patient was a college-educated 33-year-old woman with mixed hand preference (left hand for graphic tasks, right hand for other activities; all relatives right-handed) with chronic absence and atonic seizures who underwent complete surgical section of the callosum (the "splitbrain" procedure). Magnetic resonance imaging showed aberrant clusters of neurons in the subfrontal white matter (cortical heterotopia).

While under my care at a rehabilitation hospital for 2 months shortly after the surgery, her left hand interfered with activities of the right, such as programming a microwave oven and arranging alphabet blocks in sequence. She felt unable to explain this behavior and often expressed frustration. On other occasions, she suddenly required considerable effort to turn to the right while walking.

The left hand also appeared to signal to the patient on some tasks when she had been instructed not to use that hand. For example, while crossing out lines with the right hand, the left hand pointed vigorously to ones that had not yet been marked. When trying to select objects with her right hand that had been blindly felt with her left, the left tried to point to them from behind a partition.

When discussing her epilepsy or performing challenging tasks such as grammatical decision and comparing objects held in both hands, the patient rapidly and repeatedly contradicted herself in her speech, appearing very upset, and often would ask why she behaved in this manner. Once, when attempting to count her post-operative seizures with fingers on the right hand, the left hand tried to force it down repeatedly, then displayed fewer fingers on its hand. At this time the patient was unable to say aloud the number. In another interview, the right hand pointed to the word "yes" and the left to the word "no" on a message board when she was asked about her tactile function. The patient also could not recite the name of an object when it was held by the left hand, moments after it was held by the right.

The heterogeneity of these disturbances and the conditions under which they appeared argue against epileptic, psychiatric, or reflexive mechanisms. These behaviors suggest that interhemispheric disconnection may have isolated awareness of processes originating within one hemisphere from those of the other, leading to the patient’s professed lack of understanding of the left hand’s behavior and the left hand’s interference with right hand activities.

Only the left hand violated test rules, usually in a vigorous manner, while the right hand always performed according to the examiner’s instruction. The patient generally felt that she could control the right hand, unlike the left hand. These observations agree with a recently proposed model for differential hemispheric functions: the left hemisphere is more involved with conforming to societal expectations and reflection, while the right hemisphere is more involved with "primary" emotional processing.4 If this model is correct, then this patient may help to understand the commonplace observation of greater self-understanding of one’s rational, verbal processes than emotional, impulsive reactions. "Conscious awareness" of mental processes in the linguistic individual may reflect primarily linguistically-mediated cognitive functions.

Video demonstration of some of these disturbances will be shown.

References
Two well understood kinds of computation are serial and parallel processing. Artificial intelligence work has modeled human thinking in terms of one or both of these. It will be argued that the human ability to create new language and meanings involves a third kind of thinking. This process is analyzed and a physical model in terms of quantum processes in the brain is suggested.
On the Computational Utility of Consciousness
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This paper addresses the question of what the computational role of consciousness might be in human cognition. We describe a theory of consciousness in which conscious contents correspond to the information represented by the temporally stable portion of an underlying system of neural networks. We model this with a modular connectionist network and demonstrate that the behavior of stable states in this network as it performs a simple cognitive task reflects several fundamental properties of consciousness in problem-solving contexts.

The theory consists of the following principles:
1) The cortical processing architecture consists of a large number of relatively modular subsystems, which are highly interconnected and which engage in interactive processing. These modules process their inputs via parallel constraint satisfaction search of a type similar to that which occurs in connectionist attractor networks.
2) Consciousness corresponds to temporally stable patterns of activity within a module or an interconnected set of modules (cf. Rumelhart et al. 1986, Smolensky 1988).
3) There is no critical "consciousness module" whose contents comprise the contents of consciousness, or whose involvement is required for consciousness (eg, Baars 1988, Schacter 1989). Rather, representations residing in any module have the potential to become part of conscious awareness, simply by becoming stable for a sufficiently long period of time.

We report computer simulations of a connectionist model embodying these principles in a simple mental-arithmetic domain: adding two 2-digit numbers. The network contains 5 modules, each responsible for computing a specific digit of the solution. The network is initially taught to add the numbers one column at a time, in a sequence of 3 steps, resulting in two intermediate stable states. This system illustrates several general properties of stable states relevant to consciousness:
1) Stable states tend to be semantically well-formed, since they constitute the result of a semantic constraint-satisfaction process. Transient states tend to have ill-formed semantics, since they possess a poor degree of semantic constraint-satisfaction. This is in agreement with the common observation that the contents of consciousness are coherent (eg, Jackendoff 1987, Baars 1988).
2) Modules in stable states exert larger influences on other modules than do modules in transient states. This occurs because the system has learned to process semantically well-formed states, and stable states are well-formed. This provides a possible explanation for the apparently enhanced "accessibility" of conscious representations relative to unconscious ones (Baars 1988).
3) Encouraging the system to use well-formed states during processing enables it to succeed in solving problems under many conditions in which it would otherwise fail, for example, conditions of insufficient training. This illustrates an important computational role for well-formed states: they help "keep the system on track" toward a solution.
4) Stable intermediate states tend to disappear with extensive practice at a task. This occurs when the connections responsible for the transition from, say, state i to state i+1 get strong enough to effect the transition before the system has quite settled down into state i. The eventual result is that state i no longer achieves stability, and thus its contents no longer appear in consciousness.
Early in this century, Albert Einstein discovered relativity theory and ushered in a whole new physical theory of space and time with consequences for all of physical law. Both special and general relativity theories have produced astounding predictions, including the idea that space and time are variable properties based on your frame of reference, and have always proved to be correct. Since this physical theory of spacetime has been shown to impact all physical laws, this new theory of spacetime should also have some impact on information and computing theory.

As a computer engineer, it is thus reasonable to look towards physics as a guide about how to design and build better computers, since the universe can be viewed as a distributed parallel simulation. This is particularly true as the computer industry is trying to design massively parallel processor (MPP) architectures. A marriage between computer science and physics concepts may give us a better understanding about building better computing machines as well as insight into the mystery of the computational mechanisms underlying human behavior.

In the limit of the physical mechanisms for the speed of light and discrete charge of an electron, computer engineers will ultimately become applied physicists and visa versa. This paper is targeted at neither physicists nor engineers, but rather is intended to give a general introduction to concepts from the fields of physics and computer science that are useful in studying human intelligence. Man's Real Intelligence is living proof that complex computational systems are realizable.

At first glance it would seem that physics would provide the basis for all computing machines. As will be discussed, this relationship between physics and computation is really a chicken and egg problem. Thermodynamics and information theory have always had a common mathematical basis and modern physics is starting to rely on
information theory as the basis for theories on blackhole cosmology. Many physicists working on a Theory of Everything (TOE) are trying to use information concepts to build a bridge between gravity and quantum physics. It is this author's opinion that a TOE must not only predict how the universe can evolve, but must also include how human intelligence evolves from the nothingness of the big bang. This evolutionary model of consciousness must hold for either the mechanistic or the dualist approaches to consciousness.

Obviously, to develop a comprehensive Theory of Everything will take considerable effort, but some very interesting ideas from physics and computer science are already well understood that may apply to the study of human intelligence and consciousness. Many researchers point at quantum mechanics as the most meaningful avenue, because of particular interesting properties of non-locality, discreteness, and instantaneous consistency demonstrated by quantum physics.

These properties and others will be evaluated from the topological and information perspectives, and will lead to additional insight into the nature of spacetime and computation. This paper will attempt to show that computation and relativity both have the topology of space and time in common. This paper will introduce the idea that spacetime itself is the ultimate Rcomputer architectureS needed to satisfy the computational requirements for the R"Real Intelligence"S demonstrated by human behavior.
A hyperspace model of consciousness, developed by interdisciplinary scholar Saul-Paul Sirag, links consciousness at a deep level with physical reality. In his various published works, Sirag claims to have developed new solutions for some of the most fundamental problems in science: the age and size of the universe and the number of basic subatomic building blocks. One of his predictions regarding the exact number of Fermion families of particles has already been confirmed. It is from this theoretical work that his mathematical theory of consciousness has emerged.

Sirag’s model employs a Pythagorean strategy in looking to mathematics for an appropriate structure to describe the relationship between consciousness and the physical world. He finds that unified field theories of the physical forces depend fundamentally on mathematical structures called reflection spaces, which are hierarchically organized in such a way that an infinite spectrum of realities is naturally suggested. The hierarchical organization of reflection spaces also corresponds to the organization of many other mathematical objects -- e.g. catastrophies, singularities, wave fronts, and contact structures, error correcting codes, sphere packing lattices, and, perhaps most surprisingly, certain regular geometric figures including the Platonic solids.

It is generally believed by physicists working on unified field theory that space-time is hyperdimensional, with all but four of the dimensions being invisible. The reason for this invisibility is a major subject of research. Beside space-time dimensions, there are also other internal (or invisible) dimensions called gauge dimensions. In Sirag’s view both the extra space-time dimensions and the gauge dimensions are real. This provides scope for considering ordinary reality a substructure within a hyperdimensional reality. In Sirag’s approach, the structure of the hyperspace is defined directly by the properties of physical forces.

A further innovation in Sirag’s approach is that his version of unified field theory embeds both spacetime and gauge space in an algebra whose basis is a finite group. This group, which directly models certain symmetries of particle physics, is a symmetry group of one of the Platonic solids — the octahedron. Thus it is a mathematical entity contained in the reflection space hierarchy. The reflection space corresponding to the octahedron is seven-dimensional and is also a superstring-type reflection space, so that a link with the most popular version of unified field theory is provided.

The central postulate of Sirag’s theory is that this seven-dimensional reflection space is a universal consciousness, with mathematically specifiable links to individual consciousnesses and human brains. Moreover, the hierarchy of reflection spaces suggests a hierarchy of realms (or states) of consciousness. The seven-dimensional reflection space is contained in an eight-dimensional reflection space, and contains a six-dimensional reflection space, so that there would be a realm of consciousness directly "above" ordinary reality, and a realm of consciousness directly "below" ordinary reality.
Ensemble Neural Codes for Spatial Experience, and Their Reactivation During Sleep

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The discharge patterns of groups of up to 150 neurons were simultaneously recorded in the hippocampal formation of conscious, freely behaving rats. As has been well documented previously, individual hippocampal neurons fire selectively in restricted regions of the environment. From the ensemble record, we could predict the rat's trajectory through the environment to within a few centimeters, and also watch the formation of new spatial representations in a novel environment. States of correlated neuronal activity which occurred during behavior were recapitulated during subsequent slow-wave sleep episodes. Preliminary evidence suggests that neuronal state trajectories that occur in "real time" during behavior, are replayed at about 10x normal speed during sleep. These observations are of some relevance to the theory that memory consolidation occurs through an interplay between hippocampus and neocortex while the brain is "off-line."
Abstract:

William James argued that consciousness, or awareness of conscious contents is experienced as 'pulses'. Jean-Paul Sartre in his classic essay, *The Transcendence of the Ego*, seems to imply that consciousness is a backward cast 'shadow' arising from awareness of the contiguity of successive reflective awarenesses of these 'pulses'. Based on these notions and this author's empirical studies of spontaneous altered state experiences an operational model of conscious awareness is proposed. This model incorporates Tart's systems approach to conscious states, but eschews duality and unnecessary ontological ascriptions as found in many other theoretical proposals. The model is, in effect, non-epistemic and avoids the usual category error implicit in neurophysiological or quantum physical reductions. It also by-passes Searle's requirement of two ontologies because it adheres to James' call for a 'Radical Empiricism' which puts all human knowing and hence subjectivity as well as objectivity on the side of experience.


Collapse of a Quantum Field May Affect Brain Function

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Two experiments are described which support the hypothesis that collapse of a quantum field is of importance to the functioning of the brain. The results are presented in the context of the suggestion, which is beginning to be widely discussed in the literature, that consciousness may be a quantum mechanical phenomenon.
Image generation and treatment might be one of the functions supporting activities of consciousness. Images appearing in consciousness might emerge through induction or image synthesis process referring to context at unconscious phase. Features of the images might be that they are independent of position, orientation or partial scale of configurations. Restricted emergent process is applicable to simulate synthesis of structures with such features, and the simulation might contribute to estimate image synthesis at unconscious phase. Therefore, the process is proposed as a modeling tool for research on image generation.

The assembly method to which the process is applied produces structures by attaching cubic blocks to the structure being assembled, which starts from an initial block. Through discrete conversion of the process, structures with qualitatively diversified shapes can emerge in reproducible manner from input numeric series consisting of simple integers. For serial interpretation of integers defined by input data, the assembly procedure refers to field information obtained from local conformation of the structure as context. Local length in the structure can be tuned by adjusting the number of integer commanding straight growth.

Position or orientation of the output structure through the process is independent of input numeric series, but depends on initial conditions for the origin of the assembly task. Change of the numeric series (i.e., input data) can vary configuration of the output structure without programming to control relations between assembling parts. Simulation utilizing the process could provide structural patterns on display terminals.

The effectiveness of the proposed simulation method for image synthesis are illustrated by following examples:

1. growing course of structure assembly as a model for image synthesis,
2. acceleration of expected image emergence based on experienced growth patterns (learning effect), and
3. same concept arising from our recognition of images or output structures synthesized, despite changes of local length assigned by the number of continuing straight growth command.
Recent work by Roland using brain activation techniques reveal a maximal increase of 10% in overall brain metabolism of O2 using PET scanning of conscious human volunteers in two mental states; at rest and performing a complex visual task. The average increase in $v_{CMR}O_2$ was 0.5 ml/100 g/m. These findings as well as the recent work of Sokoloff, Raichle, Reivich and others similar techniques for functional brain imaging during mental and physical acts has clarified animal and human functional neuroanatomy in correlation with regional changes in brain metabolism and CBF. The central question of the organization of energy utilization for brain functions including consciousness using such techniques has however not been addressed, particularly for dynamic states. Two new findings are significant; the obligatory involvement of limbic structures in learning of new material and Roland's work with such brain activation studies which have emphasized the role of cortical fields as units of brain activation and the role of the prefrontal areas. While thinking and consciousness are clearly energy demanding activities, the efficiency of energy utilization is remarkable.

We have developed a hypothesis for defining consciousness as the outcome of sensori-motor actions evolving into the earliest types of communicative behaviour. Such acts are seen when the mechanisms for emotion develop in the course of evolution as first described by Darwin. The role of emotion is conceived as a key strategy which has evolved to moderate neural functions to enable the most efficient utilization of energy in the brain. The goal of this strategy is to ensure that actions can be carried out on the basis of incomplete information (in probabilistic terms). The 'sine qua non' of consciousness is therefore the subjective mental state of emotion which determines the objective actions that follow. Herbert Simon's definition of "hot" and "cold" cognition is therefore implausible although his thermal metaphor is most appropriate for our thermodynamic approach to emotion as consciousness. The evolutionary and neurobiological basis for our hypothesis for the emergence of emotion as consciousness will be reviewed in conjunction with our current approach which seeks to understand the organization of the energy cost of mental activity using temperature measurements in the brain. One of the recent PET scan findings by Raichle et. al. on the obligatory role of limbic structures in learning of new words was predicted by our hypothesis in 1978.
A Neural Network Model of Dissociative Disorder

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An analog model of dissociative disorders testable by neural networks is proposed. Similar model of "prefrontal" network, put forth by Dehaene and Changeux (1989), allows for central executive modulation of lower order perceptuo-mnemonic networks. Such a structure may relate to the dissociative aspects of awareness if the assumption is made that a disconnection between executive and perceptuo-mnemonic aspects underlies dissociation. Under this assumption, an active perceptuo-mnemonic network is conscious while an upstream executive network receiving inputs from the lower order network is self-conscious (i.e., processing the information of the "conscious" network). The functional and temporary nature of the "forgotten" or dissociated material is dealt with in the dynamic synaptic weights of the network. This process is analogous to language acquisition in polyglots in the following way:

(a) the native language is part of a rich semantic network not requiring effortful processing; (b) a second and a third language are added, both accessed through the native language; (c) if the third language becomes the primary language used, the synaptic weights between the native language and the two second languages will reset, favoring the route to the third language; consequently, the second language is forgotten; (d) as the third language becomes integrated into the rich semantic network (i.e., it becomes as automatic, or non-effortful, as the native language), the synaptic weights reset and the second language is remembered.

This model can be tested by fully training a network until the synaptic weights have stabilized, analogous to the automatic semantic network of the native language. The network is then trained for different inputs but only partially, analogous to the effortfully processed second language. At this point, the third set of inputs is entered and retrieval of the second set of inputs is tested at two points in time: The first test takes place before stabilization of synaptic weights on the third input set has occurred; the second testing takes place after such stabilization has occurred. It is hypothesized that (a) during the first testing, the second input would be irretrievable (dissociated), analogous to loss of the second language before the third language has become automatic; and (b) retrieval of the second input set would be possible during the second test after the third input set has been completely trained.

This model is analogous to dissociation of material/information relating to the state of the network operative at the time of a traumatic event. Such a dissociation would be unavoidable because of the synaptic resetting. Only as the trauma becomes fully incorporated into the network (analogous to automatizing the third language) are the synaptic weights reset and the dissociated material/information retrievable.

Hypothetical anatomical substrates and evolutionary/adaptive bases of dissociative disorders will also be discussed.
Quantum Coherence, Quantum State Reduction, and Consciousness

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There are good physical reasons for believing that the standard procedures of quantum mechanics will need profound modification at the level where quantum superpositions of appreciably different mass distributions are involved. In this way, the phenomenon of quantum state reduction becomes a real physical process, independent of any external observer. Such a viewpoint has important implications with regard to the application of quantum mechanics to the action of the brain.

It is argued that such a modification of the standard quantum-mechanical rules is also needed in order to explain the non-computational aspects of conscious mental activity. Accordingly, we must look for aspects of brain structure where the quantum/classical interface has a significant input to brain action if we are to locate a plausible location for the non-computable physical action responsible for consciousness. It is further argued that the most plausible place for this input is in neuronal microtubules, where large-scale quantum coherence is feasible, in an interplay with the computational action of tubulin dimers.
I will argue the following theses:

1. Consciousness serves the function of allowing a system to distinguish itself from the rest of the world, conferring a point of view on the system.

2. Consciousness within a system therefore entails that it model (relevant parts of) itself; this is a theme also argued by Kihlstrom.

3. The self-distinguishing function in turn facilitates the function of making error intelligible, and thus potentially detectable and correctable.

4. Dennett’s multiple drafts idea fits nicely into the above, and suggests a canonical “narrative self-history” that may be immune to his negative arguments that consciousness is a fiction.

5. The appearance-reality distinction (ARD; see Flavell et al) of cognitive/developmental psychology also fits into this, though with some unusual suggestions.

6. Some affective and personality characteristics may have at least metaphorical interpretations here.

7. There is a built-in (not derived) semantics, or intentionality, in the above.

8. Searle’s Chinese Room has a natural interpretation as well.

9. There is some sketchy evidence from neurophysiology.

In brief preview: Consciousness is an aspect of intelligence, hence of the ability to deal adaptively with the world. In particular, it allows for the possibility of noting and correcting a system’s own errors. This in turn requires a robust self-model M, a world model W, and a process by which W becomes seen as merely the system’s beliefs about the world (hence part of M) while the actual world is possibly different. This is simply the ARD and is well-established in humans from about the age of four on; the error-theory suggests it may in fact arise much earlier than age four. Finally, AI systems gain much power when the ARD is incorporated into them.
Discourse, Dreams and the Dawn of Modern Consciousness
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The evolution of increasingly complex life forms has resulted in
degrees of consciousness (a fully conscious butterfly is less "aware" of
the world than is a fully conscious frog, itself less aware of the world
than a fully conscious German shepherd). Likewise the self
consciousness of modern humans must have evolved by degrees, its
expression in scientifically educated humans of 1994 exceeding that in
our Homo erectus ancestors of 1.5 million years ago. This paper argues
that modern human self-consciousness is a linguistic artifact, a product
of our human ancestors having developed a code of discourse relations
that for the first time allowed them to relate utterances not merely to the
here/now world they inhabited but to other utterances—allowed them in
short to create a world of discourse from whose perspective they might
evaluate and shape the here/now world they shared with the rest of
sentient life.

This paper first sketches (as typical) the generative discourse code—
the hierarchy of recursive discourse relations—that enables speakers of
English to create coherent discourse. Then it suggests that such a code
would have enabled human beings for the first time in human history to
have created a human history, a narrative by means of which humans
escaped here/now awareness. The paper speculates that, though our
species biological brain may have been capable of learning this code a
million years ago or more, this code was not fully operative till about 50
KYA. One result of our wiring our biological brain with this discourse
code is that the narrative "voice" that then enabled us to monitor our
waking moments was also available to monitor our dreams and thus, for
the first time, to bring dreams into waking, conscious awareness. The
final speculation is that the "creative explosion" expressed from 30,000
years ago in cave paintings, amulets, burials, body ornamentation, etc. is
the result of our ancestors' having become aware of dreaming and of the
spirit world that dreaming implies.
Anesthetics effecting the dissolution of consciousness, are reported to operate on the cytoskeleton of dendrites. But consciousness consists of several distinguishable processes that build on those occurring in the synaptodendritic network. These higher order processes will be delineated and their relation to a unitary ontology described.
The aim of this paper is to discuss the relevance of the ontological interpretation of the quantum theory (Bohm & Hiley 1993) to the mind-body problem. Before tackling this specific aim in section (3) let us first consider some general issues worth keeping in mind when searching for the scientific basis for consciousness and making use of the quantum theory in this search (sections (1) and (2)).

(1) Mind vs. Consciousness It is crucial to consider the relationship between concepts like "mind" and "consciousness", if only to understand the traditionally prevalent theories in the philosophy of mind and cognitive science. Many researchers refer by "mind" or "mental" to processes that are in principle nonconscious but not necessarily reducible to purely physical processes. Often such "mental" but nonconscious processes are representational and content-involving and exhibit the feature of intentionality or "aboutness". At the same time there are those who, like John Searle (1992), seem to equate "mental life" with "conscious mental life". In this paper I follow the mainstream and use "consciousness" to refer to phenomenal and subjective experience while "mind" refers to representational processes which can be unconscious.

(2) The Quantum Theory Needs an Interpretation There is, after 70 years of debate, still no consensus about the correct interpretation of the quantum theory. Unclear areas include the nature of individual quantum systems (the result of the so called wave-particle duality), the relation between the micro and macro levels (related to the measurement problem), nonlocality, and how to understand the concept of probability at the quantum level. Different interpretations of the quantum theory can be seen as different hypothesis aimed at clarifying these problems. It is often useful to specify which interpretation of the quantum theory one is considering when applying the theory to questions like the mind-body problem. In fact, it is usually a particular interpretation of the quantum theory which seems to have some interesting implications for the mind-body problem, not the quantum formalism as such. In this paper I will be focusing on the relevance of the ontological interpretation of the quantum theory (Bohm & Hiley 1993) to the mind(consciousness)-body problem.

(3) The Ontological Interpretation, Mind and Consciousness I suggest that the ontological interpretation of the quantum theory provides a radically new way of characterizing the place of mind in nature, at least insofar as "mind" refers to primarily representational processes which are unconscious. This is so because in this interpretation the quantum wave function psi describes a new type of field which can be seen as representing the environment to the particle (instead of pushing and pulling it as a classical field would do to a particle) (Bohm & Hiley 1987, 1993). The possibility that there are primitive representational processes even at the elementary quantum level makes it plausible and intelligible that there should be more developed representational processes at higher levels with more complex systems. What is implied is a new way of "naturalizing intentionality" (Pylkkanen 1992; c.f. Fodor 1990). At the same time the representational and holistic features of quantum processes may play a more direct role in the brain processes which have to do with mind and perhaps even consciousness (Bohm 1989, 1990). I suggest that the crucial question here is whether the quantum theory points to some new (e.g. "holistic") mode of representation (Pylkkanen 1992). Regarding consciousness I suggest that the holistic features of the quantum field may make some phenomenal features of
consciousness, such as its unity, more intelligible. At the same time I consider the difficulties of reconciling the subjective, "first-person" quality of conscious experience with any physicalistic "third-person" account of the brain, including a quantum physicalistic account.

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Elementary Metaphors of Everyday Speech and Their Implications For a Theory of Consciousness.

Ellen Questel, Ph.D.

ABSTRACT

An examination of the metaphorical content of everyday speech suggests important implications for a theory of consciousness. Focussing on the double function terms first studied by the psychologist Solomon Asch (those elementary and ubiquitous metaphors which use the language of naive physics for the psychological description of people), the author explores the notion that these and other related metaphors describe interactions that are experienced as formally similar, that is, which are isomorphic. The idea that these terms refer to concrete "perceptual concepts" is elaborated upon and discussed in relation to underlying theoretical issues concerning the nature of perception and its relation to thinking. It is argued that the usual dichotomy between perception and thinking cannot be maintained in light of what is known about the active, organizing aspects of perception. The work of Rudolf Arnheim on the psychology of art is discussed in this regard.

Special attention is given to the theoretical perspective of Gestalt psychology and its challenge to traditional atomistic views of perception and cognition—those basic tenets which, despite this challenge, remain remarkably persistent in both psychology and linguistics. Consonant with the approach of Gestalt psychology and certain newer work in the field of linguistics, an interactive theory of meaning and mind is proposed that neither reduces consciousness to the arbitrary and purely subjective, nor treats it as a passive mirror of so-called objective reality.

Viewed from this holistic and interactive perspective, traditional dichotomies of literal/metaphoric, subjective/objective, and mind/matter are reconsidered. It is proposed that in a very particular sense, metaphor can be viewed as quite faithful to direct experience, and it is proposed that the poetic sensibility may in fact represent a primary mode of apprehending the world. Some further speculations on the wider implications of this approach follow.
DOES UNIVERSAL CONSCIOUSNESS EXIST?
Emerging Logic of the Periodic System of Elements, Genetic Code and Human Consciousness

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There are many approaches to investigate consciousness. We propose one which use logic (from ancient Greece logos, something what was at the beginning).

In the scientific work of D.I. Mendeleev, especially his original works, three important aspects of periodic law were examined, which in 20th century science have never been adequately understood. These are: (1) the system relations among elements, (2) spaciousness (three-dimensionality, and (3) cyclicity. In fact these aspects are of the great importance today when it is being demonstrated system entity, spatiality, periodicity and cyclicity are the most important characteristic of the genetic code.

This paper, in fact deals with very topic: the chemical code, built on the very principles mentioned and in complete accordance with the genetic code. Such a surprisingly simple model at the same time represents the Logical-Informational and Geometrical-Homeomorphic-Topological (LIGHT) system of the cube-hypercube with an inscribed sphere-hypersphere.

This paper also shows that all the relations in the chemical code and the genetic code are in accordance with periodicity and cyclicity of the natural number system with the base \( N_1 = 2^n \) (\( n = 1 \ldots 6 \)) and \( N_2 = 2(2n+1) \), where \( n = 0, 1 \ldots 5 \). These mathematical number systems lead to the Golden Mean, as one of the most important law in the Nature.

Human consciousness in some specific way express itself through the masterpieces like Goethe, Shakespeare, Tolstoy, Njegos have written. We fined that their masterpieces have been written by same law as the chemical and the genetic codes possess, Golden Mean.

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NEURAL NETWORKS, BRAINWAVES, AND IONIC STRUCTURES: 
BIOPHYSICAL MODEL FOR STATES OF CONSCIOUSNESS

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It is shown that neural networks with embedded "brainwaves" can cross the gap between the fast parallel unconscious mode of neuroscience and the slow serial conscious mode of psychology. The electromagnetic (EM) component of ultralowfrequency (ULF) "brainwaves" appears to enable perfect fitting with narrowed limits of conscious capacity in normal awake states and very extended limits in altered states of consciousness - due to the biophysical relativistic mechanism of dilated subjective time base. It also enables the mixing of the normally conscious and unconscious contents in altered states, due to the relativistic Doppler mapping of EM component of the "objective" ULF brainwave power spectrum on the zero-degenerate-frequency "subjective" one. An additional low-dielectric ($\varepsilon \approx 1$) weakly ionized gaseous neural network is necessary in these processes. This structure can be related to a displaced (from the body) part of acupuncture ionic system which can conduct ULF brainwave currents $\sim 10^{-7}$ A, inside the conductive channels of the initial ionic concentration $\sim 10^{15}$ cm$^{-3}$, with a tendency of deterioration during a period of $\sim 1$ hour. The ionized gaseous neural network, with embedded ULF brainwave currents, enables that "objective" distances can be "subjectively" optically recognized as much closer in altered states - due to the relativistic mechanism of the length contractions. Even some peculiar anticipating abilities of psyche are predicted in nonstationary altered states ($\varepsilon \approx 1$-const.) during the interchange of normal and altered states of consciousness, due to the relativistic mechanism of time dilatation in noninertial "subjective" reference frame. All that provides an extraordinary biophysical basis for traditional psychology, including short-range and long-range transpersonal interactions and experiences down to the ultimate state of thoughtless consciousness. Notions, such as "qi", "subtle body", and "causal body", are physically inevitably associated with ions, displaced (from the body) part of acupuncture ionic structure, and in it embedded an EM component of ULF brainwaves, respectively. It should be pointed out that the above successes of the model finally provide possibility to incorporate consciousness inside new scientific paradigm, implying that consciousness is subtle internal display in the form of electromagnetic component of ULF brainwave ionic currents. The extended paradigm might have great influence on fundamentals of neurosciences, psychology, medicine, biology, physics and computer sciences, with significant philosophical and religious implications.

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The Emergence of Life - and Consciousness? - Through Self-Organization of Matter

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We shall discuss some of the fundamental properties of consciousness in light of the fundamental properties of life. Thus, we shall not be discussing consciousness at the level of humans, but rather at the level of single cellular organisms.

We take this approach because the experimental as well as the theoretical understanding of life is more advanced than the understanding of consciousness and because there are reasons to believe that life and cognition - and thus consciousness - are intimately related. Most of the essential properties of living systems, such as, self-replication, metabolism, evolution, adaptation and death, can currently be produced in the laboratory as well as in simulation. However, there is still no convincing system, either in the laboratory or in the computer, that integrates all of these properties as they are seen in the contemporary cell.

How is life then related to cognition and consciousness? What are the "fine grains" of cognition, the elements or objects from which cognition emerges? Are they the same as the "fine grains" of life? Is there hope for a dynamical (= computational) foundation of life? Is there hope for a dynamical foundation of cognition? If there is, what would be the crucial properties of such a dynamics?

We shall discuss the above questions through two simple exercises: (A) a simple self-organizing physico-chemical system where molecules self-assemble to polymers and where the polymers can self-assemble to form vesicles, and (B) a conceptual analysis of the dynamical properties of life.

The major conclusions are: (i) that there are good reasons to believe that there exist a dynamical foundation of life because the self-programmable - or constructive - properties of matter can create novel structures with non-decidable properties, in the Goedel sense, as suggested by N. A. Baas; (ii) that the attempts to understand life inevitably confront us with foundation questions in physics as well as with philosophical questions about the definition of reality which are similar to the conception of the "Meaning Circuit", suggested by J. A. Wheeler; and (iii) that the emergence of life implies the emergence of cognition - and with that the most primitive form of consciousness, as suggested by S. R. Hameroff.

Description of Visual and Text Materials to be Presented:

A Projective Differential (PD) response is a rapidly made forced choice of the single abstract picture, appearing in a pairing of pictures presented side-by-side, which "somehow seems more like _____", with a topic filling the blank (e.g., a concept, object, quality...). Over a period of two decades, research has shown, perhaps surprisingly given the ambiguity of the pictures, that (1) subjects make the seemingly non-rational PD choices readily, (2) there is consistent agreement in choices among respondents, including samples from different cultures, e.g., American, South American, Japanese and European, (3) the patterns of choices across a set of PD pairings discriminate between topics, (4) PD choices predict other behaviors (e.g., ratings of the same topics on verbal instruments, voting or brand choice intentions...), (5) PD results avoid verbal response biases, allowing more direct measurement of subjects' reactions to topics and/or access to measurement of unconscious processes, (6) reliable and valid attitude scales have been constructed from PD instruments consisting of four to ten items.

The PD response phenomenon is robust. Variations in lighting conditions, sizes of the stimulus pictures, viewing angle, and the order of pairing or topic presentation only modestly impact results. PD responses bridge conscious awareness of a topic and visual perceptions of the abstract pictures. PD responses do this bridging in a manner having profoundly large amounts of information about respondents' orientations toward the topic enfolded within them.

The PD task should be useful in consciousness research. For example, psycho-physiological or neuro-physiological measurements could be recorded during the PD task. While the subject concentrates upon the topic, the two pictures are displayed briefly, with 0.2 to 1.0 seconds working best. Longer periods allow minds to wander too much, with a resulting degradation in the degree of consistency in responses among subjects. The experimental conditions can be carefully controlled (the pictures presented, the duration of their exposure, the topic, the response time...). Although our experience has only been with human subjects, we have little doubt that chimpanzees or dolphins could be trained to perform ambiguous PD tasks.

In this poster session, photographic (or videotaped) examples of PD pairings will be shown along with empirical data related to the research findings outlined above.
Positron Emission Tomography and the Conscious Experience of Emotion

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Positron emission tomography (PET) was used to investigate the neural substrates of normal human emotion, characterize their relationship to the nature of the emotional elicitor, and provide clues about their role in the dissectable components of emotion. This study was designed to elicit potent target emotions, measure these emotions, and control for aspects of the elicitor unrelated to emotion.

Twelve healthy female volunteers each had 12 measurements of regional cerebral blood flow as they alternated between emotion-generating and control film and recall tasks. Three silent films were employed to elicit subjectively, facially, and electrophysiologically well characterized emotions, happiness, sadness, and disgust; three additional film tasks were employed to control for aspects of the film task unrelated to emotion, such as emotionally irrelevant visual stimulation and eye movements. Scripts of three recent experiences were used to elicit the same target emotions; scripts of three other recent experiences were used to control for aspects of the recall task unrelated to emotion, such as emotionally irrelevant recall memory and visual imagery.

For each kind of elicitor, the average of the three emotion PET images was compared to the average of the three control PET images. An adaptation of the statistical parametric method was employed to compute normalized t-score maps of blood increases during film-generated emotion, blood flow increases during recall-generated emotion, and differences between the blood flow increases during film- and recall-generated emotion. These images were superimposed onto an averaged brain magnetic resonance image.

Film- and recall-generated emotion were each associated with significant blood flow increases in the vicinity of the thalamus and prefrontal cortex (Brodmann's area 9). Film-generated emotion was distinguished from recall-generated emotion by significant and significantly greater, symmetrical blood flow increases in the vicinity of occipito-temporal and temporopolar cortex, amygdala, hippocampal formation, hypothalamus, and lateral cerebellum.

The thalamic and prefrontal regions appear to participate in elicitor-independent evaluative, expressive, or experiential aspects of emotion. In their studies of "sham rage," Cannon and Bard implicated the anterior thalamus in the integrated expressions of emotion. Kihlstrom postulated that the difference that makes for consciousness is the connection between cognitive or perceptual processes and an integrated representation of the self which resides in working memory; since the prefrontal region has been implicated in working memory, it could be involved in the conscious experience of emotion.

The amygdala and hippocampal formation are limbic structures long postulated to be involved in the generation of emotion. These regions appear to be involved in the evaluation process which invests sensory stimuli with emotional significance; they appear less relevant to the evaluative, expressive, or experiential aspects of internally generated emotion.

PET studies of emotion, implicit and explicit memory, implicit and explicit perception, and other cognitive processes promise to help characterize the neural substrates of conscious experience.
ABSTRACT

Brain-injured patients who manifest no explicit comprehension of the meaning of linguistic stimuli can still show implicit processing of similar information (for a review, see Schacter et al. 1988). In most studies, this phenomenon has been studied using lexical decision tasks or other comparable behavioral reaction time measures (Milberg & Blumstein 1981; Blumstein et al. 1982, Milberg et al. 1987; Young et al. 1989; Tyler 1992). Such methods, however, do not tell whether the implicit effects originate in an automatically activated word-recognition system, or at the level of the conceptual system (Young et al. 1989).

Here are reported the case studies of two global aphasics who show implicit semantic activation which cannot be attributed to the purely automatic lexical level. Both of them were unable to differentiate semantically congruous sentences from semantically incongruous ones at a level supporting conscious decisions. When listening to such sentences, their auditory event-related brain potentials (ERPs) were recorded using 20 scalp electrodes. Their ERPs to incongruous final words in the sentences were different from those to congruous final words in otherwise similar sentences. The differences in the patients' ERPs are comparable to those of 17 elderly control subjects whose ERPs for the two different types of final words differed significantly from each other both in the N400 and the Late Positivity time window.

One of the patients was additionally unable to match written color words with the corresponding colors and he participated in a further study. In this Stroop-like reaction time task there were two conditions. In the Congruous condition, the word "red" was written in red letters, and the word "blue" in blue letters. In the Incongruous condition, the word "red" was written in blue letters, and the word "blue" in red letters. The subjects were instructed to react only to the color of the letters by pushing the reaction key with the corresponding color, disregarding the written word. The reaction times of the control subjects to the colors of the letters were significantly faster in the Congruous condition than in the Incongruous condition, thus showing the Stroop effect. The globally aphasic patient who had no conscious access to the meanings of the words nevertheless showed the same pattern of reaction times as the controls in this task.

Both the N400 method (Kutas & Hillyard, 1980) and the Stroop method (Stroop, 1935) arguably tap the conceptual-semantic system, not only the word recognition system (Pratarelli 1994; Stuart & Carrasco 1993). Thus, the present study shows, first, that implicit processing of language can proceed beyond the linguistic input system and reach representations at the conceptual-semantic level. Second, it shows that the N400 can be dissociated from the conscious recognition of semantic incongruency. Third, it shows that even globally aphasic patients with severe comprehension deficits can manifest preserved implicit processing of language, both behaviorally and neurophysiologically.
REFERENCES


Several recent philosophical theories of consciousness are extrinsic theories, holding that an event involves consciousness only if it is related to another thing of an appropriate kind in a specified way. These theories encounter various difficulties, several of which have been pointed out by myself and by others. In the present paper, these theories and their difficulties are reviewed very briefly, as background to the main task of developing an alternative account that will both avoid the difficulties and speak to the needs of neurophilosophy and the philosophy of psychology.

According to this alternative account, which is an intrinsic theory, pains and afterimages are examples of conscious events in the most basic sense — most basic, because other cases of consciousness are understood partly by their relations to events of this basic kind. The relations between basic conscious events and some of these other cases are explained. The question of unconscious pains is briefly discussed. The empirical character of certain questions regarding the occurrence of conscious events is considered.

Some of the properties possessed by basic conscious events, for example, datable occurrence, are shared with nonconscious events. The question thus arises as to what properties are distinctive of or essential to conscious events. It is argued that the answer can be found in "homogeneous" properties, i.e., properties that can be inherited by parts under arbitrary divisions. The contrast is with structural properties, which are neither homogeneous nor exclusive to conscious events. The relation between homogeneous properties of basic conscious events, their distal causes, and their proximal causes is clarified. Several kinds of structural properties in basic conscious events are identified.

The prospects for neural investigation of causes of basic conscious events are examined. It is argued that the situation is asymmetrical for structural vs homogeneous properties: A plausible (and in principle testable) hypothesis is that there are isomorphic correlates of structural properties to be found in the brain; but, for homogeneous properties, only correlation (and not isomorphism) is to be expected. It is also briefly argued that there is no reason to suppose that there is any small region of the brain that functions as a center in which proximal causes of basic conscious events must be located.

Finally, the bearing of intrinsic consciousness theory on the consciousness/brain problem is investigated. An explanation for the intractability of this problem is given by reference to the different relations that hold in our conceptual scheme between scientific theorizing and structural properties, on the one hand, and between scientific theorizing and homogeneous properties (which lack structure) on the other. Although this explanation is not a solution, it does point the way to the kind of conceptual development that may dissolve the problem.
SUMMARY

Consciousness is nothing more than an emergent computation that is a direct result of some minimal number of Miller chunks. The fundamental assumption of this presentation is that all untestable hypotheses are false and must be disregarded. Consciousness cannot be attributed to anything mystical. It is a computation, as is the mind. It is not assumed that the full 7+2 chunks are required for self-awareness. These experiments are discussed. The first is a left-right mirror illusion. When observing an appendages motion in a mirror there is a conflict associated with the apparent flip. It is proposed that some minimal ability (expressable in chunks) to project one's view is necessary to see this illusion. The second experiment discusses attempts to add chunks to a natural language conversational program. The goal is to investigate the number of chunks necessary to achieve some Turning perception of consciousness. The third experiment discusses our efforts to build a deja vu display. The display uses induced saccades to get the temporal/spatial synchrony out of sync to build a deja vu display. The display uses induced saccades to get the temporal/spatial synchrony out of sync.
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Processing of Single Potentials Elicited From a Working Human Brain  
can Become the Technique for Studing Consciousness-Linked Phenomenon.

The technique of recording and processing of single visual (non averaged) evoked potentials (SVEP) was developed. It is due to the fact that in part of normal subjects the amplitude of SVEPs were found to be 3-4 times larger than in the population at-large. This means that they can be studied without time locked averaging - single VEP after single VEP - and for the first time the several new variables connected with VEPs can be studied while the human brain is engaged in different experimental paradigms or cognitive tasks.

In addition to the usual average amplitudes and latencies of VEPs, we are studying: (1) amplitudes and latencies of VEPs (for peaks N80, P100, P140), (2) standard deviations of amplitudes of SVEPs ("swell"), (3) standard deviations of latencies of SVEPs ("jitter"), (4) the distribution of amplitudes of SVEPs, (5) correlations between above mentioned parameters. This introduces a many-fold increase of information which can be obtained by a non-invasive method from the working human brain and studied a short time thereafter. The quantity of a new variables can be increased in the future.

It was found that the SVEPs have their own variability reflecting the brain processing. This variability can be studied in connection for example to "evrika" phenomena, in problem solving and to other consciousness and sub-consciousness linked phenomena. The possibility of studying several new variables can lead, as we hope, to progress in many problems of human neurophysiology and, especially, in the diagnosis of mental states of brain activity, including the altered states of consciousness.

Our group included during this time:

Gershom-Zvi Rosenstein; Vladimir Furman; Haim Sohmer. (All from Department of Physiology, Hebrew University-Hadassah Medical School);

Yosef Attias, Head of Research Institute of Noise Hazards and Laboratory of Evoked Potentials, Sheba Medical Center, Israeli Defence Forces.
The idea of this presentation is stolen from the talk of James Ranck /SUNY/ during his visit to Tucson on March 21. First, I am not sure that the word "superattractor" that I would like to introduce here is nice and appropriate for this situation. I was considering some alternatives like "topological neural networks", "self-stabilizing", "constrained", "externally driven", etc. Eventually I asked few mathematicians and learned from them that there is no special term for this situation since it has not being studied separately from the general case of a dynamical system. However, later Bruce McNaughton told me that Daniel Amit and Misha Tsodyks are already thinking in this direction.

The case that I am talking about is a dynamical system, e.g., a neural network, that has a continuous rather than disjoint set of attractors (or, using terminology of Ranck, the set of all "physically possible states" of the network) which is a manifold embedded into the phase space of the system. I call this set a superattractor. It also could be called a connected non-transitive global attractor, however I do not like this term because i) it may become transitive in the presence of an external force and ii) I would like to think about it in a general way, considering each element of the set as a potentially realizable temporary attractor: not necessarily a point in the phase space, it might be a limiting cycle or even a chaotic attractor as well.

The idea is the following. Let us consider the usual Hopfield model with Hebbian learning rules. Everybody knows how to store two distinct patterns in this case. A slight and obvious modification of the rules allows one to store a line in the phase space connecting these two patterns, an extended object. Okay, in this example it will be a discrete set of points, since the phase space is discrete. But there are NN models with continuous freedoms, in that situation one possibly can store an extended object (line, circle, sphere, etc.) by similar rules. Let us take for granted now that it is possible, and the system will remain in irrelevant equilibrium at any point of the manifold.

This, however, may be not enough since any small perturbation can destroy stability. But if we assume small short term synaptic efficacies modification by the present pattern itself, then the pattern can be self-stabilized thus becoming a temporary attractor of the system, provided it is a point of the stored manifold (superattractor). Actually here we have to introduce another set of dynamical freedoms at each synapse that are relatively "slow" and can be considered as quenched variables during analysis of the fast dynamics.
Psychopharmaceuticals and the Philosophy of Mind

Despite a general interest in empirical results, philosophers of mind have almost entirely neglected certain kinds of clinical data. In particular, they have had little to say about the increasing success of the use of pharmaceuticals in the treatment of psychological disorders. It is usually assumed that this development provides support for a reductionist view of mind. My conclusion is that this assumption is unwarranted, and that a more careful analysis of the actual role of psychopharmaceuticals in the clinical context suggests a new kind of materialist view of mind which is intermediate between reductionism and non-reductionism.

Philosophers of mind who have rejected dualism assume that there are only two possible strategies for defining the relation of mind to body. Reductionists believe that psychological explanations must ultimately be eliminated in favor of physical ones. The idea is that accounts couched in psychological terms are simply placeholders we must use until we have discovered the full physical story. Non-reductionists, on the other hand, believe that an autonomous psychological level of explanation must be preserved, and that physiological and psychological accounts of human behavior must be viewed as independent.

Each of these approaches has faced serious difficulties. It is generally assumed, however, that advances in neuroscience favor the former. For instance, it is usually taken for granted that the widespread and successful use of psychopharmaceuticals suggests that the traditional psychological explanations for psychiatric disorders should be replaced with physical explanations. A careful look at the data reveals, however, that this is far from accurate. The most successful uses of psychoactive drugs indicates a need for psychotherapy, and suggests an account of psychological illness that involves a complicated interaction between both psychological and physical factors. The data thus support neither a reductionist nor a non-reductionist view, but a view that mixes levels of explanation.

Philosophers of mind have not usually considered mixed-level views, because they consider causal interactions between mind and body to be too mysterious to be helpful. The accounts of psychological illness coming out of the clinical setting demystifies these connections and shows how they can do explanatory work. These accounts thus provide a model for a general conception of psycho-physical interaction which in turn promises to have important implications for the more fundamental question of the place of consciousness in the natural order.
The diverse theories of the [nature, mechanisms, explanation] of consciousness are subsets of the total [possible, generally valid] contents of [cognitive, conceptual] consciousness. Universally [implicit, necessary, applicable] axiomatic predicates of the [nature, structure] of these possible contents provides a necessary scientific epistemological [reference, constraint] framework for all scientifically realistic [theories, definitions] [in general, of consciousness in particular]. Thus any really [fundamental, comprehensive] understanding of consciousness should be generally cognizant of the ultimate [range, scope, nature] of what it is ultimately possible to be conscious of—i.e. of ultimate reality. Achieving such scientific epistemological closure shows that the [proper, consistent, complete] domain of science must be [universal, recursively, relationally, operationally] consistent, i.e. [completely, metaphysically, ethically, epistemologically] realistic science necessarily includes all [types, fields] of (valid) conceptual knowledge. This process is analogous in [nature, power, productivity] to the mathematical evolutionary [developments, generalized extensions, increasingly universal [domain, range, operator] closures] of the number concept series of [rationals, reals, complex, vectors, multi-vectors].

The most genuinely fundamental scientific ["theories of everything", "grand unified theories"] logically are [necessarily, inherently] based on the [monotonic, truth-value [conserving, relative, centric]] [consistent, [invariant, identity] preserving, unbounded] [recursive, self-referential] closure theories of "the science of science (itself)—i.e. [self, recursion, universally]-[consistent, closed] scientific epistemology. We summarize the (presently known) [Universal, Supreme, Absolute] (USA) axioms (i.e. the [logically, rationally] [necessary, undeniable] [scientific, universal] predicate set of all [reality, rationality, values, life, [cognitive, conceptual, conscious]] action, perception, knowledge, thought, discovery, invention]. These are the most fundamental (known) [conceptual, epistemological] [dimensions, basis set] of the universe which describe the [inherently, scientifically] [integral, fundamental] [foundations, relations] of [existence, identity, causality, life, values, ethics, consciousness, knowledge]. This is an early [integral, fundamental] [development, evolution] theory of universal-in-scope scientific [ethics, epistemology, metaphysics] necessary conditions [implicit in, underlying, delimiting] the [proper, valid, effective] domain of conceptual [production operators, integrity filters]. The practical [scientific, technological, economical, social] [applications, consequences] of the USA axioms (and their [axiomatic corollaries, derivatives of all orders]) is termed the "Second Scientific [Revolution, Renaissance]" (S²R²). The USA axioms are the most [scientifically, generally, commonly, universally] [valuable, practical, highly leveraged] descriptive [abstract, scientific] knowledge in-as-much as they also form the [logical, lawful, quintessential, essential] [basis of, epistemological integrity filters for] the results of all possibly valid [thought, proof, discovery, invention] processes. The USA axioms are the [eternal, universal] [verities, invariants, irreducibles, spanning basis set, kernel] of all [possible, valid] types of [conceptual, epistemological] reductions.

The integral epistemological epicenter of universal science turns out to be the [ethical science, cognitive economics] of truth-value. Taken together, these cumulative results ultimately yield an absolutely [realistic, rational, practical] core [theory, foundation] of universal science which serves as an absolute [logical, epistemological, conceptual] reference frame for the other [less definite, more specialized] sciences. Universal science can be used [in conjunction with, to improve the efficacy of] the various scientific methods of the specialized sciences.

This theory has not yet been applied to theories of the detailed physical [mechanisms, dynamics] of consciousness; instead it aims at identifying the ultimate power of scientific consciousness to [know, act] [rationally, realistically] [in theory, in practice (by example)]. As such this program can be viewed as what the field of "artificial intelligence" should have discovered had it concentrated on [creating, improving] human intelligence [software, mindware, thoughtware]. Universal science can scientifically [filter, sort, rationalize, rectify, normalize, integrate] much of the often [confused, incorrect, inconsistent, incoherent, irrational, low quality, sophistic] content of the "soft" sciences that have previously defied distinctly rational treatment by scientific consciousness. Universal science can thus [discover, derive] superior [normative laws, future predictions]. The future consequences of scientific consciousness are far [better, different in character] than are generally [expected, predicted, appreciated]—indeed, contemporary scientific consciousness is already stumbling towards the $S^2R^2$.

Since this theory of scientific consciousness simply [identifies, explicates, differentiates, rectifies, extends, integrates] already established [concepts, trends], it should be able to substantially [smooth out, tune, accelerate] this general developmental trend. This particular theory [exemplifies, was aimed at finding] the most [important, valuable, productive, practical] known instance of all [general, specialized, presently developed] [macro, meso, micro] theories of consciousness.
"What makes an olfactory stimulus conscious? This presentation reviews recent research on EEG registration of subconscious and conscious odors. Data from low intensity odors, and selective anosmia for high intensity odors, suggest that the frontal cortex plays an important role in conscious experience in humans."
Abstract
The objective of this paper is to motivate a research movement for the formulation of guidelines and ethical standards with respect to the development and employment of artificial cognitive and adaptive systems. Given the phenomenal progress in research and development of such systems, the unprecedented number of schools, businesses and factions participating and the immeasurable power to be gained by its fruition, it is argued that such a committee is neither presumptuous nor premature. Rather, it is likely that the complexity and adaptive agility of such systems may grow unbound and unmeasured, guided only by the selfish foundations of competitive systems.

In defense, this paper integrates concepts and premises from genetic algorithms, dynamic systems, computability and complexity theory to motivate an emergent materialism perspective of consciousness as a summation of coupled dynamic processes. This perspective is expanded upon to develop a gradient scaling of consciousness with respect to the underlying physical complexity and efficiency of adaptation of an entity. The nature of such adapting entities is considered and mapped to other abstract complex systems such as social, economic and computing systems. Progress in neural systems is then addressed and the fundamental relations between neural and genetic systems are examined to emphasize their selfish motivations. Finally, the inevitable development of cognitive artificial systems is propounded and its possible ramifications are considered with respect to other expanding technologies such as robotics, communications and genetic engineering. In conclusion, some possible measures are proposed.
Self-Organized Adaptive Networks in Atmospheric Flows: A Model for Neural Networks of the Human Brain

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Abstract

The neural networks of the human brain act as very efficient parallel processing computers co-ordinating memory related responses to a multitude of input signals from sensory organs. Information storage, update and appropriate retrieval are controlled at the molecular level by the neuronal cytoskeleton which serves as the internal communication network within neurons (Rasmussen et al., 1990: Physica D 42, 428). Information flow in the highly ordered parallel networks of the filamentous protein polymers which make up the cytoskeleton may be compared to atmospheric flows which exhibit long-range spatiotemporal correlations, i.e., long-term memory. Such long-range spatiotemporal correlations are ubiquitous to real world dynamical systems and is recently identified as signatures of self-organized criticality (Bak et al., 1988: Phys. Rev. A 38, 364) or chaos. The signatures of self-organized criticality, i.e., long-range temporal correlations have recently been identified in the electrical activity of the brain (Pool, 1989: Science 245, 26). The physics of self-organized criticality or chaos is not yet identified. A recently developed non-deterministic cell dynamical system model for atmospheric flows (Selvam, 1990: Can. J. Phys. 68, 831) predicts the observed long-range spatiotemporal correlations as intrinsic to quantum-lime mechanics governing flow dynamics. The model visualises large scale circulations to form as the result of spatial integration of enclosed small scale perturbations with intrinsic two-way ordered energy flow between the scales. Such a concept may be applied for the collection and integration of a multitude of signals at the cytoskeletal level and manifested in activation of neurons in the macroscale. The cytoskeleton networks inside neurons may be the elementary units of a unified dynamic memory circulation network with intrinsic global response to local stimuli.

A cell dynamical system model for human memory circulation network analogous to atmospheric circulation network is presented in this paper.

Presenting Author: A.M. Selvam
Central to the first movement of phenomenology, to suspend all—natural attitude—worldly science, is the implication that fiction, phantasm, imaginations exist as the fundamental existent of consciousness. Pure consciousness, pure presence, finds signs-language-repetition, expression, inhabiting its enclosure, threatening its foundation at the very center (unity, idea, conception of ) in such a fashion as to displace the prevailing standard. Into this clearing, spacing, the image-object frees itself from objectivity and the delicacy of the image is granted.

Husserl's epoche opens the field of objectification to a play of imagination wherein the opposition—Idea-Thing—is effaced by a scene that resists any simple partitioning of consciousness-world being. Pure presentment, pure and primordial perception, taken as ground for classical and phenomenological psychology, is given over to the affirmation that "perception does not exist" (Derrida, "Speech and Phenomena," 1973). Into this field of "presence" and "absence" we interject a computer graphic field where these "characters" and character sets are set free to take a visible form. Capitalizing on the infinite variety of sensible-structures within the imaginative and the graphic power of current desktop computers, we have developed a computer graphics laboratory to accompany course offerings in Existential-Phenomenological-Hermeneutical Psychology. Initial motive for the development of computer images was to support the learning environment by providing a common forum for the showing of image-metaphors and themes that arouse in class pursuits. Text material, previously too difficult to penetrate, now became more accessible. Noticeably different "scenes" appeared during repetitive reading, yielding different appreciation's of meanings contained within the passages. We will report on the use of imagery in giving various textual meanings a graphic-animation character and on implications for a form of reading that takes a "greater" measure of the lived-world into its revealing. Specific projects include: temporality of consciousness—as given by Bergson, Merleau-Ponty, Husserl, Dewey & Levinas, Dasein being—Heidegger, Sartre, Sallis, Caputo, and transcendental consciousness—Husserl, Heidegger, Nietzsche, Levinas, Sartre.

*paper presenter
Conservation of the C-terminal Sequence EEEGEEY in the Brain Specific Alpha Tubulins across the Nematodes and Humans.

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Recently we have cloned and characterized the alpha-1 and alpha-2 tubulin genes of Caenorhabditis elegans encoding proteins that show a high homology to the vertebrate tubulins than from the yeast. (Fukushige et al., 1993). Remarkably, the C-terminal sequence EEEGEEY (Glu-Glu-Glu-Gly-Glu-Glu-Tyr) of the nematode alpha-1 and alpha-2 tubulins is identical to these C-terminal residues in the alpha tubulins from human, mouse, rat, chicken, and salmon isotypes that are primarily expressed in the brain tissue. To examine the tissue specificity of the nematode alpha tubulin genes, we have made the alpha-1::lacZ and alpha-2::lacZ fusion genes and studied their temporal and spatial expression pattern. Our data suggests that indeed both of these isotypes are expressed in the nematode nervous system, both during the embryonic and postembryonic development of the nematode. The alpha-1 gene is selectively expressed among others, in the six mechanosensory touch receptor neurons (ALML, ALMR, AVM, PVM, PLML, PLMR), and four classes of motor neurons (DA, DB, VA, & VB) in the ventral cord mediating locomotion. In contrast, the alpha-2 tubulin gene is expressed in two of the six touch receptor cells (PLML & PLMR), and DB and VB motor neurons in the ventral cord, and also in two non-neural tissues (20 intestinal cells, & 6 pharyngeal muscle cells). Thus, although the tubulins with the EEEGEEY are primarily expressed in the nervous system, this C-terminal sequence does not preclude the expression of such isotypes in non-neural tissues. This is supported from the tissue expression data of the alpha tubulin isotypes from human, and mouse which are known to prominently express in the brain tissue, but are also expressed at a lower level in non-neural tissue such as the lung. i.e. No alpha tubulin isotype with the conserved C-terminus sequence is strictly non-neural. The C-terminus domain is involved in binding to the brain specific dyenin, and other MAPS, and mediates inter protofilament bond in the assembly of microtubules. Since the nematode is amenable to genetic and cellular analyses, we plan to examine the role of the C-terminus sequence in the neural development.

VARS is a non-invasive, non-pharmacological means of inducing relaxation and/or a hypnogogic state. The technique requires minimal training and encourages patient cooperation for effect. The use of VARS can be applied to various aspects of anesthetic patient management.

VARS employs the use of a programmable pulse generator that pulsates signals to an audio headphone and LED-fitted eyepieces. Synchronized visual and auditory stimulation (flashing lights and pulsating tone) is delivered to the patient at varying frequencies.

With exposure to the VARS stimulus, the patients brain activity is entrained and affected as the intensity and frequency of the stimulus is varied in a controlled fashion. Entraining the patients brain wave frequencies towards the Theta and Delta stages should induce a relaxed state.

Potential Clinical Applications include use as a perioperative anesthetic adjunct, acute and chronic pain management, obstetrical analgesia, ICU psychological management.

The results of preliminary studies will be discussed.
Consciousness and its proper place in cognitive theory

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My paper's title is an obvious reminiscence of C.D. Broad's book *Mind and its Place in Nature*. 'Place' is a metaphor for the issue of the explanatory role, if any, for consciousness as a useful or descriptive concept in theories of cognition. Explanatory role can be either explanandum or explanans, or both. In the first case, consciousness (whether instrumentally or realistically construed) is part of what any adequate theory of human cognition should explain. I take it that Dennett's (1991)\(^1\) deflationary efforts paradoxically fit this characterization. Consciousness in the two latter cases, in naturalistic theories, is construed as a salient element in the overall explanatory model of human evolution. Flanagan (1992)\(^2\) has given us a clear outline of the integration of consciousness into a unified theory of cognition. Both these approaches share background commitments to scientific (and thus naturalized) assumptions that an acceptable theory of cognition must respect.

All the more noteworthy therefore is that in her book *What is Cognitive Science?* (1993)\(^3\), Barbara von Eckardt answers her own question without referring to consciousness at all, except in a brief paragraph in the Epilogue. Her detailed examination of the "framework of shared commitments" that constitute the community of cognitive scientists thus, in fact, finds no place for consciousness in cognitive theory. Her results raise two questions that bear directly on how we should proceed toward a scientific basis for consciousness. The first is whether the claimed factual case of cognitive science eschewing consciousness is well grounded. The second is, where it is true that certain conceptions of cognition disavow any theoretical role for consciousness, what are the reasons for this aversion to consciousness? There is of course a third question: Are the reasons good ones? The answer to this third question is explicit in my analysis of the first two.

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On the Relationship of Consciousness to the Physical World in the Theory of Quantum Mechanics

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A series of experiments in psychology supports the thesis that in the theory of quantum mechanics, consciousness directly affects the structure and functioning of the physical world. First, certain fundamental issues in quantum mechanics indicate the plausibility of this thesis. Among these features are (1) the nature of probability in quantum mechanics; (2) the relation of observation to the wave packet in quantum mechanics; and (3) the role of immediate change upon measurement in the quantum mechanical wave function throughout space. This third feature is the basis for the correlations between spacialike separated events found in the gedankenexperiment by Einstein, Podolsky, and Rosen (1935).

Einstein, Podolsky, and Rosen demonstrated that in quantum mechanics one may in principle immediately set up experimental circumstances with accompanying predictions concerning correlations for mutually exclusive pairs of spacialike separated events, predictions concerning which have been well-verified empirically. That nothing in the physical world prevents the immediate setting up of these different experimental scenarios indicates that it may be possible for these different experimental scenarios to simultaneously exist. The object of observation in quantum mechanics (i.e., the physical world) cannot be the basis for this situation, specifically the correlations for the members of the mutually exclusive pairs of spacialike separated events, because of the velocity limitation of the special theory of relativity. Instead, the factor upon which the simultaneous existence of these mutually exclusive pairs of spacialike separated events can be based is the subject in quantum mechanical observation (i.e., the human observer).

A research direction in psychology originated by Stratton (1896, 1897a, 1897b) on the affect of reversal of incoming visual stimuli on visual experience indicates that experimental circumstances such as those found by Einstein, Podolsky, and Rosen may exist simultaneously. This line of research indicates that individuals adapt to reorientation of incoming visual stimuli around the line of sight and come to see the world in much the same way that they perceived the world prior to reorientation of incoming visual stimuli. A gedankenexperiment is discussed that combines features of Stratton's work with fundamentals of quantum mechanics and which indicates that mutually exclusive circumstances of the type implied in the work of Einstein, Podolsky, and Rosen may exist simultaneously. There are implications from this gedankenexperiment for further research.

That mutually exclusive situations may apply to the same concrete physical circumstances simultaneously within the empirically well-verified theory of quantum mechanics, and that the simultaneous existence of these situations depends on a change in the status of the observer, provides support for the thesis that consciousness directly affects the structure and functioning of the physical world.
References


Phylogenetic mental evolution and the emergence of consciousness

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Skeletal, artifactual, and ecofactual remains of early humans provide the sole evidence for reconstructing the emergence of modern man. This archaeologic data can only be understood, however, by reference to an underlying theory which acts as an organizing principle and a framework for interpretation. For example, skeletal data are explained by physical anthropology whose foundation is the evolutionary theory of Darwinism. But artifactual and ecofactual remains provide data for an obvious concomitant to the physical evolution of the genus Homo, i.e., the evolution of mental capacities that are human's most distinguishing feature. The origin of the modern mind is probably the greatest of all intellectual puzzles, yet the exclusive source of data for this evolution has been essentially untapped. The reason is not that the importance of early human artifacts for mental evolution is unrecognized or that there has been a lack of effort expended in its analysis, rather, without unambiguous definitions of mental capacities and their relationships a coherent analysis is simply not possible. The lack of this framework prevents effective utilization of the available artifactual and ecofactual evidence. This paper hypothesizes a theory of mental evolution that provides a hierarchical set of analytic definitions of mental processes, including consciousness. The result suggests an interpretation of each individual artifactual class and a consistent global interpretation of the artifactual sequence. In particular, it provides evidence for the emergence of consciousness, as here defined, at an identifiable point in the archaeology of human phylogeny.
Towards a quantum theoretic understanding of consciousness

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ABSTRACT

The reason why consciousness automatically arises in any proper discussion of the foundations of quantum physics, as distinct to classical physics, will be discussed, and it will be shown that this remains true even in recent "realistic" interpretations of quantum theory. An attempt will be made to understand what the requirements of a satisfactory version of quantum theory can tell us anything about the nature of consciousness and its relation to the physical world.

(This talk will be extension of ideas to be published in *Synthese*. A copy of this article is enclosed).
BRAIN INJURED PERSONS IN AN ALTERED STATE OF CONSCIOUSNESS:
MEASURES AND INTERVENTION STRATEGIES
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Key words: Coma, Brain injury, Rehabilitation, Cognition, Outcome

Abstract
We evaluated the states of consciousness of seven persons who had sustained a severe head injury and
describe the behavioral manifestations associated with four treatment strategies. The subjects were between the ages
of 19 and 55 were recruited from both acute and long term care facilities; all were in an altered state of consciousness
(ASC). The severity of the injury was measured by time in coma, the scores on the Glasgow Coma Scale (1) and
the Coma Near Coma Scale (2). Structured interventions consisted of visual, auditory, olfactory, gustatory and
tactile stimulation; behavior was measured using the Disability Rating Scale (3-4) and a portion of the Levels of
Cognitive Functioning Scale (5). Sensory-motor indications were recorded using a questionnaire developed by
Freeman (6) and a quality of life instrument developed for use with individuals having multiple disabilities (7) was
adapted for the purpose of this study. Our results suggest that the use of structured interventions in the first 24
months following severe head injury is associated with a trend towards improved auditory and visual skills
performance, manual performance, swallowing and language. Whereas initially no subject had any form of
verbalization, by the final evaluation, five subjects had some form of communication, either verbal or non-verbal.

Although it once was accepted that patients in an altered state of consciousness were unlikely to benefit from
sensory and motor stimulation, a number of authors have recently contradicted this belief. Our project supports the
feasibility of using existing measurement tools to document the status of individuals in an ASC. Although neither the
Glasgow Coma Scale (GCS) nor the Glasgow Outcome Scale (GOS) can reflect subtle changes in sensory and motor
functions, the Freeman Questionnaire seems to demonstrate good potential in this regard. The items on this
questionnaire show good face validity in that they cover a spectrum of functions that have been previously identified
to be observable in those in an ASC and the range of scoring allows the documentation of small changes in status.

Nonetheless, some behaviors were not well captured by the Freeman, including the quality of verbalization
and the length of vigilance and attention. In addition, those items measuring prognostic and motivational factors
were not applicable in this group of subjects. While reliability and validity studies have not been published, the
Freeman scale appears valuable enough to warrant further tests of its measurement properties in those subjects with
ASC. This study was a first attempt to compare traditional forms of intervention to structured and goal oriented
interventions for those in an ASC. While the assignment of intervention type was not randomized, it could not be
controlled by the investigators; it is rather a question of resource availability. Our results suggest a potential positive
effect of structured intervention on the sensory and motor status of individuals in an ASC. Those receiving
structured interventions more often exhibited positive change scores in their status as compared to those receiving
traditional or family only intervention.

The structured intervention consisted of a team including health professionals and family members that all
worked towards a common and clearly defined goal. The team members met regularly to discuss the subject’s
progress and to adapt the intervention accordingly. While the semi-structured intervention did not emphasize a goal
setting and consisted of fewer sessions and professional resources it was still oriented in the similar direction. In
contrast, the traditional forms of intervention did not include interdisciplinary goal setting and the family intervention
provided the least resources. Thus, while there are too few subjects in this study to statistically confirm the
conclusion of a positive effect of structured intervention, our findings do suggest this potential and clearly invite
further research into optimal interventions for those in an ASC.

The last objective of this research was to relate our findings to some theoretical model. Posner and Rothbart
(24) suggested that different learning levels require three attentional mechanisms, all of which are related to
consciousness. The first serves as a “zoom” and is the orientation process; the second detects an event and may
result in verbalization and the third maintains the alert state permitting recognition of the stimuli. In this model,
orientation is dissociated from attention and consciousness, during information processing. Ericolo (22) identified
a form of vigilance without consciousness, a dissociation following Zangwill’s (25) principle and likely similar to that
described by Weiskrantz (26) as a “blindsight” phenomenon somewhere between attention and consciousness. Our
findings suggest that the individuals in a severe ASC exhibit the ability to respond and learn new tasks with
structured intervention. Although the sample size was small and thus the results must be interpreted accordingly, we
believe they are encouraging enough to support further research on the use of structured sensory and motor
stimulation programs with those in an altered state of consciousness or post-comatose unawarness.
Acknowledgments
The author wishes to thank the participating families, clients and therapists who helped provide the experimental and regular interventions. Special thanks are extended to Dr Nancy E. Mayo and Dr Henri Cohen for their precious contribution and similarly to Dr Nicole Korner-Bitensky for her patience in the translation of this manuscript and for her very helpful suggestions.

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A neural network 'model of the mind' is proposed. This is first posited at a general level, then a detailed neuroanatomical underpinning is given for its wiring diagram in the brain. Finally some general algorithms for the computations being performed by consciousness are suggested, and a future programme of work delineated to test the proposals.
In this paper we present a physical model based on a coupling between elastic and dielectric degrees of freedom in a microtubule. We derive equations of motion describing energy transfer along a protofilament and provide solutions under a range of external conditions (temperature, pressure, electric fields, viscosity, etc.). A simple model of growth and shrinking processes is then described which includes the role of tubulin concentration in the solution, GTP availability, temperature and fields. Finally, we discuss the problem of information processing using the fact that one of the possible phases is a dielectric spin glass phase. A particularly important effect is linked to the length of a microtubule. In conclusions, extensions of these ideas to quantum mechanical formalisms are discussed.
Whether computational or connectionist, most contemporary models of mental events are based upon "classical" views of physical and informational exchange. Such models cannot adequately deal with psi phenomena, which involve "nonlocal" exchanges between consciousness and external events. Recent meta-analyses of several hundred studies, however, strongly suggest the reality of nonlocal exchanges between a person and a) remotely located persons, b) biological organisms, and c) probabilistic microphysical processes. Additionally, several predictors of task performance have been identified, including personality traits such as extroversion, and more short-term factors such as state of consciousness and cognitive set.

Given the conceptual cohesiveness and growing replicability of these results, psi phenomena can no longer be ignored or dismissed. To be considered complete, any contemporary theory of consciousness must account for nonlocal person–environment interactions, or at least show how these are incidental or irrelevant to the theory.

In suggesting that consciousness may have a nonlocal character, psi research also raises some major epistemological issues. While "experimenter effects" in the social sciences are assumed to be mediated by subtle sensory cues, some psi-studies point to more direct investigator influences upon study outcomes. This could have important implications for a number of domains, given the range of organismic or inanimate systems which have been implicated in psi interactions. Perhaps our investigations of increasingly subtle physical processes will have to be complemented by a more thorough study of the effect of consciousness upon its attentional object.

Within the field of psi research, a novel approach is proposed to address experimenter effects: computer-based methodologies which merge the traditionally distinct roles of subject and experimenter. Software integrating mental training techniques and psi-tasks with analytical tools and rigorous controls could constitute an interdisciplinary means for both personal and scientific explorations of nonlocal consciousness.

Abstract

We extend the brain quantum model proposed by Umezawa and Ricciardi to non-equilibrium dissipative dynamics. We show that many simultaneous ground states are allowed, corresponding to many simultaneous information storage levels of the brain. We describe the mechanism of information storage (memorize or "save") and retrieval (recall or "find") in terms of spontaneous breakdown of time-reversal symmetry (only the past can be recalled!). We finally discuss the memory stability as related to stationary condition on the system free energy.
A Microscopic Model of Phase Transitions in Neuronal Membranes: Implications for the Evolution of Mind

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Investigations of natural and artificial neuronal membranes and analogies with erythrocyte data indicate that the neural membrane is a highly organized liquid crystal structure. Although membrane phase transitions in response to an applied electromagnetic field have been extensively described on a macroscopic level, the microscopic, or quantum processes involved are not yet well understood. It is proposed that phase transitions are the macroscopic correlate of highly structured interactions among Rydberg atoms in hydrocarbon acyl chains of the phospholipid lattice. These interactions involve charge configurations of promoted orbitals behaving as cellular automata. The computational power of the system would enable it to compute optimal solutions to highly intractable algorithms such as Instances of the Travelling Salesman Problem in polynomial time. The computational process begins with an afferent electromagnetic field at the outer membrane surface. This event produces a surge of sodium ions that in turn causes phospholipids to become deprotonated. The deprotonation dissociates cholesterol from the phospholipids, and removes a spin-correlated electron pair that travels longitudinally through a superconducting system. The superconductive channel is comprised of ethylenic bonds in the hydrocarbon acyl chains. The lateral field propagated by the longitudinal electron-pair movement promotes acyl-chain atoms into Rydberg states. Excitation experiments demonstrate that Rydberg atom orbitals “flow” through a series of topologically equivalent shapes. This suggests that the major constraints on microscopic computation would be hypersurface and charge. Units with complementary, dipolar hypersurfaces would combine to form larger units in a form of “quantum simulated annealing.” The configurations would eventually settle into a stable high-energy arrangement of high probability density embedded in a hyperspace. This terminal state would represent the optimum solution to a complex problem instance. Encodings may include actual or possible values of sensory, autonomic, or emotional information characterizing the organism on a moment-to-moment basis. Integrated states of consciousness are combinatorially complex problems for which massive quantum parallelism yields moment-to-moment solutions. The high-energy state of annealed automata would open an adjacent transmembrane protein channel permitting ion flux and the conduction of an action potential. This would constitute the physical basis for the conversion of information from the quantum to the classical level. It is proposed that the system originated in the thermally and chemically generated phase transitions of prokaryote membranes as a means of computing solutions to problems of metabolism, immunology, development and reproduction. Subsequent coupling of phase transitions to membrane electrical activity incrementally generated highly organized systems (???) computing sensation and movement. Organismic activity involved increasingly complex decisions relating changes of internal states to fluctuations in the environment. The most significant elaboration of the system in terrestrial vertebrate evolution occurred in Pilocene hominid species. Prolonged occupancy of a hunting-scavenging niche required progressively optimal algorithms computing Euclidian distances in relation to dangers, rewards, conspecifics, and internal affective and autonomic states. Routing algorithms combining these changing variables would approximate psychological and philosophical definitions of consciousness. It is concluded that the model introduces quantum mechanics into evolutionary theory in a nontrivial way. The emphasis on probability density as a quantum-classical coupling mechanism avoids the philosophical problems associated with wave function “collapse.” Visual feedback leading to mathematical refinement of the model may be possible through the use of the “lattice gas” variety of cellular automata.
Evidence from a variety of sources has demonstrated that preconscious processing does occur and that preconscious information can influence behavior. What is not clear is how preconscious information is integrated with information that is conscious. The world is full of cues that are not consciously perceived, yet we have little evidence demonstrating the role of naturally occurring preconscious information. The current study examines how cues that are not consciously attended to are able to influence social attributions.

Subjects are presented with a series of photographs of preschool children sitting at a table with blocks and looking towards the camera. Each subject is presented one photograph of five different children. Subjects are told that the experimenter is interested in developing categories for scoring facial expression, and would like the subject to describe the expressions on each child's face.

Five preschool aged girls were used to make the photographs. They were selected because they were of ambiguous gender appearance. Each child was photographed sitting at a table covered with blocks. The school decorations and a blackboard with several innocuous words and sketches. Each child was photographed in three conditions. The blackboard and background were identical in all conditions with one exception. In one condition the word "BOY" was written on the blackboard, in a second condition it was replaced with "GIRL," and in the third condition no word appeared on the blackboard in that location.

Sixty female and sixty male subjects between the ages of 18 and 25 viewed a pre-sorted set of five photographs. The photos were grouped so that each child was seen 20 times in each condition. For each photo subjects wrote a short narrative describing the facial expression of the child. Narratives were subsequently scored for gender attribution according to the pronoun used to refer to the child.

The hypothesis being tested was that gender assignment of the child would be influenced by the "irrelevant" background cue. Results showed that the cue significantly influenced the pronoun used to describe the child.

The results are interpreted as supporting a view of the mind in which consciousness "resolves" multiple cues. What appears to be a solid determination is actually the outcome of a process that makes the best possible sense of many different pieces of information. Information that has entered the system without conscious processing is able to bias or shape responses because it can act without awareness.
The essential functions of the brain can be described through the three different types of neurons: first, the sensitive and motor reactions which take place in and out of the brain; second, the neurons which manage the huge bulk of stimuli and responses pertaining to the sensori-behavioural world, in which we consciously live; and last, the neurons of the third type, which are those through which higher cerebral functions operate, and which are of paramount importance to consciousness.

In any case, brain cells, whether of a neural or glial type, are not sufficient to take into account the real complexity of our inner mental world, specially from a biophysical angle. This seems, to us, quite evident as far as unconscious events are concerned, but this applies, equally, to both conscious and non-conscious entities. This is why we propose the following theoretical point of view about the existence of small mental units more basic, named by us Nano-Mental Elements of Representation (NMER).

These units (NMER) may behave as a wave-function, which is one of the best known mathematical keys to quantum mechanics, enabling a probabilistic description of quantum events. The important point is that each NMER is not grounded in matter, but is a non-local entity.

These phenomena, at a nano-level (10^-9 to 10^-10 meter), are likely to have a specific timing close to a picosecond or even a femtosecond. From picoseconds to milliseconds (the latter being the normal time occurrence for nervous conduction), there is a stepwise variation seen in the specific timings leading to phenomena which become slow enough (a few 10^-10 of a second) to be perceived - through our usual senses - as consciousness. We are quite aware that quantum physics are in no way concerned directly with consciousness. This essential topic might well be nothing more than the few emergent sentences consistent with logical speech or coherent thinking or, even, with behavioural non-verbal items. Most of these various types of information are linked to, and can be retrieved from memory. All of them are present to our mind as a means of communicating with others, or with oneself.

This is why we will definitely need strong experimental backing, to relate these ultrafast phenomena to the well-known measured expression, in milliseconds, of the nervous conduction through neural networks.

This measured nerve impulse (it is the only measurement available, up to now, besides the E.E.G.’s global recording), and it could appear as the average emergent value, in milliseconds, of the whole harbouring gamut of specific timings ranging from femtosecond right up to the conscious 10^-4 of a second in the brain. This whole scale seems to be a relevant modelling by which we may look at the intricate succession of various scales to understand the discrete set of specific timings, which tune our neurobiological clocks right up to the macroscopic slow-time domain of consciousness.

This only goes to show that a very precise reflexion on this kind of basic quantum objects is totally linked, for us, to the scale-dependent biophysics of higher cerebral functions, from which consciousness is the unavoidable end-product.
EEG Dimensionality and Depth of Anesthesia


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Background: Intraoperative monitoring of the electroencephalogram (EEG) can help assess brain integrity and/or depth of anesthesia (level of awareness or lack thereof) during surgical procedures. However, reliable detection of subtle changes in anesthetic depth remains an elusive goal. Intraoperative EEG is commonly analyzed and displayed using time to frequency domain transformations. Univariate spectral descriptors such as mean frequency and spectral edge (the frequency below which 95% of the EEG power occurs) change inconsistently among various anesthetics and have shown little clinical value for fine tuning anesthetic depth.

Alternatively, dynamic systems can be characterized on the order/chaos spectrum by assessing underlying deterministic qualities. This can be accomplished by considering an n-dimensional phase space into which the variable set F(t), F(t+T),...F[t+(n-1)T] can be mapped. In the case of EEG, F is the amplitude, t is the time, and T is a fixed time interval or phase space, whereas a sequence of such states followed in time defines a curve, the phase space trajectory. As time grows a system whose dynamics are reducible to a set of deterministic laws, an ordered system, reaches a permanent state indicated by the convergence of families of phase space trajectories toward a subset of the phase space. A lower bound on dimensionality can be calculated by considering the correlation function C(R) of the attractor in "n" dimensional phase space.

\[ C(R) = \frac{1}{K} \sum_{y=1}^{K} \frac{1}{N} \sum_{x=1}^{N} H(R - |F_x - F_y|) \]

N is the total number of data points in an epoch of digitized EEG, R is the radius of an orbit in phase space, \( F_x \) is the n dimensional vector described above, and H is the Heavyside function, \( H(x) = 0 \) if \( x < 0 \), \( H(x) = 1 \) if \( x > 0 \). C(R) is used to count the number of data points Fy within a radius R. This calculation is performed using K reference points over a range of values for n and R, thus C(R) measures the extent to which the presence of one data point effects the position of the other data points. If the attractor is a line C(R) should be directly proportional to R, if it is a surface C(R) should be proportional to \( R^2 \), in general C(R) should be proportional to R raised to the d power for an attractor of dimension d. Therefore, d = \( \log C(R)/\log R \) for small values for R. If d vs. n becomes saturated beyond some value of n, the saturation value d is considered a lower bound on the dimensionality of the attractor.

This investigation of EEG under anesthetic sleep conditions was conducted to evaluate dimensionality as an EEG derived parameter which might reflect complex brain dynamical states.
Methods: Eight human subjects were studied at three anesthetic levels (1.0, 1.5, 2.0 MAC) where 1.0 MAC is a normalized dose for nominal anesthesia. EEG signals were obtained from five surface electrodes placed in the frontal and occipital regions of the left and right cerebral hemispheres. This signal was amplified and filtered (4th order band-pass, 1-40 HZ) and then recorded on a hewlett-Packard 3964A FM tape recorder. Each of the concentration levels was maintained for at least 50 minutes. For each subject, at each anesthetic level, ten 16 second epochs of EEG were digitized at 256 HA and analyzed according to the methods of Grassberger and Procaccia[3].

Results: Figure 1 shows the tendency for dimensionality to decrease as anesthetic depth increases. For six of the eight subject dimensionality decreased dramatically from 1.0 to 1.5 MAC and remained essentially unchanged from 1.5 to 2.0 MAC. Two of the eight subjects exhibited little or no dimensionality change from 1.0 to 1.5 MAC, but showed a profound decrease in dimensionality from 1.5 to 2.0 MAC. No clinical observations (including cardiovascular and neurologic monitoring data) suggested any differences between these two subjects and the rest of the group.

Discussion: Previous investigations of EEG have yielded estimates of dimensionality ranging from 2.09 (epileptic waveform)[1] to 9.7 (awake, eyes open). Dimensionality appears to be lower for sleep state EEG than for the awake state[2]. The EEG exhibits chaotic dynamics with only short periods (1-20 sec) of stationarity. A sufficient does of anesthetic can cause the EEG to become isoelectric, (commensurate with very low dimensionality). At clinical anesthetic levels, there is a tendency for dimensionality to decrease as anesthetic depth increases. However, some anesthetics may have a paradoxical excitatory effect on EEG at certain concentrations[4]. This property may prove important in the classification of brain activity and may have clinical utility as a diagnostic tool.

References

Consciousness is a result of the brain acting as a unit, of billions of neurons acting in concert. Underlying this phenomenon, the activity of each cell, is that property we recognize as its "alive" quality, is the outward expression of coordinated functioning of integrated subcellular structures, which in turn, are ordered assemblies of the basic building blocks of living matter, proteins. In this hierarchy, proteins occupy the mesoscopic level of existence, between the chaotic molecular world below and the ordered biological world above. Thus, to understand the role of proteins, we need concepts that cannot be reduced to the statistical average of properties of single molecules. We have here an emergent phenomenon that has its origin in the structure of liquid water. A basic ephemeral order exists in a latent form in water, which manifests itself as mesoscopic clusters of defined size (Prog Molec Subcell Biol (1991) 12, 113). Under certain conditions these clusters can be given a degree of permanence, giving rise to structures that resemble proteins in size, form and function. It will be discussed how protein-water interactions produce the extended cooperative 3D system that constitutes living matter, and how, as a consequence, individual mesoscopic energies can resonate and thus transform into a single macroscopic energy quantum.
Pharmacology of Consciousness

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Discussion of the range of experiences reported by users of psychoactive drugs to shed light on the relationship between brain and mind. This talk will also consider the similarities between pharmacologically induced altered states of consciousness and non-pharmacologically induced altered states of consciousness.
PROBLEMS WITH LOSS OF CONSCIOUSNESS HAVE BEEN PRESENT FROM THE ASCENT OF MAN, PARTICULARLY WHEN HE LEFT TERRA FINNA. TO EVEN ENTER THE MODERN AEROSPACE ENVIRONMENT TODAY REQUIRES LIFE SUPPORT TO PREVENT COMPROMISE OF CONSCIOUSNESS IN NORMAL HUMAN BEINGS. ALTITUDE-INDUCED HYPOXIA AND ACCELERATION (+Gz)-INDUCED ISCHEMIA / HYPOXIA REMAIN CONSTANT THREATS TO CONSCIOUS FUNCTION IN THE PILOTS OF HIGH-PERFORMANCE FIGHTER AIRCRAFT. RESEARCH AIMED AT PREVENTING +Gz-INDUCED LOSS OF CONSCIOUSNESS (G-LOC) IS CONDUCTED USING LARGE HUMAN CENTrifuges WHICH CAN INDUCE RAPID-ONSET, HEAD-TO-FOOT ACCELERATION RESULTING IN DISPLACEMENT OF BLOOD FLOW AWAY FROM THE HEAD AND THEREFORE COMPROMISE OF NEUROLOGIC FUNCTION SUPPORTING CONSCIOUSNESS. WE HAVE HAD THE OPPORTUNITY TO INVESTIGATE G-LOC IN THOUSANDS OF NORMAL HUMANS AND BY RESTORING BLOOD FLOW TO THE ISCHEMIC BRAIN, THE RETURN OF CONSCIOUSNESS.

THE CHARACTERISTICS OF CONSCIOUSNESS, UNCONSCIOUSNESS, AND THE TRANSITION BETWEEN THEM WERE STUDIED SEQUENTIALLY FROM QUALITATIVE, QUANTITATIVE, AND FINALLY KINETICS AND MECHANISM STANDPOINTS. THESE RESULTS PRODUCE A THERMODYNAMIC DESCRIPTION OF THE PROCESSES AND STATES OF CONSCIOUSNESS AND UNCONSCIOUSNESS. CAREFUL TITRATION OF CEREBRAL BLOOD FLOW TO THE NORMAL HUMAN NERVOUS SYSTEM PRODUCES A SPECIFIC SERIES OF SYMPTOMS AS CONSCIOUSNESS IS LOST AND AS CONSCIOUSNESS IS REGAINED. IF WE PREPARE AN ISCHEMIC, BUT OTHERWISE NORMAL, BRAIN AND THEN RESTORE CONSCIOUSNESS BY MANIPULATION OF THE RATE AND MAGNITUDE OF RETURN OF BLOOD FLOW (ENERGY), A SPECIFIC SEQUENCE OF SYMPTOMS CAN BE OBSERVED WHICH INCLUDE MYOCLONIC CONVULSIONS, DREAMLETS, RETURN OF MEMORY, RETURN OF VISION, RETURN OF CONSCIOUS FUNCTION, RETURN OF MOTOR FUNCTION, DISSOLUTION OF CONFUSION/DISORIENTATION, AND FINALLY RESTORATION OF NORMAL CONSCIOUSNESS. EACH OF THESE SYMPTOMS ARE KINETICALLY RELATED AND QUANTITATIVELY DEPENDENT ON THE MAGNITUDE AND CHARACTER OF THE ISCHEMIC INSULT TO THE NERVOUS SYSTEM.

THE SYMPTOMS ARE RELATED TO THE REGIONAL ISCHEMIC DIFFERENTIAL WITHIN THE NERVOUS SYSTEM INDUCED BY THE +Gz-ACCELERATION STRESS AND DETERMINED BY THE STRUCTURES RENDERED NON-FUNCTIONAL, THOSE REMAINING FUNCTIONAL, AND THEIR SUBSEQUENT INTERACTIONS WHILE IN THESE STATES. MECHANISTIC THEORY SUGGESTS THAT WE PRODUCE A PHYSIOLOGICALLY-INDUCED, REVERSIBLE BRAIN STEM PREPARATION IN NORMAL HUMAN BEINGS WHEN CONSCIOUSNESS IS LOST. THE ENTIRE PROCESS IS CONSISTENT WITH AN EVOLVED PROTECTIVE SEQUENCE WHICH BALANCES THE PREVENTION OF BREACH OF INTEGRITY OF THE CENTRAL NERVOUS SYSTEM WITH THE MAINTENANCE OF NORMAL CONSCIOUS FUNCTION THAT IS ESSENTIAL TO OPTIMAL ORGANISMAL SURVIVAL. CONSCIOUSNESS AND UNCONSCIOUSNESS CAN THEREFORE BE VIEWED AS THERMODYNAMIC STATES OF THE NERVOUS SYSTEM OF AN ORGANISM THAT HAVE ADAPTED TO ENSURE ORGANISMAL SURVIVAL IN THE FACE OF EXTERNAL (ENVIRONMENTAL) THREATS PROVIDED BY CONSCIOUSNESS AND MAINTENANCE OF CENTRAL NERVOUS SYSTEM INTEGRITY IN THE FACE OF INTERNAL THREATS (ISCHEMIA, HYPOXIA, OR OTHER) PROVIDED BY LOSS OF CONSCIOUSNESS.

THE STUDY OF G-LOC PROVIDES CONSIDERABLE INSIGHT INTO AN UNDERSTANDING OF CONSCIOUSNESS. A UNIFIED FIELD THEORY OF LOSS OF CONSCIOUSNESS, BASED ON THERMODYNAMIC CONSIDERATIONS, HAS BEEN DEVELOPED. A GRAND THEORY OF CONSCIOUSNESS LINKS EVOLUTION, MATURATION, CONSCIOUSNESS, ALTERATIONS (DISEASE/TRAUMA) OF CONSCIOUSNESS, SLEEP, UNCONSCIOUSNESS, AND DEATH AS A CONTINUUM OF NEUROLOGIC ENERGETICS.
Is it Impossible to "Measure" Conscious Feeling?

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At least during the 3000 years since Hephaestos built golden robot women, people have wondered how must a machine or an algorithm be constructed that it should 'feel'? Four centuries ago things had not progressed when Montaigne asked, "When I play with my cat, who knows if she does not amuse herself more with me than I with her?" Today all that has changed is that many doubt the question even has meaning. What can "more" mean in comparing consciousnesses? If nothing, is it impossible to study consciousness by scientific methods? As biologists we try to think quantitatively about "Life". This has been spectacularly successful in two of the three aspects of "Life": first genetics and evolution, then the chemistry and physics of evolved machinery. But the third aspect, conscious experience, still eludes scientific method. No-one quantifies pleasure or pain. We have no "consciousness-meter" whereby to distinguish the qualities and to quantify, or even just to transitively rank-order, the intensities of successive toothaches or of simultaneous toothaches among individuals of the same or different species. Nonetheless we base ethical decisions on implicit order-of-magnitude comparative estimates of conscious experience. We attempt to optimize 'the greatest good for the greatest number', even without knowing how to measure 'good' nor how to evaluate 'number' any better than counting noses. We suppose in child-rearing, in medical experiments, in the extermination and meat industries, and maybe even in making war, that we are trading off pleasures and pain to net advantage, but how do we know that ants, for example, do not feel more acutely than humans or that 1000 humans feel a given experience 100 times as much as 10 humans or $10^{10}$ cows, or that a fetus lacks conscious feeling? We act as though we routinely quantify these things, but remain unable even to imagine how it could be done in principle in some future age.

For a scientist the beginning lies in comparative observations. It is possible to non-invasively monitor neural and glial activity in various human brain nuclei and cortical maps, and to correlate such observations with subjective reports. What aspect of such observations constitutes a measure of conscious experience? Consciousness being a transaction among cells, lesser synaptic activity must connote lesser feeling (ceteris paribus), and making cells utterly incommunicative under anesthesia must zero every pertinent measure. What other features must a useful measure of awareness logically embody?

Awareness is a process, and the measure of any process has the dimensions 'per unit time', so whatever 'consciousness' may be, it must be reckoned half as intense when all pertinent processes are slowed that much. Then if the strong version of functionalism is valid, whatever 'artificial consciousness' may someday be implemented in faster devices could be implemented now even in a RISC workstation, identically except for speed. The subjective quality of such snail's-pace awareness would presumably be identical (at least for introspective aspects), only the outer world would seem to whiz by faster. If awareness is necessarily 'per unit time', might it be meaningfully integrated over time? Is a half second of orgasm 'less' of something we wish to measure than is a full second? By exactly half? If so, does it follow that there is twice the 'awareness' in two iterations of the same subjective experience, e.g., hippocampally-lesioned HM's introduction to Brenda Milner on Monday, echoed on Tuesday? This seems to me not reasonable; then is there no cumulative measure of awareness, just as there is no cumulative elevation of tone necessarily implicit in the familiar acoustic illusion of a perpetually rising pitch?

What about integration over space? Some such integration seems already implicit in the idea of measuring the consciousness of something, viz., the process going on in some region of space and time. Suppose two identical individuals (imagine an instantaneous atom-by-atom 'xerox') simultaneously experience and respond to the same joke: does that double the
experience? It would seem not so, were the individual cloned instead by merely doubling the volume of each original cell or even segregating the doubled volume into 2 adjacent cells wired in parallel; and why should the answer be any different if those cells be segregated (as in the 'xerox') into non-interpenetrating volumes? Perhaps the putative measure must remove redundancy, and should no more be doubled than if the individual were merely 'duplicated' by mirror, unless/until the clones diverge and diversify their memories and responses to make them distinct. From this point of view, nuclear devastation of a population of nearly identical couch-potatoes might be only twice 'as bad' as the deplorable effect on any 1% sampling of that population. Thus far, then, I am not sure that any putative measure of awareness can be a mere rate (how much in unit time), summable over consecutive times or over replicate individuals.

Supposing awareness to be a process also invites one to ask what aspects of a process other than sheer speed make it more 'conscious' or less 'conscious', or conscious in different ways (pleasure, pain). What features are essential? Is awareness possible without short term memory? This, at least, might be answerable empirically. What determines the 'kind' of awareness in a process containing all essential features? If we knew, some might consider it morally imperative to create and accelerate (perhaps in nuclear-powered machines) processes akin to 'joy' or 'orgasm'. In fact, we do, by fostering human population growth and striving to minimize bad experiences.

I would feel more confident in choosing experimental avenues to resolve such riddles if I could at least imagine the necessary logical features of some useful quantitative measure of 'consciousness'. Clearly, there is some essential ingredient missing from my thinking on this topic. I attend this meeting in hopes of repairing that deficit. I entreat someone to tell me what logical and dimensional features any useful measure of awareness must embody, or else to tell me what one can usefully study about awareness if it cannot even in principle be quantified or compared between episodes or between disjoint organisms.
Current research on the dreaming brain indicates that the fetus dreams over 16 hours during the later stages of fetal development. Recent studies of lucid dreamers shows that at least five stages of lucidity can be reached during lucid dream episodes characterized by greater levels of self-awareness.

Following the quantum-physical model of David Alpert, recent studies by David Deutsche, and the holographic wave model of neural memory developed by Renato Nobili, I have developed a model of the dreaming brain that shows dreams are episodes of self-referring automata. In order for the self-referral to occur the automata must recognize quantum-physically based images and superpositions of images (governed by the principle of complementarity) as well as images of themselves while they hold these other images. In this manner a hierarchy of quantum-physical superpositions of images—dream states, characterized by greater levels of self-awareness, can be built up that match the stages of lucidity discovered in lucid dream research.

At the lowest or ground stage, the automaton records a superposition of two images, and records an image of itself, I, holding both images. Each image is taken to be recorded in a parallel world. Thus the I-image is akin to holding a photograph of itself in a parallel world while recognizing a single image in one world. In this manner the automaton recognizes through the parallel world image a concept of itself. By the process of superpositions of superpositions of images, higher awareness—greater self-reflectivity—states are developed. With each higher superposition, the automaton gains reflection of itself in different and complementary poses.

Although the process of self-reflection occurs during wake states of awareness, they are enhanced during sleep, and especially reinforced during REM stages, known to occur while dreaming.

I conclude from this that dreaming is a necessary process for learning to distinguish self from non-self, and is vital for human and cultural survival.

Details of the model will be discussed more fully during the presentation.
A Quantum Physics Theory of Thinking Process: 
Toward a Quantitative Understanding of Consciousness

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The similarities between the physical process of learning a concept and the uncertainty principle in quantum physics suggest that some aspects of concepts can be described by quantum states in Hilbert space. Many phenomena of physical psychology may thus be understood in terms of the behavior of a quantum system. A by-product of this understanding is a coherent representation of knowledge that might be implementable on binary digital computers. In this context, consciousness or awareness seems strongly related to the entropy of the mind/brain system.
Vegetative state is a condition in which the patient opens his or her eyes but does not demonstrate evidence of meaningful communication with the environment. Patients in vegetative state are presumed to be awake but unaware, unable to perceive pain, and possessing only a reflexive reaction to noxious stimuli. Prior to 1980, vegetative state was considered to be a type of coma or "permanent unconsciousness." Two major influences have led to a reconsideration of this definition. First, it was demonstrated that vegetative state is not necessarily permanent: many vegetative state patients have been found to recover some meaningful communication with the environment over time. Second, a dualist model of consciousness was proposed by Plum and Posner (1980), to distinguish between coma and vegetative state. According to this model, consciousness may be divided into arousal (or "awakeness") and awareness. In coma both of these components are impaired. By contrast, vegetative state patients are awake, yet they are presumed to be without thoughts. This presumption, together with the statement that vegetative state patients do not experience pain, is based primarily on behavioural observation. Relatively little experimental research has addressed the contents of consciousness in vegetative state. Our recent experiments suggest that individuals in vegetative state may process more information than has been assumed in the past. This paper will focus on present and future experimental research concerning the nature of consciousness in this growing population.
Microtubular Self-Organization and Information Processing Capabilities

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In this paper we present a physical model based on a coupling between elastic and dielectric degrees of freedom in a microtubule. We derive equations of motion describing energy transfer along a protofilament and provide solutions under a range of external conditions (temperature, pressure, electric fields, viscosity, etc.). A simple model of growth and shrinking processes is then described which includes the role of tubulin concentration in the solution, GTP availability, temperature and fields. Finally, we discuss the problem of information processing using the fact that one of the possible phases is a dielectric spin glass phase. A particularly important effect is linked to the length of a microtubule. In conclusions, extensions of these ideas to quantum mechanical formalisms are discussed.
Clinical neurologists are uniquely placed to make important observations about the scientific basis of consciousness, because patients with damaged nervous systems have tolerably consistent abnormalities of consciousness, which are of conceptual interest. Since there are no obvious criteria which unambiguously define "normality" as applied to either brain function or consciousness, the patient's description of conscious phenomena cannot be used to distinguish between normal and abnormal brain states. For example, hallucinations due to temporal lobe lesions or peduncular hallucinosis cannot reliably be distinguished from normal psychophysiological phenomena. Thus the reports of patients with neuronal destruction are not different from those of people who are excited, epileptic, depressed or drunk. Disease, mental illness, intoxication and daydreaming are equivalent states of the nervous system, and observation of these states gives equally valid information about the biology of consciousness. In this sense, clinical neurology is a valid meta-analytical framework for the study of consciousness.
CONSCIOUSNESS:
A PSYCHOBIOMAGNETIC DYNAMO

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The macroscopic magnetic fields of cortex and other large-scale
neural networks are hypothesized to be the fundamental elements of
mind. In this interpretation, the "brain" includes all neurophysiological
processes that establish and maintain the magnetic fields composing
the mind. This hypothesis is based on neurobiological studies whose
data can be used to show that the flow of "multiunit spike activity"
(MSA) through the cortex is indirectly linked to both the
electroencephalographic (EEG) and magnetoencephalographic (MEG)
fields. This linkage is defined electrodynamically in terms of an
"impressed magnetic current." When the flow of MSA is thus defined,
the mind and brain (as defined here) can be understood to be the
"higher" and "lower" components of a self-excited psychobiomagnetic
dynamo. The spin-glass model of "energy minimization" in artificial
neural networks (Hopfield net) may be relevant to the synaptic
development of this dynamo. The most basic objective of
consciousness and mind, viewed from this perspective, may be to
simply maintain the brain in states of minimum energy. The clear
relationships found between the macroscopic electric and magnetic
fields and multiunit spike activity of the brain are indicative that
electromagnetic principles will play a major role in the future science
of consciousness and mind.