Ralph H. Abraham
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RALPH H. ABRAHAM has been Professor of Mathematics at the University of California at Santa Cruz since 1968. He received the Ph.D. in Mathematics at the University of Michigan in 1960, with a thesis in tensor calculus and applied differential geometry. He then taught at UC Berkeley, Columbia, and Princeton before moving to UC Santa Cruz, and is the author of more than 20 texts.

Research

Ralph has been active on the research frontier of dynamics — in mathematics since 1960, and in applications and experiments since 1973. He has been a consultant on chaos theory and its applications in numerous fields (medical physiology, ecology, mathematical economics, psychotherapy, etc.) and is a founding editor for the technical journals *World Futures*, and the *International Journal of Bifurcations and Chaos*. Currently active projects include:

- Predator-prey population dynamics for great white sharks and northern elephant seals
- Massively complex discrete dynamical model for the world economy
- Early warning for brownouts in the Japanese power grid
- New software for 3D visualization of chaotic behavior

Academic Positions

- UC Berkeley, 1960-62: Research Lecturer in Mathematics. Participated in the creation of chaos theory and global analysis, new branches of mathematics.
- Columbia University, 1962-64: ONR Research Associate and Assistant Professor of Mathematics. Research in global analysis.
- Princeton University, 1964-68: Assistant Professor of Mathematics. Taught graduate courses in global analysis and mathematical physics. Wrote three textbooks, including *Foundations of Mechanics*, among the most popular advanced texts on mathematical physics, still in print after 34 years with more than 50,000 copies sold.
- UC Santa Cruz, 1968-94: Professor of Mathematics. Early application of computer graphics to research in chaos theory, and teaching lower level math courses. Created graduate program in computational and applied mathematics. Taught chaos theory and the history of mathematics. Research in chaos theory, applica-

tions to the physical, biological, and social sciences. Wrote *Dynamics, the Geometry of Behavior*, among the first texts on Chaos Theory, still in print after 20 years with more than 50,000 copies sold.

- Visiting positions in Amsterdam, Paris, Warwick, Barcelona, Basel, and Florence.
- Workshops in Denmark, Sweden, England, Italy, and Japan.

Books in print

- *Foundations of Mechanics*, 2nd edn. 1978 (with J.E. Marsden)
- *Manifolds, Tensor Analysis, and Applications*, 2nd edn. 1982 (with J.E. Marsden and T. Ratiu)
- *Dynamics, the Geometry of Behavior*, 2nd edn. 1992 (with C.D. Shaw), transl. in Japanese
- *Trialogues on the Edge of the West*, 1992 (with Terence McKenna and Rupert Sheldrake), transl. in French, German, Portuguese, Dutch.
- *Chaos, Gaia, Eros*, 1992, transl. in Korean
- *The Web Empowerment Book*, 1995 (with Frank Jas and Will Russell)
- *Chaos in Discrete Dynamical Systems*, 1997 (with Laura Gardini and Christian Mira)
- *The Evolutionary Mind*, 1998 (with Terence McKenna and Rupert Sheldrake), transl. in German
- *The Chaos Avant-garde*, 2000 (with Yoshisuke Ueda), transl. in Japanese

Articles and Websites

A list of over 100 articles by Ralph may be found at: www.ralph-abraham.org/articles. The more recent ones are posted in entirety. Eight additional websites are maintained by Ralph, including:

- www.vismath.org: ongoing research activities.
- www.visual-euclid.org: new editions of Euclid's Elements, including thousands of computer graphic illustrations, including 3D graphics in VRML.
- www.visual-chaos.org: pedagogic material on chaos theory, including computer graphic animations and interactive learning environments.
- www.webographics.org: a novel method based on fractal geometry for visualizing the connectivity of a network of websites.

- www.yarrowstalk.org: a learning environment for chaos theory, in which the yarrow stalk oracle of the I Ching is used to illustrate the basic concepts of chaos theory: chaotic attractors and bifurcations.