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EDUCATION

1963 Ph. D. Physics	University of Iowa	Iowa City, Iowa
1960 M. S. Physics	Northwestern University	Evanston, Illinois
1959 B. S. Physics	Illinois Institute of Technology	Chicago, Illinois

PROFESSIONAL EMPLOYMENT

1995-2005: Professor of Physics (Professor *Emeritus* since 2000)
California State Polytechnic University Pomona, California 91768

1983-1995: Chair, Physics Department and Professor of Physics
California State Polytechnic University Pomona, California 91768

1979-83: Scientist and Energy Policy Analyst, Institute for Energy Analysis
Oak Ridge Associated Universities Oak Ridge, Tennessee

1971-79: Professor of Physics (1976-79); Associate Professor of Physics (1971-76)
Chair, Department of Physical Sciences (1971-76)
Chicago State University Chicago, Illinois

1977-78: Visiting Professor of Physics, (sabbatical leave from Chicago State University)
Harvey Mudd College of Science and Engineering Claremont, California

1963-71: Associate Professor of Physics (1969-71); Assistant Professor of Physics (1964-69);
Postdoctoral Research Associate (1963-64)
Case Western Reserve University Cleveland, Ohio

RESEARCH INTERESTS

Foundations of thermal physics, societal energy use, college and precollege science education

PROFESSIONAL OFFICES, HONORS, MEMBERSHIPS (partial list)

- President-Elect, American Association of Physics Teachers 2006 (to be President 2007; Past President 2008; served as Vice President 2005).
- Co-Chair, Gordon Research Conference on Physics Research & Education in Classical Mechanics & Non-linear dynamics, June 2004; Co-editor of theme issue (April 2004) of the American Journal of Physics on the same topic.
- Co-Vice Chair, Gordon Research Conference on Physics Research and Education in Quantum Mechanics, June 2002; Co-editor of theme issue (March 2002) of the American Journal of Physics on the same topic.
- Chair, Nominating Committee, American Association of Physics Teachers, 2002-2003.
- Elected representative of Southern California Section American Association of Physics Teachers (AAPT) to National AAPT, April 1998-2005.
- Liaison Scientist for Cal Poly Pomona with the Hacienda-La Puente Unified School District, providing science expertise to teachers and students in grades K-5, 1998-present.
- Associate Editor, American Journal of Physics, January 1992-1995.

PROFESSIONAL OFFICES, HONORS, MEMBERSHIPS (continued)

- President, Southern California Section - American Association of Physics Teachers: 1991-93; Vice President, 1989-91; Editor, 1987-89.
- Founder/Coordinator of PHUN, Physics High School - University Network, 1990 - 92.
- President of Sigma Xi at California State Polytechnic University, 1990-91.
- Co-coordinator, Physics Discipline Group, California State University System Institute for Teaching and Learning, 1989-94.
- Service on numerous committees at California State Polytechnic University, including: Core Faculty of the Center for Education and Equity in Science, Mathematics, and Technology; Search Committee for the College of Science Dean; Council of Chairs Steering Committee.
- Member: American Association of Physics Teachers, American Physical Society, Sigma Xi - The Scientific Research Society, Union of Concerned Scientists.

PUBLICATIONS

Books Published

- *Maxwell's Demon 2: Entropy, Classical and Quantum Information, Computing*
Institute of Physics, Bristol, 2003. Co-editor: Andrew F. Rex.
<http://bookmarkphysics.iop.org/bookpge.htm/book=1154p>
- *Maxwell's Demon: Entropy, Information, Computing*
Princeton University Press [USA, Canada, Japan] and Adam Hilger/British Institute of Physics [other parts of the world], 1990. Co-editor: Andrew F. Rex.
Chosen as an Alternate Selection of the Library of Science Book Club in September 1992.
- *Industrial Energy Use Data Book*
Garland STPM Press, New York, 1980
Co-authored chapters on: Agriculture, Mining, Textiles, Stone-Clay-Glass Products, Primary Metals, Fabricated Metal Products.

Articles, Essays, Notes, Reviews, Letters

62. "Entropy, its language, and interpretation," submitted for publication.
61. "Maxwell's Demon and the Second Law," in D. Sheehan, *First International Conference on Quantum Limits to the Second Law*, (American Institute of Physics, New York, 2003).
60. "Work, energy, and kinematical car data," *Phys. Teach.*, **40**, 516-517 (2002).
59. "An introduction to the theme issue," (editorial), *Am. J. Phys.* **70**, 199 (2002). Co-authors: Beth-Ann Thacker and David P. Jackson.
58. "Teaching the photon gas in introductory physics," *Am. J. Phys.* **70**, 792-797 (2002).
57. "Acceleration for circular motion," *Am. J. Phys.* **70**, 490-492 (2002).
56. "Answer to question #78. A question about the Maxwell relations in thermodynamics," *Am. J. Phys.* **70**, 104 (2002).
55. "The Boltzmann reservoir: A model constant-temperature environment," *Am. J. Phys.* **68**, 521 (2000).
54. "What if entropy were dimensionless?," *Am. J. Phys.* **67**, 1114-1122 (1999).
53. "Maxwell's demon and the culture of entropy," *Physics Essays* **10**, 125-149 (1997).
52. "Lester Hirsch" (obituary) *Physics Today* **49**, 94 (1996).

Articles, Essays, Notes, Reviews, Letters (continued)

51. "Thermodynamic entropy: The spreading and sharing of energy," Am. J. Phys. **64**, 1261-1271 (1996).
50. "Efficiency and efficacy of incandescent lamps," Am. J. Phys. **64**, 649-654 (1996).
Co-authors: D. C. Agrawal and V. J. Menon.
49. "A reminder for us all," (Letter-to-the-Editor), Phys. Teach. **34**, 134 (1996).
48. "Simple arguments for the Boltzmann factor?" Am. J. Phys. **63**, 877-878 (1995).
47. "Thermodynamic insights from a one-particle gas," Am. J. Phys. **63**, 895-905 (1995).
46. "Entropy and heat along reversible paths for fluids and magnets," Am. J. Phys. **63**, 814-817 (1995).
45. Book review: *The Refrigerator and the Universe: Understanding the Laws of Energy*, by M. Goldstein and I. F. Goldstein (Harvard U. P., Cambridge, 1993). Am. J. Phys. **63**, 282-283 (1995).
44. "Entropy of measurement and erasure: Szilard's membrane model revisited," Am. J. Phys. **62**, 994-1000 (1994). Co-author: A. F. Rex
43. "Thermodynamics of Crawford's energy equipartition journeys," Am. J. Phys. **62**, 120-129 (1994).
42. Book review: "Thermodynamics: History and philosophy: Facts, trends, debates," Edited by K. Martínás, *et al* (World Scientific, 1991). Am. J. Phys. **61**, 763-764 (1993).
41. "A mixing route to thermodynamics," Am. J. Phys. **61**, 667 (1993).
40. "Stopping objects with zero work: Mechanics meets thermodynamics" Am. J. Phys. **61**, 121 - 127 (1993). Co-author: A. J. Mallinckrodt.
39. "All about work," Am. J. Phys. **60**, 356-365 (1992). Co-author: A. J. Mallinckrodt.
38. "Entropy," *Magill's Survey of Science: Physical Science Series* (Salem Press, 1992).
37. "Resource Letter: Maxwell's demon," Am. J. Phys. **58**, 201 (1990). Commissioned article. Co-author: A. F. Rex.
36. "Illuminating physics with light bulbs," Phys. Teach. **28**, 30 (1990).
35. "Conveyor-belt work, displacement, and dissipation," Phys. Teach. **28**, 172-173 (1990).
34. "Maxwell's demon, power, and time," Am. J. Phys. **58**, 135 (1990).
33. "Thermodynamic cycles with nearly-universal maximum-work efficiencies," J. Phys. A: Math. Gen. **22**, 4019 (1989). Co-author: P. T. Landsberg.
32. "Conveyor-belt problem can be a slippery one" (Letter-to-the-Editor), Phys. Teach. **26**, 483 (1987).
31. "Thermal efficiency at maximum work output: New results for old heat engines," Am. J. Phys. **55**, 602 (1987).
30. "Available work from a finite source and sink: How effective is a Maxwell's demon?" Am. J. Phys. **55**, 701 (1987).
29. "'Counterrevolutionary' Physics" (Letter-to-the-Editor), Am. J. Phys. **54**, 776 (1986).
28. "Kerosene vs. electric Portable Heaters: The Question of Risk," *Environment* **26**, 31 (March 1984).
27. "Energy Information needs for U.S. state-level policy making: Minimal data requirements during normal and emergency periods," *Energy Systems and Policy* **7**, 65 (1983). Co-author: J. N. Barkenbus.
26. "Resolution of an entropy maximization controversy," Am. J. Phys. **47**, 385 (1979). Co-author: A. E. Curzon.
25. "Heat engines and the performance of external work," Am. J. Phys. **46**, 218 (1978).

Articles, Essays, Notes, Reviews, Letters (continued)

24. "EER, COP, and the second law efficiency for air conditioners," Am. J. Phys. **46**, 19 (1978). Co-author: W. D. Teeters.
23. "Comments on renormalization group series," Physica **89A**, 427 (1977). Co-authors: A. J. F. Siegert and D. J. Vezzetti.
22. "Multisystem temperature equilibration and the second law," Am. J. Phys. **45**, 252 (1977).
21. "Entropy changes in real gases and liquids," Am. J. Phys. **43**, 1098 (1975).
20. "Irreversibility, entropy production, and thermal efficiency," Am. J. Phys. **43**, 973 (1975). Co-author: G. L. Jones.
19. "An exact solution to the classical anisotropic Heisenberg model with long-range Kac interactions," J. Stat. Phys. **10**, 205 (1974). Co-author: K. Millard.
18. "A constant-magnetization ensemble for the classical anisotropic Heisenberg model," J. Stat. Phys. **6**, 133 (1972). Co-author: K. Millard.
17. "Phase transitions for the anisotropic Heisenberg model," Phys. Letters **35A**, 137 (1971). Co-authors: M. Flicker and K. Millard.
16. "The infinite-spin limit of the quantum Heisenberg model," J. Math. Phys. **12**, 1000 (1971). Co-author: K. Millard.
15. "Correlation inequalities for coupled oscillators," J. Math. Phys. **12**, 569 (1971).
14. "Proof of the third law of thermodynamics for Ising ferromagnets," Phys. Rev. **A2**, 2368 (1970).
13. "Thermodynamics of systems with internal adiabatic constraints," Am. J. Phys. **38**, 546 (1970).
12. "Entropy differences between ideal and non-ideal systems," Am. J. Phys. **37**, 548 (1969).
11. "On the connections between thermodynamics and statistical mechanics," Am. J. Phys. **37**, 65 (1969).
10. "Difference equation solutions for the linear Ising model and nearest neighbor fluid," Am. J. Phys. **36**, 591 (1968). Co-author: M. Flicker.
9. "On the Bethe hypothesis for the anisotropic Heisenberg model," Phys. Rev. **168**, 578 (1968). Co-author: M. Flicker.
8. "The symmetrization postulate of quantum mechanics," Phys. Rev. **163**, 1353 (1967). Co-author: M. Flicker.
7. "Translational invariance properties of a one-dimensional fluid with forces of finite extent," J. Math. Phys. **8**, 434 (1967). Co-author: M. H. Coopersmith.
6. "Translational invariance properties of a finite one-dimensional hard core fluid," J. Math. Phys. **8**, 306 (1967). Co-author: M. H. Coopersmith.
5. "Remarks on condensation theory," Phys. Rev. **148**, 92 (1966).
4. "Asymptotic densities in statistical ensembles," Phys. Rev. **135A**, 355 (1964).
3. "Statistical thermodynamics of incompletely specified systems," J. Chem. Phys. **41**, 596 (1964).
2. "Class of ensembles in the statistical theory of energy-level spectra," J. Math. Phys. **5**, 763 (1964).
1. "Systematic characterization of m th order energy-level spacing distributions," J. Math. Phys. **5**, 756 (1964).

PRESENTATIONS

Papers Presented Since 1995 at American Association of Physics Teachers' Meetings

"From Lord Kelvin's Warming Machine to Groundwater Heat Pumps," National Summer 2004 Meeting, Sacramento, California

"Using data to teach energy and environment," National Summer 2003 Meeting, Madison, Wisconsin.

"Home activities on electrical energy use," So. California Section Spring 2003 Meeting,, U. Laverne.

"Maxwell's demon and the Second Law," invited presentation at the First International Conference on Quantum Limits to the Second Law," University of San Diego, July 2002.

"Electrical energy use: Home activities for pre-college and college," National Summer 2002 Meeting, Boise, ID.

"Ideal gas vs. photon gas," (poster presentation) National Summer 2001 Meeting, Rochester, NY.

"Efficiency of electric power plants," National Summer 2001 Meeting, Rochester, NY.

"Ideal Gas vs. Photon Gas," So. California Section Spring 2001 Meeting, Harvey Mudd College.

"Carbon dioxide production and trends in U.S. vehicle sales," National Summer 2000 Meeting, University of Guelph.

"Car weight, efficiency, and carbon dioxide," So. Calif. Section Fall 1999 Meeting, California Lutheran University.

"What is kT?," National Summer 1999 Meeting, Trinity University, San Antonio, Texas, August.

"Peer Instruction in a Conceptual Physics Class," National Summer 1998 Meeting, University of Nebraska. Co-author: Hany Tawadrous, Cal Poly Physics graduate.

"Dimensionless entropy," National Summer 1997 Meeting, University of Denver.

"Does entropy of mixing exist?" National Summer 1996 Meeting, University of Maryland.

"Efficiency and efficacy of incandescent lamps," National Summer 1995 Meeting, Spokane, Washington (Co-authors: D. C. Agrawal and V. J. Menon).

Other Presentations Since 1995

"Maxwell's demon: 1867-2006 and beyond," invited talk at Loyola Marymount University, Los Angeles, September 2006.

"Entropy, its language, and interpretation," invited talk at AAAS Pacific Region Symposium on the Second Law of Thermodynamics, University of San Diego, June 2006

"Entropy, the 2nd law & Maxwell's demon," invited talk at California State University, Long Beach, April 2006.

"Maxwell's demon: From 1867 to the third millennium," University of LaVerne, October 2001.

"California energy: Knowing and saving," Soroptomists Club of Cal Poly, Sept. 2001 and to Walnut Valley Kiwanis Club, June 2001.

Presenter, BroncoFest Physics Magic Show, April 2001.

"Science activities with a magnetic personality," 15th Annual CEEMaST Conference, February 2001.

"The photon gas as a teaching/learning tool," invited presentation at the Gordon Research Conference on Statistical and Thermal Physics, Plymouth, New Hampshire, June 2000.

"Maxwell's demon in physics and beyond," in the PHY 306 - History of Physics class, Fall 1999.

"What's new in physics teaching?" Cal Poly Pomona Physics Department Seminar, November 1999.

Other Presentations Since 1995 (continued)

- "Light Bulb Detective Science Activities," 13th Annual CEEMaST Conference, May 1999.
Co-presenter, Physics Magic Show, Pomona Unified School District's Mathematics And Science Technology Science Fair, Ganessa H.S., April 1999.
- "The Light Bulb: A Physics Teacher's Dream," Covina Lion's Host Club, December 1998.
- "Illuminating Physics with Light Bulbs," a 3-hour workshop, Physics Summer Institute, Cal Poly Pomona, July 21, 1998.
- "Mirror, Mirror on the Wall: Science with Mirrors" and "Science Activities with Paper and Paper Clips," CEEMAST workshops for Headstart teachers, July 1998.
- "Illuminating physics with light bulbs," a two-hour hands-on workshop for Physics Summer Institute participants at Cal Poly Pomona, August 1997.
- "Learning about motion and energy with easy-to-make paper objects," a two-hour hands-on workshop for teachers in the Head Start Summer Institute in Mathematics and Science at Cal Poly Pomona, June 1997.
- "Making a convection wheel and learning all about convection," a hands-on activity for children in grades 4-6, developed for and presented to eight classes at four schools (Lorbeer Middle School, Ranch Hills Elementary School, Westmont Elementary School, and Kellogg Polytechnic Elementary School) in the Pomona Unified School District, May-June 1997.
- "Reflection of light," a hands-on activity designed and implemented with a science club, consisting of children in grades 3 - 5, at the in the Creek View Elementary School in the Ontario California School District, May 1997.
- "Rolling balls down inclined planes and inside plastic cups," a hands-on activity designed and implemented with kindergarten children at the Baldwin School, La Puente-Hacienda Heights School District, April 1997.
- "Making string and paper cup telephones," a hands-on activity designed and implemented with third grade children at the Baldwin School, La Puente-Hacienda Heights School District, January 1997.
- "Paper Helicopters," presented to two groups of middle school students at Cal Poly's Power of Pi Conference, February 1997.
- "The light bulb: From Edison to the third millennium," presentation to the University Club of Claremont, February 1997.
- "The light bulb: A physics teacher's dream!", presentation for the SCAMPI Summer Institute, consisting of 42 mentor high school teachers and SCAMPI staff, July 1996.
- "Learning physics with toys," presentation to two seventh grade classes at Hillview Middle School, East Whittier School District, May 1995.
- "Learning physics with toys," presentation to two seventh grade classes at Emerson Middle School, Pomona Unified School District, May 1995
- "Inflation can be fun: Science activities with balloons," invited presentation at The 1995 CSME Conference on Mathematics, Science & Technology, Cal Poly Pomona University, April 1995.

MISCELLANEOUS

- Biographical Profiles in:
 - American Men and Women of Science.
 - Who's Who In California, 25rd Edition.
 - Who's Who In the West, 24th Edition.

Who's Who in American Education, 4th Edition.

- Drummer in the Out-Laws of Physics band, consisting of members of the Cal Poly Physics Department (2003-present). Genre is country plus rock, blues, and swing.