(Cambridge U. Press, 1992); for a study of cosmic-ray physics, Thomas Gaisser's *Cosmic Rays and Particle Physics* (Cambridge U. Press, 1990) is tough to beat. Grupen's book does not improve upon those efforts.

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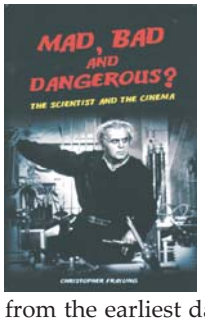
Mad, Bad and Dangerous?

The Scientist and the Cinema

Christopher Frayling
Reaktion Books, London, 2005. $35.00 (239 pp.). ISBN 1-86189-255-1

Christopher Frayling, rector of the Royal College of Art in London and the chairman of the Arts Council of England, is a raconteur of the Anglo-American cultural scene. His astonishingly eclectic resumé encompasses *Strange Landscape: Journey Through the Middle Ages* (BBC Books, 1995) and *Once Upon a Time in Italy: The Westerns of Sergio Leone* (Harry N. Abrams, 2005). In his scholarly work, *Mad, Bad and Dangerous? The Scientist and the Cinema*, Frayling draws on his considerable knowledge of film to survey relationships between science and modern society as depicted in movies. His book focuses on European and American science fiction and biopic films over the 20th century, from the earliest days of silent films to later blockbuster movies.



In contrast to Jay P. Telotte's comprehensive *Science Fiction Film* (Cambridge U. Press, 2001) or Vivian Sobchack's esoteric analysis of American sci-fi films in *Screening Space: The American Science Fiction Film* (Ungar, 1987), Frayling examines film portrayals of scientists as protagonists to gauge the general public's level of science comfort. His detailed historical descriptions of the early kinetograph efforts of such filmmakers as Georges Méliès, whose famous *A Trip to the Moon* debuted in Paris in 1902, are particularly charming and fun to read. Somewhat more disturbing is Frayling's account of the links between Fritz Lang's 1929 *Woman in the Moon* (which followed his 1927 classic *Metropolis*) and Hermann Oberth's development of rocketry in Germany. Oberth's efforts were apparently financed in part by residual money from his serving as a technical adviser on the 1929 film. His assistant during the film's production was a teenager named Wernher von Braun, who in 1937 would become technical director of the Third Reich's nascent rocket program, serving as an SS officer and production head of the slave-labor, V-2 rocket facility in Peenemünde, Germany.

In 1955 von Braun would team up with Walt Disney to produce the short television film, *Man in Space*. Frayling's descriptions of the connections between the early German sci-fi film concepts of space travel and the later rise of von Braun as a postwar American icon closely parallel those of M. G. Lord in her *Astro Turf: The Private Life of Rocket Science* (Walker, 2005), in which she recounts the roots of the US space program at the Jet Propulsion Laboratory in Pasadena, California (for a review of *Astro Turf*, see PHYSICS TODAY, February 2006, page 54). Both Frayling's and Lord's accounts are fascinating—and chilling. Frayling writes from an erudite, but lively, historical perspective, focusing on the first half of the 20th century. His analyses of more recent films tend to be overly crisp; if the book has any shortcoming, that may be it.

Society's perception of scientists should be a concern to us. Much like the character Blanche DuBois in Tennessee Williams's *A Streetcar Named Desire*, scientists have come to depend on the kindness of strangers—in Congress, in the media, and in the general populace—to get research support. How those "strangers" see us as scientists—with respect, fear, acceptance, or contempt—has crucial bearing on our professional progress and on society's well-being. To ignore that fact would be at our peril. For most people, film and television profoundly shape perceptions of reality; thus Frayling's insightful examination should carry import. He quotes from Carl Sagan's *The Demon-Haunted World: Science as a Candle in the Dark* (Random House, 1995): "We've arranged a global civilization in which most crucial elements . . . profoundly depend on science and technology. We have also arranged things so that no one understands science and technology. This is a prescription for disaster." Frayling asserts that the gap between the need for science and technology and societal understanding generates both public suspicion and wonder, a tensional paradox exploited by filmmakers.

Frayling describes the stereotypes that have painted scientists as "saints like Newton" or "sinners like Frankenstein" since the days of Christopher Marlowe's story of Dr. Faust's pact with the devil. Quoting from Roslynn Haynes's *From Faust to Strangelove: Representations of the Scientist in Western Literature* (Johns Hopkins U. Press, 1994), Frayling points out that those images of scientists are worth pondering: the maniacal alchemist seeking arcane hidden knowledge, the obsessed absent-minded professor who neglects every other aspect of his life, the inhuman rationalist ignorant of the moral implications of his work, the heroic adventurer going where no man has gone before, the helpless scientist whose work gets hijacked by nefarious government or corporate interests, and the social idealist, a maverick hero pitted against government and industry.

Frayling asks, Should scientists dismiss those generalizations as "low brow cultural phenomena . . . unworthy of serious consideration" or should we show "an awareness that popular images matter and can be challenged . . . to raise the quality of public discourse?" Frayling votes for the latter—and rightly so. He does point out, however, "that this is a difficult task in the era of the sound bite and when publicity is becoming increasingly important for research funding." For the foreseeable future, opines Frayling, scientists may well be stuck fighting Homer Simpson's succinct appraisal: "Pah! Eggheads—what do they know?"

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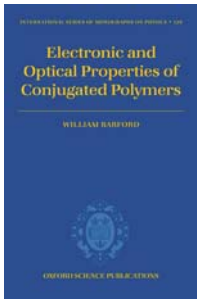
Electronic and Optical Properties of Conjugated Polymers

William Barford
Oxford U. Press, New York, 2005. $112.50 (262 pp.). ISBN 0-19-852680-6

Conjugated polymers became a major research field in solid-state physics when Alan Heeger, Alan MacDiarmid, and Hideki Shirakawa discovered in 1977 that it was possible to dope polyacetylene (PA) to high electric conductivity. The three were later awarded the Nobel Prize in Chemistry in 2000. In the 1980s research on conjugated polymers mainly concentrated on the conductive and charge-storage properties of those materials. The discovery in 1990 of electroluminescence in poly(para-phenylene vinylene), or PPV,

by Richard Friend's group at the University of Cambridge's Cavendish Laboratory in England reawakened interest in conjugated polymers.



William Barford's *Electronic and Optical Properties of Conjugated Polymers* is a theoretical complement to the high experimental culture of British research on conjugated polymers. Currently, the semiconducting properties of undoped, conjugated polymers are the focus of that research interest. Scientists are driven by the desire to understand the electronic and optical properties of the phenyl-based, light-emitting polymers in the hope that those materials will be exploited in a range of technologies. Such technologies include cheap and flexible light-emitting displays, photovoltaic devices, optical switchers, FETs, and all-polymer integrated circuits. Moreover, conjugated polymers are active components in many biological processes, such as the collection of light during photosynthesis and vision.

Interest in conjugated polymers is based not only on possible applications but also on the fact that in low-dimensional solids, the electron–electron and electron–lattice interactions are of particular importance to the electronic structure of solids. Understanding the complex effects of those interactions is one of the cutting-edge fields in condensed matter research. Conductive polymers belong within those low-dimensional systems because they are quasi-one-dimensional; therefore, their electronic properties are quite different from inorganic semiconductors such as silicon.

Barford's book starts with a treatise of noninteracting π-electrons in conjugated polymers. Then, step by step, the author includes electron–lattice and electron–electron interactions. He discusses the influence of those interactions on the ground-state dimerization and on dipole-allowed and dipole-forbidden excited states. In particular, Barford covers the weak-coupling limit, the strong-coupling limit, and the relevant intermediated range of electron–electron interactions. He explains how those interactions determine the character and the energetic order of excited states. He also describes why in PA the lowest excited state is dipole forbidden, which leads to a nonluminescent polymer, while the lowest excited states in PPV and in poly(para-phenylene), or PPP, are dipole connected to the ground state, thus allowing the conjugated polymers to be used for light-emitting diodes.

The book has excellent chapters on the dynamics and binding energy of excitons in conjugated polymers; the interactions between polymer chains in real materials; linear and nonlinear optical properties; and strategies for enhancing the singlet exciton yield, which determines the internal electroluminescent quantum efficiency of organic light-emitting diodes, by interconversion from the triplet states. At the end of the book, the author compares the experimental results for nonluminescent, conjugated polymers (PA, for example) and luminescent, conjugated polymers (such as PPP and PPV) with theoretical results calculated within the framework of correlated electrons, including strong electron–lattice effects. I feel the author could have also included experimental results on the exciton dispersion from electron energy-loss spectroscopy and the charge gap from photoemission spectroscopy.

Barford, who teaches at the University of Sheffield in England, is a well-regarded scientist whose research is principally focused on the theoretical and computational modeling of the correlated electronic structure in low-dimensional solids, such as conjugated polymers, and, to a lesser extent, in the field of high-T_c superconductors.

Throughout his book the electronic models of conjugated polymers are developed in the second-quantization representation. His approach makes the text clear and instructive, but readers need some prior knowledge of the theory for the electronic structure of condensed matter. But the author helps less-informed readers by including appendices that explain the second-quantization representations and other theoretical tools.

What makes *Electronic and Optical Properties of Conjugated Polymers* as a whole so enjoyable to read is that it gives a complete overview of the influence of correlation effects on the ground and excited states of those materials. It is a comprehensive treatise aimed at theoretical physicists and chemists working in the field and at graduate students and other researchers who need to analyze their data in terms of theoretical models. The book is long overdue.

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