



Instead of partnering with experts at the Department of Energy, who struck them as overly idealistic reformers, Kilby and TI sought patrons in the military who shared a more pragmatic vision of solar power. Despite promising back-channel conversations, the Pentagon ultimately deferred, arguing that expanded fossil-fuel production was the best way to ensure America's energy security.

The collapse of TI's solar-energy system mirrored the fates of similar projects that the squares initiated during the long 1970s. Regardless of their desire to solve civilian problems, many found it difficult to disconnect from Cold War military partnerships or acknowledge the expertise of stakeholders with different political views or professional backgrounds. In addition, most of the squares' public-facing initiatives relied on external incentives. Once that pressure was removed, those programs were shelved. The Reagan administration's cuts to alternative-energy funding in the early 1980s curtailed future solar projects, while the completion of the space shuttle led NASA to abandon its various terrestrial endeavours.

Still, the persistence of academic rhetoric surrounding interdisciplinarity and responsible innovation reminds us of a period when it was possible to imagine that the squares' technical expertise would be mobilized for the public good. If we wish to cultivate a similar sense of civic duty among contemporary researchers, there is much to learn from their 1970s predecessors, many of whose stories remain untold. Mody suggests a number of potential follow-up studies, most notably an examination of racial politics and technoscience in the post-civil rights South. His book also leaves room for a gendered discussion of squareness that examines the relationship between masculinity and scientists' professional identities. Whether considered on its own or as a starting point for future investigations, *The Squares* deserves attention from historians and policy makers for demonstrating the importance of scholarly engagement with the scientific 'silent majority.'

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## **Jeffrey Womack, *Radiation Evangelists: Technology, Therapy, and Uncertainty at the Turn of the Century***

**Pittsburgh: University of Pittsburgh Press, 2020. Pp. 288. ISBN 978-0-8229-4609-0. \$35.00 (hardcover).**

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Immediately after Wilhelm Röntgen's discovery of X-rays in 1895, a surge of technological enthusiasts swiftly seized upon its therapeutic potential. Spanning a diverse spectrum of backgrounds and orientations, these radiation therapists – including physicians, physicists, experimental biologists, diagnosticians, X-ray technicians and radium salespeople – are gathered together using Jeffrey Womack's evocative label: 'radiation evangelists'. Womack's book presents a captivating account of the early history of the contentious practice of radiation medical practitioners in Britain and America between 1895 and 1925. Womack chooses a religious term to capture the fervent faith of these technological

enthusiasts, who devoted themselves passionately to the hyped promise of X-rays and radium, which sadly left many of them crippled and burned.

Womack's meticulous scholarship traces the intricate landscape of early radiation pioneers and evolving technologies. Drawing extensively from diverse historical sources – ranging from newspapers, magazines and academic journals to letters and archives – Womack unveils the therapists' enthusiastic endeavours from the dawn of the 'Röntgen rush' to after the First World War. In the early twentieth century, journals and societies were founded to create a space for specialists and non-degree-holding technicians to exchange views on standards, ethics and licensing issues against quackery during the wave of medical specialization, as illustrated in Chapters 2 and 3. During the same transformative period, refinement of cathode tubes and comprehensive explorations of mechanisms of therapeutic actions were launched, as detailed in Chapters 4 and 5 respectively. Attracted by the lucrative medical marketplace, some evangelists also engaged in the mythmaking of the scarcity and miracle of radium, to a certain extent misleading the public to consume more radium than advisable, even by contemporary standards, as exposed in Chapters 6 and 7.

Nearly all of these stories have a tragic end. With the exception of Frank Hartman – the radium broker depicted in Chapter 7 who was fearful of radium – most evangelists ended up as martyrs, even though they were at least vaguely aware of the uncertainty and hazards of radiation from the beginning. Uncertainty cast a shadow from multiple angles, such as deficiencies in the X-ray apparatus framework, inaccuracies in dosimetry and the obscure mechanism of the effects of ionizing radiation on human bodies. But these technical shortcomings and medical uncertainties failed to quell the evangelists' enduring technological optimism. The hazard, evidenced by dermatitis, erythema and cancers, was downplayed to a level of tolerance. It inflicted patients with skin problems while therapists suffered from insufficient shielding from radiation exposure. Meanwhile, therapists embraced as an ethical principle the golden rule of conducting experiments on themselves before applying treatments to patients, which added a self-sacrificial tinge to the evangelical mission of these therapists. But the narrative of medical martyrdom – a religious label that was adopted by the radiation evangelists themselves – is greeted with scepticism by the author, who attributes much of the self-inflicted tragedy to undue enthusiasm for new technologies and underestimation of the associated uncertainty.

These factors contributed to the poignant fate of almost an entire generation of radiation therapists and patients, who succumbed to diseases induced by uncontrolled dosages of radiation and long-term risks of radiation exposure, as viewed from a modern-day perspective. Mourning the martyrs of radiation, Womack appeals to prudence and precaution in the application of innovative technologies to the human body, regardless of their apparent promise. Whereas other historians have unravelled the perilous fallout of technological optimism, such as Zuoyue Wang in his study of the President's Science Advisory Committee in Cold War America, Womack contributes a focused analysis of the clinical dangers of hasty adoption of new technologies for medical treatments, which became a matter of life and death.

*Radiation Evangelists* speaks to existing scholarly work in the history of biology, including the history of radium presented by Luis Campos in *Radium and the Secret of Life* (2015), the history of radiobiology by Angela Creager in *Life Atomic: A History of Radioisotopes in Science and Medicine* (2013), and the history of radioactivity in modern American history by Matthew Lavine in *The First Atomic Age: Scientists, Radiations, and the American Public, 1895–1945* (2013). Weaving together insights developed from a careful investigation of specialized journals, medical textbooks, advertisements, meeting agendas, memoirs, correspondence between journalists and experimenters and personal records from early therapists, the book is primarily intended for historians of medicine and historians of

technology, but historians of modern America and Britain intrigued by the paradox of one of the most important medical interventions in the early twentieth century will likely find the book immensely appealing, if not somewhat alarming.

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## Milena Ivanova and Steven French, *The Aesthetics of Science: Beauty, Imagination and Understanding*

London: Routledge, 2022. Pp. 224. ISBN 978-1-032-33718-0. £110.00 (hardback).

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Edited collections are acts of resistance. We are told that they weigh less in research assessments and that book chapters are not as valuable as articles and monographs, and yet we stubbornly hold on to this enduring academic format for some of our most important publications. Milena Ivanova and Steven French's *The Aesthetics of Science* is a brilliant example of why we do this, why our resistance to institutional pressures is entirely justified, and why we should indeed continue to resist: because edited collections are the materialization of the time and spaces we reclaim as researchers to engage in new conversations that transform our fields.

*The Aesthetics of Science* consists of nine chapters, authored by leading experts in philosophy of science and aesthetics. The introduction, co-authored by Ivanova and French, sets the agenda for the volume. Aesthetic judgements are ubiquitous in science: scientists often compare their theories to works of art, assume (but rarely justify!) a relationship between the beauty of a theory and its truth, and routinely invoke aesthetic considerations in that contested process that philosophers have come to characterize as 'theory choice'. These judgements, and the aesthetic vocabulary they mobilize, need to be taken seriously – but this does not entail that they can simply be taken at face value. To investigate the work they do in scientific practice, Ivanova and French argue, philosophers of science should stretch beyond epistemology, and join forces with scholars in the field of aesthetics.

Beauty, truth, theory choice: why, readers of the *BJHS* will ask, should historians of science go back to these philosophical debates? *The Aesthetics of Science* reframes these philosophical questions in profoundly novel ways, leaving behind (convincingly – and hopefully for good!) the relics of an older epistemology that contributed to drive a wedge between historians and philosophers of science. Instead, it offers a philosophy of aesthetic *practices* in science that is pluralistic, context-sensitive, and naturally in dialogue with history.

The volume's key themes are captured by its subtitle: *Beauty, Imagination and Understanding*. These three notions intersect in ways that cast new light on the performative aspects of science and the transformative potential of aesthetics. Several chapters position debates across aesthetics and philosophy of science firmly within the tradition of integrated history and philosophy of science. Steven French, for instance, examines the aesthetic properties of theories as properties of scientific practices and performances,