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Why we write (nuclear) history

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Essay Review

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Luis A. Campos, *Radium and the Secret of Life*. Chicago and London: The University of Chicago Press, 2015. Pp. 352. ISBN 978-0-226-23827-2. $55.00/£38.50 (hardback).

Timothy J. Jorgensen, *Strange Glow: The Story of Radiation*. Princeton, NJ: Princeton University Press, 2016. Pp. 512. ISBN 978-0-691-16503-5. £24.95 (hardback).

Nuclear history always compels. Scholars (and readers) can immerse themselves in the existential threat posed by the atomic bomb and its successor weapons, the tantalizing prospect of carbon-free energy, or the study of a natural phenomenon deeply at odds with our everyday experience of the world. There is thus always something profound at stake when we write nuclear history – be it physical, economic or intellectual. And while it may seem that the end of the Cold War should have diminished the academic attention accorded to the subject, it actually just allowed the historiography to evolve. To the wealth of technical and political studies that once dominated nuclear history, we can now add a host of excellent cultural, environmental, literary and transnational studies.[1] Those of us who entered the field shortly after the break-up of the Soviet Union have been able to follow these developments first-hand, from the initial uncertainty of where nuclear history would go without its original *raison d'être* to seeing the possibilities opened up in a post-Cold War world. The books under review here provide important and timely additions to this historiography. Luis A. Campos's *Radium and the Secret Life* provides a rigorous and compelling account of the uses of radium in early twentieth-century biology; Timothy J. Jorgensen's *Strange Glow: The Story of Radiation* offers an accessible and illuminating analysis of the benefits and risks of radiation. The books also make for a fascinating juxtaposition. They complement each other well, but also contain some intriguing differences that allow us to reflect on the nature of nuclear history in the early twenty-first century.

It is difficult to imagine a better exemplar of the changing historiography than *Radium and the Secret of Life*. In fact, one could argue that this book is not nuclear history at all: Campos is a historian of biology and his book is deeply engaged with the concerns of

1 See, for example, Alex Wellerstein, 'Nuclear history bibliography, 2015' *Restricted Data: The Nuclear Secrecy Blog*, at http://blog.nuclearsecrecy.com/2016/02/05/nuclear-history-bibliography-2015. Wellerstein's website has several bibliographies, providing an excellent overview of current nuclear historiography.

that field. Its story unfolds almost entirely before the Manhattan Project began, and its thematic focus is quite different. For Campos, radium is important as a means to explore developments in the history of biology, not physics. He tells a story in which physicists, botanists, evolutionary biologists and geneticists all saw the new element as something that could help explain fundamental processes of life. And the word 'nuclear' itself appears in the index only once. But this apparent absence, I would argue, is precisely the point. We can only think of the book as non-nuclear if we use a particular definition of what nuclear history is – and when it took place; confining it to the products and processes of the military–industrial systems created during the Second World War is all too easy. Yet long before radioactivity became an integral component of Cold War narratives, scientists were actively using it to explore some of the most pressing questions in biology. They incorporated radium into their experimental toolkits and drew heavily on its (perceived) meaning in their interpretive work. The first case study, for example, examines research done by the physicist John Butler Burke, who made headlines when he claimed to have used radium to produce half-living "radiobes" that could shed light on the processes by which life originally came to be. Other chapters follow less sensational but ultimately more sound uses of radium in the work of other scientists: Daniel Tremblay MacDougal, Charles Stuart Gager, Albert Francis Blakeslee, Thomas Hunt Morgan and Hermann J. Muller (among others). Telling their stories allows Campos to make two main arguments – one about experiment, and the other about rhetoric.

On the first point, he contends that his case studies 'not only uncover heretofore unknown but important dimensions of radium's life in biology, but also help to revise canonical moments in the early history of genetics' (p. 8). Campos offers compelling accounts of the role radium played in contemporary debates about spontaneous generation, speciation and the nature of mutation. For many of his subjects, radium was a means of producing the very changes under study. This was true of Burke and his half-living radiobes – so named because of radium's role in their production. It was also true of his successors, who turned their attention to the origin of species (as opposed to the origin of life). The second case study features a pair of scientists – MacDougal and Gager – who studied the effect of radium on plant physiology. They were not the only biologists interested in these questions, but among the more successful in making the investigations concrete; Campos writes that 'MacDougal was arguably the first to make the evolutionary link between the transmutation of radium and the transmutation of species *experimentally* explicit' (p. 123, original emphasis). From there, Campos turns to 'radium genetics' – experimental attempts to understand the nature of heredity, whether through chromosomes or genes. By 1927, the work of Blakeslee and Gager had demonstrated that radium 'could induce chromosomal mutations and, as such, was an important first tool in the experimental control of heredity' (p. 190). The fourth and final case study centers on Hermann J. Muller, whose groundbreaking research used radium before X-rays; in fact, he seems to have switched to the latter only because of an accident in shipping the former to his laboratory (p. 215). This chapter also contains a fascinating exploration of the mechanisms through which the pre-Muller work has been obscured in historical memory, a process by which his

'important advance in a well-worked field' became retold as 'an epochal moment of revolutionary change' (p. 224). Scholars interested in the dynamics of narrative creation will find this section of particular interest.

Muller's story thus confirms Campos's first argument – about the technical importance of radium – in two ways. Not only does it show the importance of radium in the making of a seminal research programme in the history of biology, but also the subplot about the making of the Muller myth helps explain why our collective amnesia about the earlier role of radium should not be taken as evidence that it didn't exist. All of this, however, constitutes only the first argument of the book: that radium played a central (and underappreciated) experimental role in the history of biology. This is an important point, but Campos goes beyond simply correcting the historical record. He contends that radium played a conceptual role for his actors, not just an experimental one. The ways that they interpreted their results – and often the very means by which they designed their investigations – were deeply influenced by their assumptions about the meaning of radium. Muller's work provides a particularly compelling case study. Campos cites numerous instances in which Muller's emergent understanding of mutation was framed by his pre-existing ideas about radium; his notes for a 1916 lecture, for example, indicate his belief that mutations 'happen at random and uncontrollably, like Ra[dium]' (p. 197). The key phrase here is 'like Radium', which shows not merely rhetorical flourish but also how a pre-existing category helped to define a new one. Muller made a similar move six years later, when he invoked the concept of a half-life to express his views about the mutability of genes. 'The rate of change,' he suggested, 'is found to be so rapid that at the end of a few decades half of the genes descended from those originally present would have become changed' (p. 201). Again, a concept from the study of radioactivity appears to be the key towards presenting – and perhaps even conceptualizing – the study of heredity.

Pre-existing ideas are always important to the study of new phenomena. But radium proved to be a particularly powerful source of images, associations and metaphors. In the book's first chapter, Campos lays the groundwork for his case studies with a compelling synthesis of the ways in which radium became imbued with rhetorical power. These included the historic association between heat and light, narratives of decay associated with thermodynamic laws, contemporary debates over spontaneous generation, and post-Darwin attempts to link cosmic and biological evolution. Culturally speaking, radium was much more than a newly discovered element; it became a site for fantasies of both limitless power (nuclear energy) and fundamental knowledge (the secret of life). Readers familiar with the work of Matthew Lavine on the radium craze and of Spencer R. Weart on the history of nuclear images will recognize these arguments.[2] But Campos is ultimately less interested in the cultural life of radium than in the scientific; his first chapter focuses on the ways in which radium promised to transform existing debates within biology. Among his actors, only Burke claimed to have used radium

2 Matthew Lavine, *The First Atomic Age: Scientists, Radiations, and the American Public, 1895–1945*, New York: Palgrave MacMillan, 2013; Spencer R. Weart, *Nuclear Fear: A History of Images*, Cambridge, MA: Harvard University Press, 1988.

to create life (or something lifelike, at least). But all of them understood the possibilities of their own research in terms heavily influenced by the Curies' famous discovery:

> like radium, genes transmuted; like radium, genes sometimes differentially reproduced, giving rise to transmuted daughter genes that were similar to, but not quite the same as, themselves; like radium, genes existed near the border between the living and the nonliving. They both emanated, they both radiated, they both contained secrets within themselves. Genes reflected the elements of radium in all these ways, and all at once. Genes were the new radium. (p. 202)

So powerful was this tendency that it appears even in the work of scientists who tried to disavow it. Campos describes how Charles Stuart Gager was critical of the links that Burke had drawn between radioactivity and life. But his own interpretations showed the same sort of intellectual moves; they were just subtler and perhaps unconscious. 'The powerful associations between radium and life in the early twentieth century', Campos writes, 'not only led to the *possibility* of Gager's experiments, but even helped to characterize the nature of the very knowledge he obtained from them' (pp. 143–144, original emphasis).

In *Radium and the Secret of Life*, radioactivity is at the centre of a history of biology. In Timothy Jorgensen's *Strange Glow*, it is the principal thread in a story of health and illness. This focus naturally brings Jorgensen closer to the iconic moments and actors of the nuclear age; the subject cannot be explored without reference to the radium girls, the *Lucky Dragon* incident or Chernobyl (among many other examples). This is partially because of his desire to use stories to increase accessibility; he opens the book by declaring both his goal of reaching 'the widest possible audience of readers, regardless of whether they have any technical background' and his belief that storytelling is the best way to do so (p. ix). But it also stems from the nature of the material. Much of what we know about the health risks (and benefits) of radiation is rooted in historical experience. Jorgensen draws, for example, on the Life Span Study begun after Hiroshima, as the definitive cohort study through which later assessments have been made. Other case studies include analysis of the radon exposure of one particular family in Pennsylvania in 1984 (pp. 275–278) and the use of caesium isotopes to assess the potential dangers of eating fish from the waters near Fukushima (pp. 330–333). Historical examples thus provide not just the rhetorical flourish and narrative appeal of Jorgensen's book, but much of the technical data as well. This is an intriguing confluence. It means that, in this case at least, no definitive separation can be made between science and the history of science.

Strange Glow is divided into three parts, all of which focus on questions of health, illness and risk. The first – and shortest – section is largely introductory; Jorgensen uses it to present some of the necessary technical information. He provides this background in an accessible and engaging manner, relying heavily on accounts of some of the more famous figures in the early history of radioactivity: William Roentgen, Henri Becquerel, Marie Curie, Ernest Rutherford and James Chadwick. He also showcases a knack for describing concepts quickly and well. The opening section, for example, is filled with lucid explanations of complicated topics; Jorgensen discusses the importance

of wavelength in determining the properties of radiation (pp. 33–36), the definition of radioactivity (p. 42), and the importance of the half-life concept for human and environmental health (pp. 46–47).

The second section moves explicitly towards considering radiation and health. Jorgensen writes of the early research pioneers, many of whom took cavalier attitudes towards safety (pp. 67–68, 123); in some cases – such as Curie's mistaken belief that the effects were reversible – it was simply imperfect knowledge that led to their nonchalance (p. 99). The Manhattan Project proved to be a major impetus for standardizing procedures and the assessment of risk, and Jorgensen makes clear that this was not an easy process. Interestingly, the original motivation for long-term study of radiation and health was to measure genetic effects; Thomas Hunt Morgan and Hermann Muller thus enter Jorgensen's story, providing a concrete link with Campos's book. Such studies quickly became moot, however, once it was realized that the threshold for cancer susceptibility was lower (pp. 229–230). Jorgensen also spends significant time on the discovery and refinement of medical techniques; *Strange Glow* is not an alarmist text, nor is it blind to the benefits of radiation.

In fact, the book ultimately leans away from alarmism altogether. In the final part, Jorgensen focuses on cost–benefit analyses, using case studies such as radon, mobile phones, and nuclear power plant accidents. In most cases, he concludes that the risks have been overstated – sometimes greatly so. With radon, for example, he notes that smokers are at much greater risk than non-smokers. This is a fact of considerable importance for analysing risk. Even if you accept a high-end estimate of radon-induced deaths from lung cancer (21,000, or 3.5 per cent of the annual cancer deaths in the United States), the risk to non-smokers is considerably smaller (2,000 deaths, or 0.3 per cent of overall cancer mortality). This represents one-tenth the number of people who die annually from influenza (pp. 287–288). He performs similar analyses in the case studies on food (fish from Fukushima) and mobile phones. But he is not universally dismissive of the risks of radiation, pointing out in the chapter on diagnostic radiography that the cost–benefit analyses of screening get complicated quite quickly. In the absence of other clinical indications, he writes, it is not clear that regular mammograms are worth the risk for women aged fifty (pp. 298–302). And even with mobile phones, he acknowledges that it is difficult to establish certainty on the question (pp. 320–321). Although the first two sections are engaging and accessible, much of the intellectual energy of the book comes from these final chapters; it is in the case studies that we can truly see Jorgensen's expertise at work.

Readers may still raise questions after reading these analyses, of course. For example, I found myself wondering about the limits of disaggregating radiation risks; case studies are analysed individually, but our bodies experience them simultaneously. Jorgensen also seems, at times, to overstate the degree to which individuals are in control of their own exposure (pp. 321–322, 361). But there is no doubt that he meets his goal of writing an accessible, engaging and useful book. He places particular emphasis on this final point; Jorgensen wants to enable his readers to be able to understand radiation better and to assess its risks more accurately. Part of his success on this score is a focus on the methods and thinking of risk assessment. He does not shy away from offering

assessments on particular issues. But his greater contribution lies in educating readers on the thinking behind risk assessment. He introduces important concepts (such as NNH and NNT, the 'number needed to harm' and 'number needed to treat'), discusses the challenge of dealing with uncertainty, and stresses the importance of placing statistics in context. For example, he cites one study that suggested that those at the highest levels of mobile phone usage may have a 40 per cent higher risk of gliomas. But even if this finding were to hold across other studies, it may not be as bad as it sounds; Jorgensen walks the reader through calculations indicating that there would be only one additional case for every 420 mobile phone users (pp. 314–315). Of course, that may still be too high for comfort. The point of Jorgensen's exercise – and similar ones through the book – is to give readers tools to understand what research findings mean in actual practice.

Taken together, these two books offer an intriguing set of comparisons. In some respects, they are similar. Both, for example, help move nuclear historiography beyond a focus on weapons technology and Cold War politics. And both are interdisciplinary in their focus and appeal: Campos's actors quite consciously mixed physics and biology, while Jorgensen's interest in health leads him to integrate medicine, statistics and biology throughout the book. But without meaning to underplay the resonances between them, I find myself drawn more to their distinct approaches – and to what we might learn from those differences. *Radium and the Secret of Life* is scholarship that historians of science will easily recognize and appreciate; it uses archival research and deep immersion in the scholarly literature to make a novel argument about a process of knowledge creation. In contrast, *Strange Glow* is popular science. History is important to both the presentation and the substance of the book, but its animating questions are about risk analysis. The upshot is not just that Campos's book is geared towards an academic audience while Jorgensen's is written with more general readership in mind – although that is certainly true. More fundamentally, the two works reveal very different models for how to think about the role of history in academic scholarship. At the risk of oversimplification, we might say that one of these books *is* a history, and the other *uses* history. This is an important distinction. *Strange Glow* contains many historical highlights, and uses them to good effect. But it is not a sustained argument – either about a particular era or about a process of historical change. This is not necessarily a bad thing; there is no reason why professional historians should have a monopoly on what history is and how it should be used. But it does highlight a difference in method that is potentially consequential, and should not be overlooked simply because both approaches use historical storytelling to make their points.

Thinking about the nature and uses of history, of course, is not unique to scholars of the nuclear age. But it seems to have particular urgency in a field that is not used to having to actively justify its own existence, or to think about the reasons for its own importance. The historian of science Daniel J. Kevles, writing just after the end of the Cold War, noted that 'physics in the United States has been irreversibly incorporated into the conventional political process, making it a creature of political democracy, its fortunes, like those of other interest groups, contingent upon the outcome of the

fray'.[3] A generation later, something similar seems to have happened in nuclear history. Campos, in particular, seems to be well aware of this – although his reference point is the history of biology, not physics. Throughout the book, he deploys the idea of a half-life as a metaphor as well as a scientific concept, to describe the diminishing but not quite vanished cultural and historical interest in radium. That is not quite the situation in nuclear history more broadly, although there is certainly a parallel. But Campos's and Jorgensen's conscious exploration of how history operates in their books is a good reminder to us all. We have many new questions we can ask about nuclear history, and it intersects with other fields in the history of science in novel ways. But we can no longer assume that its place is either privileged or obvious. Nuclear history may still compel – but for different reasons, and in different ways, than it once did.

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3 Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America*, reprint, Cambridge, MA: Harvard University Press, 1995; first published 1977, p. xlii.