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SURVEY REVIEW

Radioactivity redux

Marjorie C. Malley: Radioactivity: A history of a mysterious science. New York: Oxford University Press, 2011, xxi+267pp, $21.95 HB

Lauren Redniss: Radioactive: Marie & Pierre Curie, a tale of love and fallout. New York: itbooks, HarperCollins Publishers, 2011, iv+205pp, $29.99 HB

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As readers of *Metascience* probably know, just as 2005 was the International Year of Physics, commemorating the centennial of Einstein's *annus mirabilis,* and 2009 was the International Year of Astronomy, commemorating the 400th anniversaries of Galileo's telescope and of Kepler's *Astronomia Nova*, 2011 was the International Year of Chemistry, commemorating the 100th anniversary of Marie Curie's Nobel Prize for Chemistry, "in recognition of her services to the advancement of chemistry by the discovery of the elements, radium and polonium, by the isolation of radium and the study of the nature and compounds of this remarkable element." In 1898, Curie coined the term *radioactivity* to describe the properties of radium and polonium and similar substances.

Neither of the two books under consideration in this review calls attention to the IYC, but, because of their link to Curie, it is perfectly appropriate that they were both published in 2011. Each book garnered more than a measure of praise, with Malley's selected by the editors at Amazon.com and the staff of the *Christian Science Monitor* as one of the "nine best books of August" 2011, and Redniss's becoming a finalist for the 2011 National Book Award for nonfiction. Though the titles of the two books underscore the link between them, the raison d'être, presentation, and scope of the two books could hardly be more different. Each would be a fine addition to the personal and institutional libraries of *Metascience* readers.

For a 21st-century author, Malley has remarkably little presence on the Web, and what personal details I could glean about her professional life come mostly from the OUP press release, the book jacket, and her own preface, footnotes, and bibliography. *Radioactivity* appears to be her only book, but among her published articles are several on radioactivity—a topic originally suggested to her "many

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years ago" by her UC-Berkeley graduate school advisor, notable historian of science John Heilbron. Malley has also served as a member of the review panel for the National History Standards and as chair of the Education Committee of the History of Science Society. From the preface, we learn that she undertook the project that resulted in this book when a friend asked her to recommend "an overview of the history of radioactivity." Realizing that "nothing was available for … interested nonspecialists who did not have the background, time, or inclination to piece together a full historical narrative from the available materials," she decided to fill that gap for a broad target audience, including "specialists in related fields such as physics, chemistry, and history; … nonspecialists wishing to know more about this remarkable episode in modern science; and … readers interested in the world at the turn of the 20th century." The book is divided into three sections, with the longest being the first, "A New Science," which successfully conveys the excitement of the pioneers of radioactivity research as they tried in fits and starts to unravel the mysteries presented by this "totally unanticipated and mysterious phenomenon." The much shorter second section, "Measuring and Using Radioactivity," describes not only "applications, methods and instruments" but also "the institutional structures that supported the new science." The even somewhat shorter third section, "Beyond the Story," summarizes the background behind the development of the science of radioactivity and its evolution into nuclear and particle physics, and puts this episode in the history of science into a more general context of "the ongoing human search to comprehend the world."

Among the many things I admire in Malley's survey is her shedding light on the contributions of lesser known individuals to the field of radioactivity research. Of all the radioactivity researchers covered in this book, students today may recognize only the name Curie, while their professors are likely also to recognize the names Rutherford and Soddy. Malley has done a service in reminding us of the important work done by others, including the Germans Julius Elster and Hans Geitel and the Austrians Egon Ritter von Schweidler and Stefan Meyer, the latter being particularly influential in his role as first acting director of the Institute of Radium Research in Vienna. We learn, too, that in 1911–12, it was a nonscientist, Antonius J. van den Broek, "a Dutch lawyer who closely followed developments in recent physics," who first suggested that the periodic table should be ordered by atomic number rather than by atomic weight, and who also asserted that atomic number corresponded to nuclear charge. Malley also identifies the first to demonstrate the effects on human skin of radium exposure as a German dentist, Friedrich O. Walkoff. It was an article by Walkoff and his organic chemist friend Friedrich Giesel, who provided him the radium sample, which inspired Pierre Curie to burn his arm intentionally by exposing it directly to radium for several hours, ultimately ushering in the field of radiation, or Curie therapy. Malley pays homage, too, to those "laboratory technicians" working in the background, including "mechanics, glass blowers, demonstrators, laboratory stewards, and other assistants," without whose "skill, inventiveness, and perseverance … many investigations would not have been possible." Malley also notes how the young field of radioactivity research was more welcoming to women than other, more established fields. Among the

names of women she rescues from obscurity are those of Rutherford's assistant Harriet Brooks; the Hungarian-born pioneer in radioactive tracing, Elizabeth Rona; and Bertha Karlik, a student of Stefan Meyer's who ultimately succeeded her mentor as the director of the Vienna institute.

Related to Malley's generosity in acknowledging scientific effort is her exploration of the not uncommon problem of ascribing credit to a single individual for a discovery that is made simultaneously by many. Among other examples, she focuses on the concept of isotopy, credit for which is traditionally given to Frederick Soddy, despite the fact that several other less well-known scientists had also suggested "that inseparable elements might share a single position in the periodic table." I was amused by her reference to "the Matthew effect," which gets its name from a verse in *Matthew* 12:12: "To anyone who has, more will be given and he will grow rich." As she summarizes, "Fame and credit tend to accrue to those who are already famous," so that Soddy alone is usually credited both with the concept of isotopy and with the laws of displacement, according to which "the electrochemical properties of a decay product depend upon whether the parent element emits an alpha or a beta ray."

Malley also sheds light on how the nature of science has been perceived differently by different national cultures and different scientific disciplines. She explains, for example, that in 19th-century France, as on the continent in general, positivism held sway, championing "a noncommittal, mathematical approach," which "shunned visual models for phenomena," while in England at the same time—perhaps inspired "by the industrial machinery around them"—some physicists "devised concrete, visual models to represent physical phenomena such as electricity." The Curies' reluctance to accept the Rutherford–Soddy explanation of radioactive decay, she argues convincingly, can be traced to their having been steeped in the culture of positivism. Similarly, she roots the differing reactions of physicists and chemists to the theory of radioactive decay to the different approaches of the two disciplines. While the former "overwhelmingly accepted the Rutherford–Soddy theory," chemists did not, since they not only "distrusted a theory based on evidence from the physicists' electroscopes and spectroscopes" but also had trouble accepting a theory that "depended on experiments with quantities of matter much too small for chemical tests." Until radiochemistry became a recognized field, many chemists were reluctant to pursue work in radioactivity; they had traditionally "identified elements by their atomic weights, yet it was impossible to find atomic weights for minute traces of materials that could vanish before anyone could weigh them."

Although it is Redniss's book rather than Malley's that focuses on the Curies as its central figures, as someone who has done biographical work on the couple for nearly twenty years, I am particularly intrigued by Malley's psychological portrait of Marie, which, developed mainly in the second and in the final chapter, more or less frames the book. Malley suggests that the death of Curie's mother, a devout Catholic, when Marie was only 10 and her mother only 42, only ostensibly knocked the religion out of her. Famous in life (and in the 1943 Greer Garson film *Madame Curie*) for the austerity of her scientific commitment, Curie, in Malley's view, may have turned her back on established religion but in effect "took on the behavior of

one dedicated to the religious life," with scientific research replacing "the traditional goals of religion" and the lab becoming her sanctuary. Likewise, her graduate school garret took the place of a convent cell, and her preference for unadorned dark clothes emulated "the prescribed uniform of clerics and nuns." In a final section on the "Mythological and Romantic Dimensions of Radioactivity," Malley explains that the media "portrayed Curie as a heroine, almost a saint," and compares her search for pure radium to the "pursuit of the Holy Grail," with radium becoming for a time "a miraculous healing agent, the elixir of life." Malley notes that following the detonation at the end of World War II of atomic bombs, dependent as they were on radioactivity, what had once been viewed as "a magical elixir" became to many "an incarnation of the poisonous apple, the fatal temptation," with the result that scientific research "was demoted from its status as humanity's savior." This outcome, however, in no way contradicts what seems to me a very apt comparison of Curie's character with ascetic religious practice. As it turns out, Redniss quotes remarks by Pierre ("I vowed … to lead a priest's existence") and by Marie ("He caught the habit of speaking to me of his dream of an existence consecrated entirely to scientific research, and asked me to share that life") that bolster Malley's assertion.

If asked if I found anything missing in Malley's survey of the history of radioactivity, I might mention two things. As a biographer, I might have preferred a longer book that included more personal information about the scientists. Malley introduces each of the fourteen chapters with at least one epigraph, and in some cases the significance of her choice of quotations might have been enriched by inclusion of more detail. In particular, in the choice of epigraphs for Chapter 4, "The Radioactive Earth," and Chapter 5, "Speculations," the excerpted quotations from Rutherford would make more sense to readers if they knew more about his career. In the first case, Rutherford in 1904 found himself in a ticklish situation when Lord Kelvin, the grand old man of British physics, showed up in the audience at the Royal Institution where Rutherford was about to challenge the older man's theory about the age of the earth. After surviving the encounter, Rutherford enjoyed telling a humorous story about how he mollified Kelvin. In the second case, once the role probability played in the rate of atomic transformation became clear to him, Rutherford, though now the head of physics at the University of Manchester, was not too proud to audit a series of lectures on probability, or to be seen taking copious notes during the lectures.

What I missed in the book even more than biographical detail is an explanation, even if only in an appendix, of how we got from the basic unit of the "curie," which Malley introduces in her coverage of the International Radium Standards Committee of 1910, to the proliferation of units for measuring radioactivity. I am often asked the difference between becquerels and curies, and among sieverts, grays, roentgens, and rads, and it would have been useful to have a list identifying each unit and distinguishing among them.

While I admire Malley's useful contribution to the literature, Redniss's is in a different category entirely: It is at once an unconventional biography of Marie Curie, an exploration of the idea that both science and love are double-edged swords, and an unusual work of both literary and painterly art—a mix that should

not surprise us, since Redniss is artist-in residence at the American Museum of Natural History, a faculty member at Parsons The New School for Design, and a former fellow at the Cullman Center for Scholars and Writers at the New York Public Library and at the New York Institute for the Humanities. Although the book has many features that make it, so to speak, an orange to Malley's apple, the two books also tread more common ground than might be initially apparent. On purely formal terms, for example, Redniss, like Malley, introduces each chapter with at least one epigraph, and as is the case with Malley's book, these epigraphs are often but not always effective. In addition to pointing out, either explicitly or implicitly, that science replaced religion in the Curies' lives, both Redniss and Malley develop the theme that radioactivity seemed magical to the early researchers.

For Redniss, however, the magic seems completely to have faded, and both science and love come in for rough handling by the author. At the very opening of the first chapter, we learn first that Pierre Curie was born on the Paris street named for Georges Cuvier, an advocate for the geological theory of catastrophism, according to which "time lurches forward in sudden disasters." On the facing page we learn that Marie's three experiences of romantic love over the course of her life all ended in loss. Redniss, moves from her historical tale to a variety of related nuclear catastrophes, including the negative outcomes of the Hiroshima bombing, the accidents at Three Mile Island and Chernobyl, and the still unsolved 2006 murder of a former KGB officer in London through the use of polonium-210. (The book was published before the 9.0 earthquake and subsequent tsunami that hit Japan on March 10, 2011, causing damage to the Fukushima Nuclear Power Plant, or she would surely have covered that incident also.) In addition, she calls attention to the corneal–retinal burns caused by thermonuclear blasts at Bikini and Eniwetok Atoll in the Pacific Ocean and to the illnesses caused by the atomic testing program carried out in Nevada from 1951 to 1999. She does introduce a young man whose non-Hodgkins lymphoma, diagnosed when he was 14 in 2001, was treated with the 21st-century version of Curie therapy, but she devotes twice as much space to the "Merry Widow Health Mine," a contemporary "radon spa," where gullible visitors suffering from a variety of ailments submit themselves to treatment by breathing in air with dangerously high radon levels.

While I do not endorse Redniss's message—I am among a perhaps dwindling number of people who still believe that nuclear energy has a place on a planet threatened by global climate change—I do admire some aspects of her method. The appealing features of Redniss's book include the literary use of chapter titles with more than one meaning and the evocative artwork. Examples of double-entendre titles are "Magnetism" for chapter two, which develops the personal magnetism that develops between Pierre and Marie following their introduction by a mutual scientific colleague, even as it explores Pierre's discovery of a link between heat and magnetism, and "Fusion," for chapter three, which not only describes how the couple's lives fuse but also foreshadows the connection between Marie's understanding that there was energy within the atom and the human ability to mimic nuclear fusion. And while I claim no abilities as an art critic, I am impressed by Redniss's explanations of the cyanotype imaging and Eusapia LR typeface she invented for the purposes of this book, the former for capturing "what Marie Curie called radium's 'spontaneous luminosity'" and the latter for resembling the typeface

on title pages of manuscripts Redniss consulted in the archives of the New York Public Library, and which Redniss named for the medium whose séances the Curies attended.

As intriguing as this book can be in its leaping back and forth between the past and the present, the method can also result in some jarring juxtapositions, as in her inclusion of an idiosyncratic list of "luminaries, flora and fauna from the land known today as Poland" as if to compensate for the fact that the public was more interested in the second element Curie discovered, radium, than in the first, polonium, which she named in honor of her native land. Among the juxtapositions that make more sense to me is Redniss's focus on the birth of the father of the atom bomb, J. Robert Oppenheimer, in 1904, the same year as the birth of the Curies' younger daughter, Eve. (A perhaps more forceful juxtaposition she might have included is pointed out by Richard Rhodes in *The Making of the Atomic Bomb*: On the day of Curie's death, July 4, 1934, Leo Szilard, a physicist born in Hungary in 1898, the year Curie discovered polonium and radium, filed a patent describing a device that could produce an explosion by releasing the energy inside the atom. Some years later, Szilard helped conduct the first sustained nuclear chain reaction that led to the development of the atomic bomb.)

The book also contains a smattering of small factual errors. Redniss says that following Pierre's accidental death, Curie moved to Sceaux, where Pierre grew up, so that she and her daughters "could be near his father," but in fact Dr. Eugène Curie had been living with her family since his wife's death shortly after the birth of the Curies' first daughter (and future Nobel laureate), Irène, in 1897. Redniss also incorrectly states that Einstein "had fathered an illegitimate daughter with a former student," but Mileva Maric, the mother of that child, was not a former student but a former classmate at the Zurich Polytechnic. Although Redniss's coverage of Curie's breakdown following the scandal in 1911 caused by her affair with her married colleague Paul Langevin is quite good, she incorrectly asserts that Curie returned to France after a period of self-exile only with the outbreak of World War I in summer 1914, where in fact Curie returned in October 1912.

I recommend both books, but Malley's is the one I believe I will come back to for reference over the years, while I am likely to suggest Redniss's to students and colleagues as an out-of-the-ordinary, one might even say quirky, treat for the eyes as well as the intellect. Let me conclude with one such spicy treat for the intellect, courtesy of Redniss. It is well known that as the Langevin scandal intensified in autumn 1911, several attempts were made by the Nobel committee to convince Curie to postpone her acceptance of her prize in chemistry until after the scandal had passed, but that she refused to do so and insisted on attending the ceremonies in Stockholm. One argument was that her presence at the Nobel banquet would be upsetting to the Swedish royalty who would be attending. What is less well known, however, is that the music chosen for entertaining the Nobel banquet guests included selections from two operas about seductresses (Bizet's *Carmen* and Moret's *Cleopatra*) and that the reigning monarch, King Gustav V, would later be implicated in a long-term homosexual affair with a married man, which the royal family unsuccessfully tried to cover up by paying "hush money"! For the sake of morsels like this, I am willing to overlook peccadillos including a small number of grammatical errors and several typos.