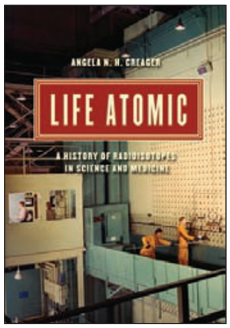
The power of the atom



Life Atomic: A History of Radioisotopes in Science and Medicine

Angela N.H. Creager

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Reviewed by Kenneth Krohn

In *Life Atomic*, Angela Creager weaves an engaging tale of the history of radioisotopes. Much of her material came from government documents from the Manhattan Project that were declassified during the Clinton administration. As an individual who teaches university students about the exciting role of radioisotopes in science and medicine, I found the book hard to put down, and I believe that any reader with a general familiarity with atoms will enjoy it. I cannot point out any factual errors in the book, but the expert reader may at times disagree with the author's choice of the most important players or accomplishments in the field.

Creager introduces the concepts and vocabulary of radioisotopes at a level that any reader can appreciate. She relates how brilliant scientific insight and good luck came together in the first half of the twentieth century to produce a golden age of physical science during which much of what every child now learns about the structure of the atom was developed. The Manhattan Project during World War II forever changed how science is performed and communicated. One of the fascinating themes in the book explores how military and security needs led to new opportunities in science and technology that eventually served all of mankind.

Radioisotopes are the most important contribution of atomic research to society. The leaders of the Manhattan Project searched for peaceful uses of discoveries that started with a purely military focus. They realized that, unlike nuclear power, with the long lead time needed to make it practical, radioisotopes could immediately be used in science, technology and medicine. Radioisotopes had been available in small quantities from cyclotrons prior to the war, but reactors developed during the war produced much larger quantities. So the first part of the book deals with the effort centered at Oak Ridge Institute of Nuclear Studies to provide radioisotopes to scientists. The challenges were numerous—selling a product that required the infrastructure of a nuclear reactor, setting up a marketing and distribution system and training a generation of scientists about safe radioisotope use.

Much of the book focuses on the knowledge gained in experiments using radioisotopes. For example, biochemical pathway research started at Berkeley, with cyclotron-produced carbon-11 used to study how plants produce sugars after exposing algae to radioactive CO_2 and light. The challenge of carbon-11's very short half-life was resolved when carbon-14 became available, and Melvin Calvin's group worked out carbon metabolism pathways as they appear in textbooks today.

The use of radioisotopes in human research has always been controversial. Creager is deft at taking the reader from human experiments that could now be considered ethically suspect to Nobel Prize–winning research. For example, the collaboration between military interests and biomedical research led to studies of radioisotopes for therapy, including some of the radiolabeled antibodies that are now used for cancer therapy, and also eventually led to peer review of human experimentation.

Creager discusses the use of radioisotope beams for radiation therapy. Large quantities of cobalt-60 and cesium-137 were available from reactors, and General Electric designed a housing to contain them for delivering beam radiation. Treating cancer with radioisotope beams was politically expedient and led to a large increase in patient referrals to sites that had the equipment.

Government officials were concerned about the impact of effluents and radioactive waste. One study used phosphorus-32–containing phosphate in a pond to measure the cycling of phosphorus and showed that plants from the pond contained 1,000-fold more radioactivity than an equivalent amount of water. Other studies asked whether the volume of freshwater needed to cool reactors would introduce heat, toxins and radioactivity into the water that could harm fish in neighboring rivers. Plankton accumulate radioactivity and introduce radioisotopes into the food chain. Also, radioactivity could be released into the air and accumulate in birds, mammals, reptiles and insects. The impact of nuclear reactors on their environment has had a lasting negative impact that is still argued today.

Creager ends the book by providing her perspective on the history and future of atomic science. I had the most trouble with this section because the author presented the government's role as mostly related to nuclear power and weapons. Clearly, the government was excessively exuberant about nuclear power, but its dual role in regulating and promoting the industry did not work, and by the time these functions were separated, public opposition had gathered force. Accidents such as Three Mile Island and Chernobyl increased public skepticism of nuclear power, probably more than is deserved. Government and industry clearly share blame for the poor reputation of nuclear power. But society and the political world also carry responsibility. We need to motivate industry and scientists to solve the problem of safe care of radioisotope waste and to appreciate that nuclear power could still be an important source of clean green energy.

Medical applications of radioisotopes followed what Creager calls "a strikingly different trajectory," becoming routine in research and therapy independent of the backlash against nuclear power. But she suggests that there will be a limit to radioisotopes as scientific and medical tools, in large part due to the burden of regulation and the radioactive waste disposal problem. Fluorescent tags can sometimes replace radioisotope tags, and it is unclear whether aging reactors can sustain the demand for radioisotopes. Nevertheless, I am optimistic that the use of radioisotopes will increase due to their value in unraveling the secrets of our natural world.

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The author declares no competing financial interests.