The deaths of young women who painted dials with radium made the public aware of radiation dangers in the 1920s and 1930s.

Chapter Eleven

Radiomedical Fraud and Popular Perceptions of Radiation

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In 1918 the famous physician Sir William Osler searched for the perfect metaphor to describe the mystery, vitality, and interest of the human condition: "May not man be the Radium of the universe? For us, he is a very potent creature, full of interest, the spark whose mundane story we are only beginning to unravel."

Today, it is rare to hear a good word in the popular press about ionizing radiation—much less to see it used as a symbol for all that is good and engaging in humankind.

How did things get so bad? From the vantage point of the 1990s it is easy to imagine that radioactivity and radiation medicine have always endured negative public images based on deep-seated fears of technology and associations with cataclysmic wars and reckless, man-made catastrophes. Yet, this gloomy picture is far from accurate. For more than a quarter of a century, radioactivity and nuclear science enjoyed the same sort of breathless reportage and media lionization now reserved for fields like astrophysics and molecular biology.

As physics historian Spencer Weart noted in his book Nuclear Fear, radioactivity seemed at first to offer the possibility of a shining utopian society basking in the limitless power, everlasting warmth, and inexhaustible raw materials generated by a ceaseless stream of silent radioactive emissions. Almost overnight, flickering skeletal "cathodographic" images produced by evacuated Crookes tubes truly transformed the art of medical diagnosis. Marie Curie's discovery of radium several years later appeared to some well-known biologists and theologians to provide not only limitless medical promise but a good candidate for the elemental essence of life. Only when the news reports and images of nuclear devastation and radiation-associated deaths at Hiroshima and Nagasaki began to filter back to Western society did the public finally begin to lose faith in this unblotted genie. This chapter will trace the history of the popular conceptions of radioactivity and radiation medicine during the first half of this century and will consider some of the social forces that contributed to the current negative public perception of radiation.

The earliest popular descriptions of the series of experiments conducted by Röntgen in the fall of 1895 described his discovery of "a new kind of light"
25 March Edison had contracted to have the Thomas A. Edison X-ray Kit mass-produced for home use. Although his interest in X-ray technology continued for several years, he was never able to make good on his publicly stated goal of being the first to produce a cathodographic image of the working human brain. Ultimately he turned away from X-ray research, in part because of the clear dangers to his assistants, but in large part because it soon became clear that the X-ray would not become a fixture in every home medicine closet.

The first field to wholeheartedly embrace the new radiographic technology was not medicine but photography. For both professionals and hobbyists the prospect of producing "skiligraphic" images of hidden or concealed objects seemed tantalizing and of eminently commercial potential. Writing cautiously in the journal *Photography*, an editor noted that:

If that which is stated to be true is so, it will be possible for a person fully clothed to "sit" for a photographer who will produce from him a photograph showing his skeleton only...who knows but that the latest fashionable craze will yet be skeleton photographs of yourself and friends—hardly attractive to present ideas, but we may get used to it in time?"
General interest magazines in these last years of the nineteenth century alternated between astonishment and whimsy when reporting on the developing field of radiography. Cartoons and poems published in Life magazine in early 1896 suggested that the new photography might be useful for detecting money in the pockets of miserly friends or for documenting the cold steel hearts of fickle girlfriends (Figs. 11.1 and 11.2). A London firm advertised X-rayproof underwear for modest women afraid of peeping Toms, and theologians pondered the moral implications of a power capable of seeing the previously unseen. In a move described by the New York Times as "fascinating and coquettish," a bold New York society lady allowed herself to be X-rayed without her customary corset to produce a cathograph of her "well-developed ribs." An amateur photography magazine noted the hysteria building around Röntgen's discovery and sought to dispel the concerns of some readers that "armed with this light and a camera, a man might go around town taking snap shots of other people's brains and stealing their ideas."

Attempting to establish some kind of credible context for the new phenomenon, Century Magazine published "Symposium on the Roentgen Rays" in May of 1896. This multi-author article attempted to trace the history of Röntgen's discovery from the early work of Crookes and Faraday and included the latest investigations by influential scientists such as Thomas Edison and William James Morton. Such sober assessments did little to stem the rising tide of "X-ray mania." Less than six months after the initial discovery and characterization of X rays by Röntgen, popular magazines were speculating wildly on the role of this new physical phenomenon in the fields of medical diagnosis, jurisprudence, energy production, metallurgy, instrument testing, and entertainment.

The second phase of the public's love affair with radioactivity began in February of 1896 in Antoine-Henri Becquerel's laboratory at Paris' École Polytechnique. Becquerel had heard about Röntgen's new rays and wondered whether some naturally luminescent materials might give off similar rays after exposure to sunlight. In testing a series of such elements, he noted that uranium ore appeared capable of exposing wrapped photographic plates even before the ore was primed by exposure to the sun. He suggested that uranium and other "phosphorescent bodies" were emitting a new kind of radiation with characteristics somewhat similar to the artificial roentgen rays. Two and a half years later, Marie and Pierre Curie identified a new element in uranium-rich pitchblende ore that appeared to be far more radioactive than uranium itself. They named this element radium, and by 1901 they had partially purified enough of the substance to begin loaning small samples to other interested scientists. Becquerel borrowed a small tube of this partially purified radium and—despite Pierre Curie's warnings—carried it around in his waistcoat pocket for several hours. The subsequent erythematous skin reaction on his abdomen appeared to be identical to the roentgen ray burns that had already been noted by physicians and amateur radiographers, and the link between the biological effects of external X rays from cathode tubes and internally generated gamma rays from naturally radioactive substances became evident, if not immediately explicable.

The discovery of radium marked a major change in the way that the public perceived the potential societal impact of radiation and radioactivity. Whereas the discovery of X rays was lauded as a major advance in technology, the discovery of radium appeared to be a natural gift from God, the revelation of a primordial secret of the ages, perhaps even the holy spark of life itself. Semi-scientific accounts in the lay press and in popular science journals dwelled on the fascinating powers of this new element, including its ability to induce radioactivity in some nonradioactive elements left nearby and its mysterious ability to melt its own weight of ice in an
hour. Journalists vied with one another to create ever more powerful images conveying the power locked within this extremely rare and gently glowing substance. Pierre Curie himself calculated that there might be as much as 50 billion calories in a gram of radium (an overestimate), and popular accounts of the element's characteristics held that a single gram could raise "10,000 tonnes a mile high" or provide light equal to "several million candles."^{19,20}

Moreover, these new radioactive elements did not simply decay at a fixed rate. Careful measurements revealed that the rate of radioactive emissions slowed as the elements decayed, a phenomenon dubbed the half-life effect. To many it seemed as if the element itself was attempting to conserve energy in order to continue forever. Amateur inventors hailed the discovery of radium as the first step in the development of perpetual motion machines and envisioned radium-powered ships, planes, and rockets. A farmer proposed mixing radium with chicken-feed so that hens would lay hard-boiled eggs. This blend of high technology and natural vitality created a very potent image that was to capture the public's imagination and enthusiasm for decades (Fig. 11.3).^{21}

During the early 1900s the popular press reported advances in understand-

![Fig. 11.3 Radium was soon found to have beneficial effects on both surface and deep-seated cancers and increasingly became identified as a radiant hope—perhaps the source of prolonged or even eternal life—for sufferers with a wide range of maladies. This depiction appeared in the Los Angeles Examiner on 28 January 1914.](image-url)
supply of seemingly pollution-free nuclear energy first surfaced in the technical journals at the turn of the century.

From both a medical and a technological point of view, radium was viewed by some as being the next essential step in the development of a new, more egalitarian society. Journalists like Waldemar Kaempffert, science editor for the New York Times, saw the new science of “atomic” energy as eventually transforming society, allowing for the creation of complete new cities and towns with plentiful, clean energy, healthy occupants, and radioactive rocket-based transportation systems (Fig. 11.4). Moreover, the nuclear “transmutation” of elements such as thorium into radium, first elucidated by Rutherford and Soddy in 1901, seemed to recall medieval quests for effective methods of alchemy and elemental transport, subjects that had never lost their allure for the popular technology audience. As Soddy wrote in 1908 in a popular book titled The Interpretation of Radium, “A race which could transmute matter would have little need to earn its bread by the sweat of its brow. Such a race could transform the desert continent, thaw the frozen poles, and make the whole world one smiling Garden of Eden.”

Perhaps the most interesting of the early popular images associated with radiation and radioactivity is the set of associations surrounding the use of radium as a kind of physiological catalyst, a vital force related to the primordial spark of life. Some historians have suggested that the association of radioactivity and life-force may date back to an early mythic consciousness about the centrality of the sun and radiant energy in all vital processes. These rays of life embodied the popular notion of a sort of pure energy soul that could invest matter with animate properties. Displays of electricity had fascinated the public in the late nineteenth century, and the idea that the dead could be brought back to life with the proper application of electrical current was commonplace in popular technical literature and science fiction. The growing public awareness of radiation tapped directly into this set of mythic images but with two important distinctions: First, radioactivity appeared to be a much more powerful and mysterious force than electricity, and its effects on human tissues appeared much more difficult to predict. Second, unlike electricity, the occult power in radium was apparently innate, inexhaustible, and infinitely divisible. Even a small speck of
Until 1910 radium was too scarce and expensive to incorporate into such mass-market products. However, when large deposits of uranium were mined in Colorado and Canada, the price dropped from over $500,000 a gram to a relatively conceivable $120,000 a gram, and radium came into wide use in cancer hospitals and dermatologic clinics. At the same time, technical advances in X-ray equipment, especially the invention of the hot cathode tube in 1913 by William Coolidge of the General Electric Company, allowed radiology departments to proliferate and expand their services. Full-time radiologists began to open combined diagnostic and therapeutic practices in many major hospital centers, and academic departments of radiology formed with active teaching, publication, and research programs.

By the beginning of World War I radioactivity and radiologic health sciences were firmly established in medical practice. Marie Curie and a number of other prominent scientists and physicians soon recognized the importance of X-ray images in diagnosing the sort of trauma and foreign body injuries prevalent in wartime, and Curie herself headed up the effort to establish a mobile X-ray service for the French army.

Recipe for "Liquid Sunshine."
To be used at the Technology Club Banquet.
 Fifty thousand parts of water.
 Fifty thousand parts of quinine.
 Stir until dissolved in a glass.
 Insert a tube of radium until sufficient radioactivity is developed to cause the water to throw off violet or ultraviolet rays.
 Drink it in the usual manner or champagne.

Fig. 11.5 The notion of marketing the radiant qualities of X rays led some patent medicine manufacturers after 1896 to dub their medicines "X-ray potions."
Slocum's 1898 plaster system contained no radiation, but played off the public's interest in the new rays. (Courtesy of the Center for the American History of Radiology, Reston, Va.)

Fig. 11.6 The advent of radium made it possible to put radioactivity into patent medicines and nostrums. In 1904 a group of scientists at the Massachusetts Institute of Technology took advantage of the "solubility" of radium emanations, mixing cocktails made of quinine and water, stirred "with a tube of radium until sufficient radioactivity is developed to cause the water to throw off violet or ultra violet rays." The lights were dimmed, and the scientists socialized in the glow of their "liquid sunshine." (Reproduced from the Hammer Collection, National Museum of American History, Smithsonian Institution).
These responsibilities occupied most of her time during the war years, and dramatic pictures of her war service and the utility of field radiography added to the growing luster associated with the benefits radiation promised.

The end of World War I allowed scientists throughout Europe and the United States to refocus their efforts on humanitarian and social concerns. In the field of radiation research, this meant that many scientists and physicians who in wartime had devoted themselves to perfecting devices for X-ray diagnosis of war injuries could now return to their benchtop investigations of the fundamental effects of radioactivity on living organisms. Many of the early radiomedical investigators were physician-tinkerers who became obsessed by the study of these strange, invisible rays that seemed to have such magical effects on living organisms. Marie Curie, returning to her work at the Curie Institute, set as one of the institute’s postwar priorities the investigation of the effects of minute, “nontoxic” quantities of radium on cells, animals, and humans. In Great Britain this field was designated “mild radium therapy” to differentiate it from the better known—by then—well-accepted role of much larger, destructive doses of radium in the treatment of cancer and other neoplasms.\(^2\)

The history of the mild radium therapy movement can be traced back to the homeopathic and physical medicine schools of the nineteenth century. These schools taught that most true healing processes were natural and that tiny (usually infinitesimal) quantities of naturally occurring “stimulatory” compounds (which in large quantities would be toxic) could cure most maladies. Many of these groups also believed in the legendary healing powers of the great European hot springs like Brambach in Germany, Joachimstal in Czechoslovakia, Ischia in Italy, and Sallies-Bains in France. Devotees established sanatoria on the grounds of many of these hot springs, claiming that the waters were useful in the treatment of various “metabolic” diseases such as melancholy, rheumatism, credinism, and impotence.

These healing waters posed a mystery, however. They appeared to lose their powers after just a few days when they were removed from the springs and bottled. The great German chemist Justus von Liebig attempted to analyze the waters from the Gastein springs, eventually ascribing their power to a dissolved gas with mysterious and transient electrical effects. In 1903 the discovery was made that the apparent pharmacologic agent dissolved in these waters was radon (radium emanation). After Rutherford’s Nobel Prize-winning investigations of alpha particle emissions from radium and radon, the transient healing effects of the hot springs were ascribed to the energetic and short-range alpha particles ejected from the radon nucleus during its short (three-day half-life) decay period.\(^{3,1}\)

Radioactivity became identified with the legend of healing waters—in fact, it became the validating and scientific explanation for hydroopathic effects—and soon hot springs across the United States and Europe advertised the radiant qualities of their waters (Figs. 11.7 and 11.8).

Although public interest in radioactivity and its healing effects remained high throughout the 1920s, most of the ongoing medical investigations focused on the penetrating beta and gamma emissions of radium and its decay products. The high-energy alpha particles...
received the Nobel Prize in chemistry for his work on radioisotopes. In that same year, Banting and Best isolated insulin. In 1923, Banting and Macleod were awarded the Nobel Prize in physiology for their insulin research. It was not clear at the time, however, how the endocrine system actually produced its effects. What was missing, it appeared, was a fundamental biophysical energy transduction mechanism that could account for the apparent energy transfer processes mediated by the endocrine hormones.

To some investigators, radioactivity seemed to be the spark required to ignite these major physiologic processes. The German physiologist George Wendt, in his address to the thirteenth International Congress of Physiologists, reported that human leukocytes exposed to low-level radium radiation began migrating toward the radium source and that moribund vitamin-starved rats could be temporarily rejuvenated by exposure to radium. Radium, with its energy-charged alpha particle emissions, truly seemed to be the basis of the fountain of youth legends.

Packaging this mini-miracle for sale seemed an obvious and potentially lucrative next step for those on the fringe of legitimate medicine. Because radium was considered a natural element rather than a drug, it was available over-the-counter in a variety of preparations (in microscopic amounts) and was not regulated by the Food and Drug Administration (FDA), an agency with very limited authority at that time. Radioactive candles, liniments, potions, and creams were widely available by 1915, and pharmacopoeias from the time list dozens of "mildly" radioactive medicinal preparations. Though initially the mild radium therapy movement appears to have been largely confined to Europe, American interest in the medicinal, "catalytic" properties of radium and its decay products surged after double Nobel laureate Marie Curie’s whistle-stop railway tour across the United States in 1921. Like the stuff of homeopathic legends, radium appeared to be a substance with two distinct modes of medical efficacy: in large
quantities, it was destructive and could be used to kill tumors; and in tiny quantities, it appeared to be restorative and could be used to recharge the endocrine system. As one American physician who had worked at the Curie Institute noted, “Having had the luck of studying radium with its discoverer, I wish to say that radium possibilities are innumerable and in the very near future all the progressive physicians will use it, as radium therapy will be one of the most powerful weapons for the elimination of disease and the prolongation of human life.”

The proliferation of radium-containing nostrums and home-use products testifies to the powerful public image conveyed by radiation science. Besides radioactive candies and patent medicines produced by companies hoping to cash in on the radium fad, other fraudulent medical companies quickly began producing a full line of radioactive belts, harnesses, and patches designed to rejuvenate aching muscles and flaccid organs. Radioactive toothpaste, hair tonic, contraceptive jelly, eyeglasses, and hearing aids (said to contain a magic ingredient called “hearnum”) were all widely available in the postwar years (Fig. 11.9).

In 1915 Dr. Sabin von Schocky invented a luminous paint activated by radium-226 and zinc sulphide. Called “Undark,” this paint cast an eerie, shimmering glow in the dark. Although Schocky promoted its decorative and artistic uses for the design of self-illuminating toys, costumes, and special effects, the principal commercial use of the material involved the illumination of indicators and dials for watches and machinery. In 1920 more than four million radium-illuminated watches, doll eyes, fishing tools, buttons, and gunsights were produced in the United States. Schocky’s U.S. Radium Company employed more than 250 workers during its peak years, many of whom were women paid by the piece to highlight the numbers on watch faces with the radium paint. Many of these dial painters subsequently were to develop necroses of the jaw from “tipping” the highly radioactive brushes with their tongues so as to be able to paint finer lines on the dials. For the first time reporters began to question self-proclaimed “radioactivity experts” about potential toxicity resulting from exposure to radium and its byproducts.

By the mid-1920s it had become clear that radioactivity and X irradiation were far from harmless. In 1904 Clarence Dally, Thomas Edison’s thirty-nine-year-old assistant who was intimately involved in X-ray testing, died of extensive radionecrosis and radiation-induced cancer. Before he died Dally underwent sequential and disfiguring amputations of first his left hand, then most of his right hand, then his left forearm, and finally his right forequarter. Shaken by the experience, Edison announced publicly that he was “through with electricity as a therapeutic agent.” By 1908 members of the American Roentgen Ray Society had reported dozens of cases of severe radiation burns to both patients and doctors. Despite the development of rudimentary shielding devices and basic radiation protection principles, radiation-related deaths continued in the medical profession. The great success of diagnostic radiography during wartime muted the calls for greater regulatory oversight and health protection.
THE BYERS AFFAIR: A LANDMARK TRAGEDY IN RADIO-ENTREPRENEURSHIP

The general public’s attention was finally focused on the dangers of radium and radioactivity by the widely-publicized case of Eben M. Byers, a millionaire sportsman, industrialist, socialite, and man-about-town (Fig. 11.10). Byers died early on the morning of Wednesday, 31 March 1928, the victim of a mysterious syndrome that for eighteen months had ravaged his body, corroding his skeletal system until one by one his bones began to splinter and break. Byers had been a broad-chested, multi-talented athlete and sportsman, an expert trapshooter, and the United States Amateur Golf Champion in 1907. As chairman of the A. M. Byers Iron Foundry, he had been the personification of the roaring twenties, a millionaire socialite and steel tycoon who had clambered into the upper reaches of New York’s high society and continued to lead a life of privilege even after the market crash of 1929. Well-respected as a prudent captain of industry, Byers was also known as a rakish romantic, and this lifelong bachelor was no stranger to rumors of wild living and trans-Atlantic trysts. At his death Byers’s once robust body weighed just 92 pounds. His handsome face had been horribly disfigured by a series of last-ditch surgical operations that removed most of his jaw and part of his skull in an attempt to stop the relentless bone destruction. His bone marrow and kidneys were rapidly failing, but, despite a brain abscess that had left him nearly mute, he remained heid almost to the end. He died at 7:30 a.m. at Doctors’ Hospital in New York.
City, and his physicians immediately notified the New York Medical Examiner's office.

By the following afternoon the authorities had begun a criminal poisoning investigation and were preparing the body for an extensive forensic autopsy by the Chief New York Medical Examiner, Dr. Charles Norris. The next day, the New York Times announced the preliminary results in a front-page headline: "EBENEZER BYERS DIES OF RADIUM POISONING." Byers, it was soon revealed, had for about four years been consuming large quantities of Radithor, a popular and expensive mixture of radium-226 and radium-228 marketed as a health elixir and endocrinologic stimulant, touted as ameliorating the effects of over 150 "glandular" diseases including rheumatism, hypertension, obesity, neurasthenia, impotence, and baldness (Figs. 11.11 and 11.12). Like many of the radioactive nostrums available during this time, Radithor was completely unregulated and was available over the counter and through the mail.

RADITHOR was the crowning entrepreneurial achievement of "Doctor" William J. A. Bailey, dean of the radioactive patent medicine industry that seemed to thrive along with the American economy in the 1920s. Bailey and his career are representative of a group of pop-technology inventor/entrepreneurs who were associated with medicinal radioactivity during its heyday. Born in Boston in 1884, he was a quick-witted, fast-talking Harvard dropout from the class of 1907 (Fig. 11.13). After trying his hand at running an import-export business and promoting himself unsuccessfully for the post of trade representative to China under Teddy Roosevelt, Bailey decided to make his fortune as an inventor and high-technology entrepreneur. His attempts in a number of industries were unsuccessful.

Between 1915 and 1921 Bailey appears to have been involved with a number of manufacturing and pharmaceutical scams, including a patent medicine company advertising "restoratives" for impotent men. This era appears to have been the beginning of Bailey's fascination with endocrinologic stimulants and aphrodisiacs, an interest he was later to combine with his enthusiasm for radioactivity and its purported physiologic restorative powers. It is not known whether William Bailey actually encountered Marie Curie during her triumphant 1921 American tour, but it is clear that beginning in the early 1920s he became enraptured with the study of radioactivity and its effects on life. He produced a trans-
in an embossed, velvet-lined case and was approximately the size of a slim deck of cards. It sold first for $1000, then $500, then finally $150 as the rather specialized market became saturated. Even at these exorbitant prices, radioactive nostrums found ready buyers during the energy-crazed 1920s. Dozens of affluent and highly-placed citizens, including Mayor James J. Walker of New York City, later confessed to using radioactive rejuvenator devices and products to treat a variety of ailments during this period.

Bailey and the other radio-entrepreneurs routinely sought opportunities to present their theories at legitimate scientific meetings in hopes of applying the patina of professional endorsement to their unorthodox treatment philosophies. In a public relations coup, Bailey managed to secure an invitation to speak at the medicinal products session of the American Chemical Society meeting in Washington, D.C., on 25 April 1924. Bailey's talk focused on the use of radium in the cure of the hopelessly insane and in the reversal of the aging process. "We have cornered aberration, disease, old age, and, in fact, life and death themselves in the endocrines!" Bailey thundered. "In and around these glands must center all future efforts for human regeneration." The next day, the New York Times excerpted the talk in a lengthy and complimentary article about the new science of "radioendocrinology" (Fig. 11.14).

In 1925 Bailey moved to East Orange, New Jersey (no doubt, in part to partake in the nearby aura of Edison's old invention center) and began to market his promotional masterpiece, Radithor. The radioactive tonic was an immediate commercial success, and orders poured in from around the world. Over 400,000 half-ounce bottles were sold between 1925 and 1930. Radithor was advertised as "the climax of thirty years of research and the fullest achievement in internal radioactive treatment," with efficacy against over 150 diseases. Like many other patent medicines of the day, the RADITHOR promotional pamphlets (always shipped separately as "complete..."
mentary monographs" so that the outrageous claims in the pamphlets could not be construed as warranties of product efficacy were filled with testimonial letters from satisfied patients and physicians, urging skeptical doctors to "put one or two of your most obstinate cases on radium water so that you may observe its action in your own practice."

By 1930, when Eben Byers first began to experience unusual aches and pains, some of the mania for the expensive radioactive nostrums had begun to subside. Byers began to lose weight and complained of headaches and toothaches. A radiologist in New York, Dr. Joseph Steiner, looked at Byers's radiographs and noticed some similarities between the developing bony lesions in Byers's mandible and those described in the recently deceased radium dial painters. Frederick B. Flinn, the prominent radium expert from the department of industrial medicine at Columbia University, was called in as a consultant and confirmed Steiner's suspicions: Byers's body was slowly decomposing, the result of massive radium intoxication from the Radithor.

A Federal Trade Commission (FTC) attorney sent to Byers's Long Island mansion to take the deposition later described the scene in vivid detail.

A more gruesome experience in a more gorgeous setting would be hard to imagine. We went to Southampton where Byers had a magnificent home. There we discovered him in a condition which beggars description. Young in years and mentally alert, he could hardly speak. His head was swathed in bandages. He had undergone two successive jaw operations and his whole upper jaw, excepting two front teeth, and most of his lower jaw had been removed. All the remaining bone tissue of his body was slowly disintegrating, and holes were actually forming in his skull.

This lurid description was reprinted in Time magazine and in various sporting journals and society papers, and the Byers case rose to international prominence. With his death in 1932 the FTC reopened its investigation and the FDA began campaigning for broader powers. Physicians issued stern warnings on the dangers of radioactivity, in one case even holding up a victim's bones next to a Geiger counter on a radio broadcast to demonstrate "the deadly sound of radium."

Medical societies took the welcome opportunity to denounce all patent medicine sales, and calls for radium control laws were voiced throughout America and Europe. The forerunners of the current regulations restricting the sales of radiopharmaceuticals to authorized users actually date specifically to the Byers affair. With the institution of these regulations the radioactive patent medicine industry collapsed, and the era of mild radium therapy came to
an end. By the late 1930s the public was growing increasingly wary of radiation, and even some oncology experts were becoming skeptical that radiation treatments could significantly impact on the cancer problem.

POSTWAR DISENCHANTMENT

The final phase of public disenchantment with radiation and radioactivity began with the first newsreels showing the catastrophic effects of the atomic bombs dropped on Japan. An uneasy public began to hear more and more about long-term consequences of contact with radioactivity and nuclear energy, and radiation-related concepts such as "fallout," "carcinogenesis," and "genetic mutations" became familiar terms. Highly publicized fears of East-West nuclear exchanges and nuclear power-plant accidents spilled over into public concerns about even low levels of exposure to radiation. The evolution of this broad-based postwar public phobia has been traced in detail in a number of recent publications and will not be repeated here.49,48

However, it seems important to note that, even in the 1990s the health effects of chronic exposure to low levels of radia-

Fig. 11.15 The public is not unanimous in fear of all things radioactive. As late as the 1980s promoters advertised the health benefits of descending into abandoned radium mines to breathe the emanations. (Courtesy of the Center for the American History of Radiology, Reston, Va.)

tion are not as well established as the public might imagine (Fig. 11.15). Although most industrialized societies continue to reject the use of ionizing radiation for virtually all nonmedical uses (and insist on tight constraints on its use even within the clinical sphere), most objective analyses suggest that public perceptions of ionizing radiation as an environmental menace are somewhat overblown compared to the levels of danger associated with other environmental and behavioral risks in an industrialized society. Nevertheless, this image of radiation as a force for death and destruction, a genie unleashed by an unwitting and arrogant technologic aristocracy, has continued to exert a powerful influence on society's view of radiation and radioactivity.

CONCLUSION

Are there any lessons to be learned from the saga of the rise and fall of the public's interest in and infatuation with radioactivity? Several come to mind. First, it is clear that the discovery of radioactivity coincided with the culmination of a long period of popular fascination with electromagnetic beams and invisible but powerful physical forces.44 The bioeffects of these mysterious forces had been studied since before the time of Paracelsus and appealed especially to the enlightened turn-of-the-century environment that celebrated the elucidation and demystification of "vital" living processes. It seemed that radioactivity might indeed be the missing link that connected chemistry and physiology. Contemporary discoveries in the fields of biochemistry, enzymology, evolutionary biology, and endocrinology had strengthened the reductionist trend toward thinking of living organisms as simply machines made of common elements. Radioactivity seemed a perfect natural "fuel" to explain the life force that flowed through these elemental machines. In addition, although the influence of church theocracy had waned considerably by the late nineteenth century, people still clung to the notion that there must be some power-
ful, mystical force that imbued living creatures with the power to move and function. Radioactivity appeared to be a good God-given candidate for that function, and appealed with particular urgency to those seeking to reconcile the new science with religion. The mysterious ability of radiation to at least temporarily (and in many cases permanently) alleviate many types of skin diseases, inflammatory conditions, and cancers seemed clearly to identify radiation as a healing force. Only later, as the chronic effects of radiation overexposure became apparent, did the public image become more negative and skeptical.46

Historian James Harvey Young has commented on the gradual decline during the twentieth century of what he calls the "Doctrine of Progress," the popular conception that technologic advances will inevitably lead to social improvements and the betterment of mankind.46 Public infatuation with Curie, Edison, Lindbergh, and the other great heroes of the age of technology gradually gave way to skepticism and disillusionment with science and progress—a jaded anti-technical point-of-view only ameliorated in the last ten years by the proliferation of the personal computer and the so-called Information Revolution. Young quotes a character in dramatist Maxwell Anderson's 1935 play Winterset who says, "What faith men will then have, when they have lost their certainty of salvation through laboratory work, I don't know." The rise and fall of the public's enthusiasm for radiation science mirrors a broader skepticism and disillusionment with scientific progress of all types. Radiation and radioactivity seemed to be the archetypical example of the public's greatest fear: a powerful force unleashed by arrogant and naive technocrats who lacked the moral maturity to understand the disastrous social consequences of their scientific investigations. The ultimate development of the atomic bomb completed this apparent re-enactment of the story of Dr. Frankenstein's monster, underlining the parallels between the history of radiation science and the famous fictional tale of a scientific discovery gone berserk.47

A final observation on the subject concerns the prevalence during the early decades of the twentieth century of radiomedical fraud and pseudo-science: why were the concepts of radiation and radioactivity so rapidly and completely exploited by the makers of nostrums and patent medicines? Certainly, part of the answer has to do with the sheer excitement and enthusiasm produced by the technical glamour and medical triumphs of the new radiation science. It was at first difficult to define the reasonable limits of this novel set of medical processes and effects. Most claims of "revolutionary" technological breakthroughs initially inhabit an uneasy no-man's-land between acknowledged brilliance and refuted quackery, and radiation medicine was no exception.

However, the immediate and sustained appeal of radiation as the basis of putative cures for hundreds of diseases suggests that this concept touched a deep chord in popular culture of the time. One possible explanation involves the observation that successful promotion of medical quackery often uses one of two major classes of advertising strategies: (1) Romantic "secret-of-the-ages" promotional strategies seeking to label a product or process as a long-lost "natural" or "native" cure for various intractable diseases; or (2) "Scientific breakthrough" promotional strategies identifying a particular nostrum as the final triumphant result of years of intensive work by a heroic group of dedicated scientists.

The discovery of radioactivity and its translation into radiation medicine were readily adaptable to both promotional philosophies. Radiation science encompassed both the study of age-old natural forces and the development of certifiable high-tech marvels. In appealing successfully to both types of promotional images, radio-medical nostrums, inhalers, and other apparatus quickly captured the public's interest and succeeded in sustaining that interest through the 1920s. Radioactive forces seemed the perfect physical embodiment of the high-energy, fast-moving spirit of those years. And, at
least for a while, the radioactive future seemed limitless. As William Bailey noted in one of his promotional pamphlets for Radithor, "Radioactivity is one of the most remarkable agents in medical science. The discoveries relating to its action in the body have been so far-reaching that it is impossible to prophecy future developments. It is perpetual sunshine." And this sunshine would appeal to several generations of Americans, only to be obscured by the mushroom clouds of mid-century concern—shadows which linger today in the public perception of medical radiation.

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