The extraordinary attention that greeted Röntgen's announcement of the X rays extended well beyond the academic confines of medicine and physics. "With no discovery within my recollection has the immediate and general excitement been so intense...as with this discovery of Professor Roentgen," noted a San Francisco physician in 1897 in the Journal of the American Medical Association (J.A.M.A.). As the early unrestricted and empirical applications of the rays to disease became more structured and as awareness of the potential dangers grew, distinct schools of practice evolved around various specialists in the United States and Europe. What ensued was a virtual apprenticeship system in academic and clinical medicine, where specific and often idiosyncratic approaches to radiation therapy were learned and passed on to physicians in training. The very limited numbers of persons specializing in the field kept this system in place until well into the twentieth century. The advent of standardized radiation measurement, of enhanced efforts at radiation protection, of increasingly stringent requirements for training and certification, and of large controlled studies has carried the profession into modern times.

This brief overview of instruction and education will survey what has formed the backbone of the history of radiation oncology: those mechanisms by which the field has communicated its growing body of knowledge and experience to successive generations of dedicated practitioners.

**The Early Years: 1896-1915**

The X ray was a particularly democratic phenomenon in its earliest years—seeing through rich and poor equally and appearing to offer career opportunities to an eclectic range of professionals and hobbyists. Edward Trevert, author of the popular how-to manual, *Something About X Rays for Everybody*, noted in June 1896 that "The layman as well as the professional has been experimenting and trying to obtain knowledge of the source, action, and effect of these rays" (Fig. 6.1). By "professional" Trevert did not mean to imply only the licensed medical doctor. His definition included professional physicists, electricians, photographers, glassblowers, and inventors. The true
amateur was the hobbyist, interested in seeing the wonders of Röntgen's discovery in his or her own home. Trevert assured these legions of science fans that "with proper care and the necessary apparatus even an amateur may meet with wonderful success" in obtaining radiographs of everything from the family cat to long occluded foreign bodies. Trevert's volume was followed closely by W. Meadowcroft's breezy *The ABC of the X Rays*, a title implying the very simplicity with which the field could be mastered.

Soon a variety of instructional materials were available, many through the mail, to assist fledgling roentgenologists with their work. Röntgen's own *Eine Neue Art von Strahlen*, reprinted for the third time in the spring of 1896, boasted advertisements for a variety of illustrative materials, including Röntgen's own radiograph of the hand of the anatomist Von Kolliker. The earliest issues of the *Archives of Clinical Skilography*, published later that year, featured similar compendiums of illustrative radiographs and instructional booklets for sale (Fig. 6.2). In New York City, also in 1896, William J. Morton's educational X-ray prints were sold and offered as premiums by E. B. Meyrowitz, an X-ray equipment manufacturer.

But despite a growing medical literature citing the possibility and soon the certainty that the new rays had startling and beneficial effects on a variety of surface and deep-seated diseases, almost all of the earliest instructional materials concentrated exclusively on radiography and diagnosis. The emphasis was on providing examples of anatomical radiographs (on the not unreasonable assumption that many of the recipients had neither studied anatomy nor witnessed traditional postmortem dissections) and descriptions of workable combinations of generators, X-ray tubes, and screens. Instruction in therapy seemed to follow without additional comment. The implication was that one sat the patient down, aimed the X-ray tube with optimistic intent, turned the machine on, waited an unspecified period of time, and hoped for the best.

Throughout this early period tips on shielding, distance, voltage, and tube placement appeared in both medical and popular journals. Publications from the *New York Times* to *Electrical Engineering* to *Century Magazine* issued detailed drawings and instructions. Soon a number of individuals began to specialize in the new rays, while others sought instruction in their use.

Although there were no hard and fast lines of demarcation, medical practice in the United States at the turn of the century was divided. In the east, urban-oriented physicians schooled in mainstream institutions remained closely tied to European traditions of medical education. In the rest of the country, physicians were trained at
more eclectic schools and received the bulk of their education as apprentices to older physicians. The two groups and their mutual disdain would be reflected in divisions among radiologists for decades.

The X ray was received quite differently by the two groups. In the east radiology developed within teaching hospitals, many of which opened their own X-ray rooms. In the midwest X-ray education appeared simultaneously in a variety of settings: independent X-ray “laboratories,” private clinics, osteopathic and homeopathic schools, and in the fraudulent vending of certificates of expertise. Much more attuned to the promising notion that the X rays offered “something for everybody,” midwesterners were the first to begin formalized (if eclectic) instruction in radiology and to experiment with possible therapeutic effects.

In the 22 July 1896 issue of the Electrical Engineer, Harry Preston Pratt, a Chicago physician, claimed to have treated “an almost hopeless case of consumption with results so far but little short of marvelous.” Advertisements for Pratt’s “X-Ray and Electrotherapeutic Laboratory” appeared almost immediately, noting that published articles would be sent out for instructional purposes (Fig. 6.3). Wolfram Fuchs, proprietor of the large Chicago X-ray Laboratory, also advertised instruction in the use of the new light. In St. Louis both M. E. Parberry, an electrician, and Heber Robarts, a physician, offered to teach the elements of radiation therapy at their respective offices (Figs. 6.4 and 6.5). Physicians were invited to drop in at Robarts’s office between 10:00 and 2:00 to see “patients under treatment, with cancer, lupus, rodent ulcers, neuralgias, and those diseases rebellions to medicine, or inoperable.” What these and others offered was specialized, one-on-one instruction by example—short apprenticeships—in the mechanics of the X ray, with additional pointers on successes and failures noted so far.

Emil Grubbé, the putative American pioneer of radiation therapy (see Chapter 1), felt keenly the opprobrium of practice on the fringes of respected medicine. At the 1898 establishment of an X-ray clinic at Hahnemann University Hospital in Chicago, Grubbé (armed with a newly-mined medical degree of his own) was named professor of roentgenology. He found that much of the work pertained to diagno-
sis, however. In an effort to elevate instruction in the use of the new rays in therapeutic applications, Grubbé spearheaded the movement to incorporate the Illinois School of Electrotherapeutics, located in the Champaign Building, with a faculty of licensed physicians and the advertised promise of a “handsome engraved certificate” for the three-week course. For physicians in a hurry, the “two-weeks’ course will make you self-dependent.”

The school opened in August of 1899, with several rooms outfitted with equipment for demonstrations in both electrotherapy and radiation treatment (Figs. 6.6 and 6.7). Patients were accepted by referral from staff and other physicians. Grubbé’s designation of this venture as a medical school may seem somewhat generous today, but it was probably no better or worse than many similar enterprises claiming to give medical instruction at the turn of the century. In fact, Grubbé was scrupulous in refusing to issue diplomas by mail to students who had never attended classes. To his delight, he found that there were students eager to attend the school:

At last, a turning point had been reached; the medical profession had awakened from its sleep and was really becoming interested in x-ray therapy. I had positive evidence of this awakening for, nearly every day, physicians would call at my office to have me explain this new treatment, and to see with their own eyes just how x-ray applications could be made to various pathological conditions located in or on different parts of the human body.11

Many of these visitors attended classes at the Illinois School of Electrotherapeutics, which, in its twenty-one years graduated more than 5,000 students. The school closed in 1920 because of what Grubbé called “the disruption of postgraduate medical teaching produced by World War I,” a defensive way to rationalize the advent of the more stringent standards for medical education that would close many such schools.12

While much of the early instruction in X rays in the east came directly from physicians associated with teaching hospitals, the region was not immune to less orthodox teaching methods. The Electrical Institute of Correspondence Instruction in New York City advertised a mail order course in roentgen ray therapeutics which by 1900 had been “followed successfully by thousands.”13 The Brooklyn Post-Graduate School of Clinical Electrotherapeutics (often referred to simply as the New York School), headed by noted electrotherapist and X-ray author Samuel Monell, advertised a wide curriculum, including the option of education by correspondence using Monell’s textbooks (Fig. 6.8).14

Doubtless many electricians and photographers used diplomas from these and other short courses to gain entrance into legitimate medical practice. Despite the outpouring of invective against such practitioners by mainstream physicians, it is not at all clear that in their later work they did not perform as well as their more traditionally trained colleagues.15

In fact, the best medical training in radiation therapy in these earliest years (and for years to come) was through either one-on-one association or through journals and textbooks. Practitioners, however, they were trained, looked to the literature for
innovations in apparatus, advice on techniques, and reports on therapeutic successes and failures. Medical journals were a primary resource for anyone hoping to remain in the field. The leading American journals of the time, the Boston Medical and Surgical Journal, American Medicine, Medical News, and J.A.M.A., supplied a steady stream of reports on therapeutic achievements with the new rays. Most attempted to give enough description and details so that the reader could attempt to replicate the results.

Typical of these were regular reports in J.A.M.A. by William Pusey. In May 1900 Pusey noted distance, timing, and voltage for treatment of lupus, eczema, and "for the purposes of epilation." He also listed criteria for determining when a single exposure had been carried far enough:

1. Appearance of erythema and pigmentation.
2. Blanching of the hair.
3. Loosening of the hair.

However subjective such observational methods of dosimetry may appear today, they were the types of benchmarks by which a generation of radiation therapists honed their practice.

So astonishing were the results reported by some practitioners, and so urgently did some editors feel the need to disseminate this news, that a single isolated case was often hailed as a proven new regimen. A successful treatment of lupus vulgaris was reported by J. T. Knox of Cincinnati in 1901. After detailing his efforts at shielding, multiple treatments, and distance, Knox stated, "Although this is the first case of lupus I have treated by this method, I have no hesitancy in stating that I regard it as an infallible one, if properly applied and continued a sufficient length of time." The interested reader of these reports of idiosyncratic cures must have been further cheered by accompanying photographs of miraculous transformations in patients treated with radiation (Fig. 6.9). The unfortunate fact that many of these photos were clearly airbrushed beyond clinical significance was apparently an acceptable journalistic practice at the time.

Another reason for the careful inventory of treatment variables and outcomes in these early articles was the prevention of so-called "X-ray burns." Although the cause was unknown, an armamentarium of dos and don'ts was built up in an effort to spare both patients and practitioners. E. A. Codman, writing in the Philadelphia Medical Journal in 1902, noted that "...therapeutic exposures will continue to be dangerous, and it is therefore important to record the exact condition of the patient's local and constitutional idiosyncrasies, as well as the tube." The idea that masses of unrelated, accretive reports might somehow yield up useful verities was not isolated to roentgenology in these years.

Articles proliferated with detailed case histories of patients, their treatments, and their reactions. Pusey included thirty-six detailed and disparate case histories in a 1902 article. Others reported case after case, usually with few deductions offered about general application. This growing mass of episodic reports of treatment must have seemed baffling to practitioners who wanted to take up the new field. The suggestion was that, with a certain amount of caution and the right apparatus, almost any treatment could be attempted—and the results would be eminently publishable.

Some authors produced tables and
charts designed to assist the beginning radiation therapist with his or her work. Francis Williams, drawing on his groundbreaking work at the Boston Hospital, published a chart of relative distances and intensities for the rays, deriving from these a column of "safety limits" based on skin erythema (Fig. 6.10). The problem with these tabulations and others like them was that, invariably, they omitted one or more of the crucial variables necessary to achieve even vague comparisons between different sets of results.

The advent of journals specializing in radiology and radiation therapy did not go far in giving coherence to the confused mass of individual cases, results, and advice. The American X-Ray Journal, founded by Robarts in St. Louis in May 1897, published results of radiation therapy and electrotherapy, as did the early Transactions of the American Roentgen Ray Society (1902–1908). Both were widely read within the field but did nothing to provide guidelines aside from description and comparison of cases and methods. The American Quarterly of Roentgenology, which began publication in 1906 and became the American Journal of Roentgenology in 1913, printed numerous articles on radiation therapy. Novel applications and new diseases treated seemed to have earned first publication in these journals, with the emphasis more on possibilities and opportunities than on explanations for results.

"What we need," wrote one roentgenologist, "is a large series of carefully reported cases and lapse of time sufficient to prove that treatment is of lasting success." The author was calling for an end to education by the accretion of empirical evidence and a move to a more scientific basis for the field. A system was needed, and several authors sought to provide it by codifying a number of cases and observations into textbooks.

These early textbooks, ranging from physics and electrical how-to manuals to complete and well-informed volumes, were the mainstay of radiation therapy education in these earliest years. The most widely consulted included Francis Williams's monumental Roentgen Rays in Medicine and Surgery (1901), Samuel H. Monell's System of Instruction in X-Ray Methods (1902), W. A. Pusey and E. W. Caldwell's Roentgen Rays in Therapeutics and Diagnosis, W. H. Rollins's prescient Notes on X-Light (1901), and Mihrun Kassabian's Roentgen Rays and Electrotherapeutics (1907), as well as texts by Carl Beck and George McKee (Fig. 6.11).

Most of these texts were quite lengthy, giving detailed instruction in the physics and production of the rays, with sections on diagnosis and therapy. Many included sections on other light and ray therapies: Grenz rays, X-rays, electrotherapy, actinotherapy, and Finsen ray treatments. Often the radiation therapy sections were longer than their diagnostic counterparts, and most included extensive descriptions of protective measures and elaborate methods for estimating dosage.

Fig. 6.10 Williams, a conscientious investigator and clinician, recorded his own experiences with the rays in an effort to assist others in forming judgments about treatment distances, voltages, and safety. This is typical of early charts made in an effort to standardize and assess treatment success. (Courtesy of the Center for the American History of Radiology, Reston, Va.)
Kassabian's book, written as the author was already disfigured by exposures to radiation and only three years before his death, was a thorough and reasoned synopsis of all that was known about the X-ray in 1907. To be absolutely complete, Kassabian surveyed thirty-one American and European practitioners specializing in roentgenology. One appendix included not only thumbnail descriptions of their preferred apparatus, but also complex charts surveying additional apparatus, dosage, and practical applications. From these charts it was possible to replicate as closely as possible the clinical scene and treatments of the great names in the field, among them Freund in Vienna, Baetjer at Johns Hopkins, Girdwood in Montreal, and Caldwell and Morton in New York. Kassabian's book, like that of Williams, served the confused practitioner in that it assembled many of the separately published case histories, grouping them by disease. But little attempt was made to draw conclusions about similarities or differences among results in these cases. Instead, the books were aimed at "the practical physician," providing the facts—and lots of them—and, as Kassabian proudly noted, "no space has been encumbered with the recital of fanciful theories or those of a controversial nature."

The volume by Pusey and Caldwell was the most widely used by roentgenologists and general practitioners. In his preface to the first edition section on X-ray therapeutics, Caldwell set out his own notion of a textbook:

I have given as fully as possible the details of my own experience and of the experience of other workers, for it is only by the accumulation of such data that it becomes possible to arrive at a satisfactory estimate of the value of the method.29

What followed there and in the second edition of the book were more than 500 of the authors' own cases, with many more descriptions from other physicians. The results from these early aggregate texts may have been the illusion of an education in the field, but two things were needed before true education could begin: first, adequate apparatus and dosimetry devices to ensure comparability of results and, second, an informed rationale for applying the rays in a specific manner to individual diseases.

Comparability would have to wait, but soon volumes devoted exclusively to radiation therapy appeared, and many of their authors had methods which could be interpreted as systems. The 1904 translation of Leopold Freund's now classic Elements of General Radiotherapy for Practitioners was widely consulted and cited.30 Some readers even referred enthusiastically to the "Freund" method, though the elements of that method seem today difficult to tease out from the mass of disparate data, techniques, and observations.31 Nobel M. Eberhart, a professor at Grubbe's Illinois School of Electrotherapeutics, published Practical X-Ray Therapy in 1907.32 Two years later another Illinois School colleague, Gordon E. Burdick published X-Ray and High-Frequency in Medicine.33 Other specialized books, of varying quality, appeared with regularity.

But at whom were these texts and specialized manuals aimed? There were no formal hospital programs in radiation therapy, and the number of persons in the United States and Canada concentrating exclusively in the field could be counted on two hands. Eberhart, who referred to his work as "a brief and handy working manual,"
made clear his intended audience. The book, he wrote:

...is especially designed to meet the requirements of the busy practitioner who has installed an X-ray outfit in his office and, after having been instructed by the maker of the apparatus in the general management of the same, finds himself confronted by [numerous] questions.\textsuperscript{34}

Freud noted in his introduction that he had "purposely presupposed but little knowledge on the part of the reader."\textsuperscript{35} Other radiation therapy textbook authors, like one-time electrotherapist William Benham Snow in 1908, remarked on the inexperience of most who intended to use the X-ray in therapeutics.\textsuperscript{36} In fact, despite the growing mass of clinical reports and evidence, running just beneath the surface of early instructional literature was the notion that radiation therapy offered something for every doctor. There was no hint in any of these books that the reader might choose to specialize in general radiology, much less radiation therapy. This information was aimed at a general awareness of the field for those who wished to employ it as an adjunct to broader medical practice.

Teaching hospitals and medical schools offered little more to the interested student than a brief acquaintance with the new rays. Although radiation therapy with both X-rays and radium had earned a place in many hospitals prior to World War I (most notably with Pfahler at the Hospital of the University of Pennsylvania, William Morton in New York, Francis Williams in Boston, and Howard Kelly and Frederick Bantinger at Johns Hopkins), there was no systematized course of training.\textsuperscript{37} Henry Pancoast recalled that as a young physician at the University of Pennsylvania in 1902 he was asked casually whether he would like to "try the new X-ray work." Training for the new position meant spending eight to ten hours with William Goodspeed in the physics department. "At the expiration of that time," wrote Pancoast, "he told me that was all he knew of the subject and that any further knowledge would have to be gained through experience—and so it had to be."\textsuperscript{38}

As time went by, the reluctance to institute formal training stemmed in part from the fact that both radiology and radiation therapy were thought of as mere adjuncts to more established fields within the hospital. One influential German physician was quoted in American publications averring that "radiologists should be trained dermatologists to begin with."\textsuperscript{39} At a 1905 meeting of the College of Physicians of Philadelphia devoted entirely to radiation therapy, radiologist George Johnston rose to proclaim that in therapy "the legitimate X-ray man does not consider himself the successor of the surgeon, but is proud to be accorded the position of assistant."\textsuperscript{40} Many hospitals consigned all of radiology and its practitioners to the regions of the hospital usually reserved for what were at that time designated as "auxiliary services": brace-and-limb, medical photography, and physical therapy. Few United States hospitals had separately recognized X-ray departments in these early years; none had departments for radiation therapy. Providing courses of instruction in such circumstances was difficult if not impossible. Interested students could learn by spending more time with the radiation therapists—for all practical purposes apprenticing, just as their non-hospital trained counterparts did. At institutions like the Memorial Hospital in New York, where James Ewing and a group of surgeons and pathologists were beginning pioneering work in radiation and radium therapy, a few students were able to carve out for themselves an education in the field.\textsuperscript{41}

In a search for a reliable system and for instruction that was not based solely on a compilation of unrelated experiences, many North American physicians went to Europe to learn about radiation and radium therapy. These seekers were part of a long tradition of medical "grand tourists," who since the 1820s had pursued the education and added cachet offered by European universities and specialists. With the advent
of radium and the rise of different schools of medical thought on radiation therapy in Europe, many Americans went for brief periods of study and observation with the Curies, Albers-Schönberg, Freund, Bécqère, and other noted professors. Robert Abbé of New York made several trips to Paris to study with Marie Curie, bringing back radium for use in his own practice. Others who went for long or short periods of European study included Pfahler, Morton, and Williams. In 1902 the Johns Hopkins Medical School sent Fred Baezter on a year-long expedition to study European X-ray and radium treatment of cancer. Those who followed Baezter in the next ten years would add much to the American store of information on radiation therapy and would begin to formulate ideas about ways in which the field should be organized and taught. It would not be until after the unexpected exposure to European methods occasioned by service in World War I and a radical change in thinking about all types of medical education that United States physicians would look seriously at formalizing education in radiation therapy.

BECOMING A PROFESSION: 1915–1950

Historians often designate the first World War as a dividing line between the old world and the new. In radiation therapy the war years had special meaning. They saw the beginning of the widespread use of Coolidge's improved X-ray tube and resulting improvements in reliability and results. Efforts were underway to achieve international agreement on standards for radiation dosimetry. Physicians who served abroad were made aware of teaching traditions already well formed and active in London, Paris, Vienna, and Stockholm. On their return they found a medical educational system at great pains to remake itself in the wake of damning reports on widespread inefficiency and corruption. The scene was set for reform in medical education, and the right tools finally were available for radiation therapy to become a science. The question was whether or not the field was ready to meet this challenge.

In 1914, as a partial response to the revelations made in the Flexner Report and other studies critical of medical education, the AMA's Council of Medical Education and Hospitals (CMEH) published a list of hospitals with approved internships. This would be followed by a list of hospitals with approved graduate education in medical specialties. This mild attempt to impose standards had almost no effect on radiation therapy. Most of those interested in the field continued to receive training by what amounted to ad hoc preceptorships within the few institutions with radiation therapy facilities. Strong loyalties tended to attach to the individual mentors willing to provide education in the field, a tradition which has lingered in radiation oncology. James Case, in looking back on the history of education in the field, noted the extraordinary influence of teachers like Baezter and Hickey.

A few hospitals offered more structured education in the field. Memorial Hospital in New York was one of the first institutions to formalize training in the early 1920s when Cornell medical students began rotations through the cancer treatment facilities. Memorial also adopted the European tradition of welcoming professional "visitors," who observed for periods from two days to six months. In 1921 and 1922 more than 300 visiting physicians observed radiation therapy at Memorial. Other institutions, including the Mayo Clinic, the Massachusetts General Hospital, the Hospital of the University of Pennsylvania, and Johns Hopkins, opened radiation therapy sections through which medical students rotated or visited regularly as an adjunct to other service rotations. The short-lived Philadelphia Post-Graduate School of Roentgenology, sponsored in 1915 by the Philadelphia Roentgen Ray Society, may well have been the first school dedicated to the specialized academic training of radiologists but graduated no
radiation therapists. At a time when the field was struggling to establish itself as a separate entity, initiating only those who had already chosen to specialize in the field might have seemed the most prudent course.

Case, like a growing number of others, believed that acquainting the undergraduate with all aspects of radiology was essential both in turning out well-prepared physicians and in gaining recognition for the specialty. Even he acknowledged, however, that the chances for formal undergraduate study of radiation therapy were not good. And, while at least 619 hospitals in the United States offered some form of postgraduate education (internships) in 1932, Case was realistic about the limits of the standard internship and radiation therapy:

The field of roentgen therapy is so complicated that it is to be doubted whether more can be done in the way of instruction during the intern year than to teach the general principles of treatment, the selection of cases, the realization that it is possible to make accurate dosage, and the limitations of the method.

The Move Toward Certification

Efforts were already underway that would make postgraduate education in radiology, however problematic, a requirement. This process would establish, once and for all, that radiology was a medical specialty, but the status of radiation therapy would remain less clearly defined.

In 1917, as a response to unregulated practice, the American Board of Ophthalmology was formed to set standards and confer specialty certificates. Like radiologists, ophthalmologists struggled in a field in which both physicians and lay persons regularly usurped their area of expertise.

Throughout the 1920s radiologists looked at ways to upgrade their own standards for teaching and practice in an effort to bring greater legitimacy to the specialty. Albert Soiland's efforts to have a section on radiology authorized as part of the AMA in 1923 and his subsequent founding of the American
College of Radiology (ACR) were a part of this larger effort. Others proposed nationally standardized programs of postgraduate education, with three-year courses with projected curricula in which diagnosis would take clear precedence over therapy.

Standardization was at least a more plausible eventualty in radiation therapy than it had been twenty years earlier. With more reliable apparatus able to generate larger and larger voltages, improved radium devices, and more effective radiation protection, the field was achieving remarkable results in a widening range of benign and malignant conditions. At the second International Congress of Radiology in 1928 (where the theme was "Education and Medical Training in Radiology"), the Committee on Units and Measures reached an agreement on an international standard radiation measure, the roentgen. At least in theory, results from all over the world could now be compared and favorable clinical outcomes duplicated. Radiation therapy was ready to move forward as a specialty. The ties between diagnosis and therapy meant that they would move together.

In 1933 representatives from five radiological organizations (ARRS, ACR, American Radium Society, [ARS], the Radiological Society of North America, [RSNA] and the Section on Medicine of the AMA) met in Milwaukee to discuss the formation of a "qualifying board." The American Board of Radiology (ABR) was incorporated in Washington, D.C., in May of 1934. During its first year 404 candidates were approved as certified radiologists. The oral examination (which many of the original candidates bypassed) was directed by an examining board of eminent radiologists, with examiners in physics added later. Certificates were granted in radiology, roentgenology, diagnostic roentgenology, therapeutic radiology, and therapeutic roentgenology—a series of classifications that remains as confusing today as it was in the 1930s.

By 1937 the ABR's Committee on Graduate Radiologic Training recommended a one-year medical internship followed by at least three years of postgraduate work in a recognized institution. The plan called for "examination in the basic sciences of radiology as well as in the clinical aspects thereof," with no specific mention of the weight to be given to therapeutic radiology in this training. Byrll R. Kirklin outlined a suggested course of instruction to satisfy the new requirements. His three-year residency program would include a year of diagnosis, nine months of basic and technical medicine, six months of electives, and nine months of radiation therapy. Other radiologists proffered different potential curricula for radiology residents.

United States medical schools were not entirely ready to take on the new burden of educating radiologists. In 1937 there were sixty-eight "Class A" medical schools with four-year programs leading to the medical degree. Of these, forty had separately chaired radiology departments. One offered no instruction in radiology, while twenty-seven of the schools included radiology under other department headings: anatomy, pathology, and surgery. Moreover, many of these schools "farmed out" instruction in radiation therapy to private practitioners with hospital ties. This practice was deplored as leading to idiosyncratic and unreliable techniques, but throughout the 1930s even ABR board examiners advertised private preceptorships for interns and residents. While the formation of an effective specialty board brought recognition to radiology in general, it did little to train professional radiation therapists. Of the first seventy-two diplomates certified in radiology, forty-four were surgeons, gynecologists, and dermatologists. Still more were general radiology candidates who failed the diagnostic portion of the exam and were granted instead a certificate for therapeutic radiology. This awarding of certification in therapeutic radiology almost as a consolation prize persisted into the 1950s.

In 1939 there were fewer than fifty physicians devoted to the exclusive practice of radiation therapy in the United States. Of these, a number had
immigrated from training centers in Europe. There was not a critical mass of academicians sufficient to realize a broadly-based standardized course of instruction in radiation therapy. Exactly where such training would fit within the larger field of radiology was unclear.

In 1948 George Holmes suggested a simplification of ABR certification to three areas: radiology, diagnostic radiology, and therapeutic radiology. The war years froze changes in the ABR, and Holmes’s suggestion was not even printed until 1946 and did not see implementation until 1959. His idea was that this simplification would clear up the confusion of the old categories, at the same time that it would consolidate and give additional weight to the practice of radiation therapy. Holmes knew quite well that he was fanning a fire that had been smoldering since the incorporation of the ABR: the threat of civil war in the ranks of radiologists.

A Separate Specialty?

For years radiation therapists had fought off the claims of other medical specialists to their field. With the establishment of the ABR, radiation therapists at last had bona fide standing within a specialty. They were members of radiological organizations (ACR, ARRS, RSNA, and ARS) that exerted increasing influence on medical and social issues and legislation. Yet the radiation therapists found themselves outnumbered and sometimes outvoted, both in organizational and institutional settings, by their diagnostic colleagues. As early as 1938, Swedish roentgen pioneer Gösta Forssell advocated the separation of therapy from diagnosis:

A complete divorce of these two branches of radiology offers such great advantages for research and instruction, as well as for the utilization of radiology in practical medicine, that it is fervently to be hoped for as soon as possible at university and other large hospitals.

Douglas Quick, in his Carman Lecture to the ARS in 1947, gave a long and impassioned rationale for the separation of diagnosis and radiation therapy into separate hospital departments, noting the tendency of practitioners to be overshadowed by their diagnostic colleagues. He went on to suggest that radiation therapy and radium therapy be divided services (a situation in place at the Mayo Clinic since the 1920s). "Nothing short of the insistence of the Board [the ABR]," he said, "...will change this indifference to the establishment of adequate training." Quick also pointed out the operational flaw in his plan: the problem of "how the additional trained personnel in therapy is to be supplied." A concerted effort, he believed, including the use of resources like those of the proposed Registry of Radiologic Pathology at the Army Institute of Pathology, would soon yield a functional separate field of radiation therapy.

If many radiation therapists were unresponsive to these suggestions, a number of general radiologists found them appealing. In a starkly honest appraisal of the situation, Thomas Groover, founder of the large Washington-based practice Groover, Christie, and Merritt, had advocated dumping radiation therapy from private practice partnerships. Groover found radiation therapy not as profitable, and, "from a strictly economic standpoint, our group is overbalanced on the side of therapy. Radiologists [diagnostic] cannot continuously provide out of their earnings the subsidy which efficient radiotherapy of cancer requires." Few hospital radiation departments shared Groover’s views, and fewer department heads wanted to see a portion of their staffs and revenues taken away to form new departments.

Among radiation therapists and radiation educators, however, feelings were moving toward a split. Ursus V. Portmann surveyed the current state of radiation therapy instruction in 1950 and found it wanting. He noted the new vistas opened by radioisotopes and treatment units, the poor instruction received by many students, and the loss at which many who wished to specialize in the field found themselves:

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In view of the vast differences in diagnostic and therapeutic radiology it should be obvious that separation of these branches is advisable, and should be initiated in large teaching institutions in this country as soon as possible to improve the status of both.67

But many in the field, both diagnosticians and therapists, were threatened at the notion of divided academic programs within a divided field. Portmann had correctly pointed out that change was needed. At mid-century radiation therapy was poised for expansion and ready for systematized educational reform. In contemplating a break from the long partnership with diagnostic radiology, some radiation therapists ignored new partners on the post war horizon: organized medicine and the federal government.

1951—PRESENT: NEW PARTNERSHIPS TOWARD RADIATION ONCOLOGY TRAINING

The academic, organizational, and clinical worlds of radiation therapy were changing rapidly at mid-century. Powerful new weapons against cancer had become available, and their origins in war research put them under the close scrutiny of new government agencies. American medicine was becoming more organized, encouraging standardization of medical education and postgraduate training. In radiology, physicians who had returned from the war with X-ray training swelled the field’s diagnostic ranks, while radiation oncology remained what several writers referred to as the “stepchild” of the field.

Those who had sought to sever radiation therapy from diagnostic radiology faced an insurmountable obstacle: there were not enough radiation therapists to see the numbers of patients who sought treatment, much less to form a separate and active specialty. Either massive funding in the form of not entirely welcome government interaction was needed to create, almost overnight, a new field, or radiation therapy would need to remain in concert with the rest of organized radiology in addressing mutual goals.

Arguing against precipitous action, Juan del Regato summarized this dilemma in 1953:

To call for division of the large departments of radiology into departments of radiodiagnosis and radiotherapy is to ask for delivery without gestation for, at the present time, even cancer hospitals with a high sense of responsibility for the lives of their patients must do without radiotherapy for lack of well qualified aspirants to the positions. To divide departments of radiology and to entrust radiotherapy to self-trained neophytes may prove to be the hardest blow yet given to therapeutic radiology. To stiffen the specialty board examination would result only in penalizing young students for a poor quality of training for which they are not responsible; and to require special certification by a radiotherapy board of examiners offers no better solution.68

del Regato called for a versatile, patient-oriented clinical training in special cancer centers. At the time he was working toward developing such a center at the Penrose Cancer Hospital in Colorado Springs.69 Similar efforts continued at Memorial Hospital in New York and were underway with Gilbert Fletcher at the M. D. Anderson Hospital in Houston and Henry Kaplan at Stanford. At each institution it would take the force of individual will to shape a well-codified teaching program, and the graduates of each program would bear the stamp of these forceful mentors.

Difficulties in reaching agreement on uniform standards in radiation therapy training reflected both the strong spirit of the few teachers specializing in the field and the scattered institutions in which they were taught. As late as 1960 the twenty-nine institutions which claimed to have training programs in “straight” (full-time) radiotherapy listed only twenty-five residents.70 Most of these hospitals had only one or two radiation therapists on staff with only one resident. In such situations elaborate teaching programs were not possible.

But organized medicine was moving toward systematized accreditation of
THE AMERICAN CLUB OF THERAPEUTIC RADIOLOGISTS/ THE AMERICAN SOCIETY FOR THERAPEUTIC RADIOLOGY AND ONCOLOGY

Founding a specialty medical society can be a delicate undertaking. At mid-century, despite growing numbers of practitioners and an increasingly complex field, those who specialized in radiation therapy in the United States had no society of their own. They were represented in the ranks of the American Radium Society (ARS), but so were the surgeons, gynecologists, and other specialists who believed the use of ionizing radiation should fall with their purview. Radiation therapists were represented in the Radiological Society of North America (RSNA), in the American Roentgen Ray Society (ARRS), and in the American College of Radiology (ACR), but in each they formed only a very small percentage of the total membership.

Juan A. del Regato and other radiation therapists who quietly discussed the possibility of a separate society understood that members of these larger organizations might perceive this as a threat. Several radiation therapists had already proposed splitting off radiation therapy from diagnostic radiology in hospital services, and del Regato and his colleagues did not want to appear to be leading a secession movement. It was necessary to conduct the most subtle of organizational moves and to make it clear in doing so that radiation therapy intended to remain allied with all of radiology.

In 1953 the International Club of Radiotherapists was organized in Copenhagen. del Regato served as secretary of the American wing of the International Club and took the initiative of inviting the other American members (fifteen in all) to a dinner during the annual meeting of the RSNA in 1955. He noted that the RSNA, like the ARRS and the ACR, had turned down requests to form separate sections for radiation therapy and was suspicious of his request. To contract for a dining room he had to get written permission from the RSNA secretary. Other radiation oncologists were invited as guests of the International Club members. The meeting was a great success, and the group met twice annually thereafter at the RSNA and ARS. Although substantive matters were discussed, the meetings had a social character which none of the larger societies perceived as a threat. del Regato later recalled:

The gatherings represented two groups, members of the Club and their guests. As expected, the idea arose to create a single American Club to include everyone. I was ready with a one-page Founder's Agreement. In Chicago, in December of 1958, fifty-six of us approved the foundation of the American Club of Therapeutic Radiologists, with provisions to eventually 'formalize the informality.'
Those who know del Regato well suspect that he had been carrying the founders’ agreement since the first meeting in 1955. He understood that the club had to develop naturally out of the collegiality of its members, rather than as a reaction against other organizations in radiology. Fifty-four members signed the founders’ agreement.

The club was incorporated under the laws of Colorado in 1962, and a crab surrounded by electronic orbits (designed by del Regato) was adopted as its official seal. By 1962 membership had risen to 252, and by majority agreement the name was changed to the American Society of Therapeutic Radiologists. In 1970, with 308 in attendance, the society held its first separate scientific meeting. In 1972 Cancer became the official publication of the society, and in 1976 the society sponsored the international journal of Radiation Oncology•Biology•Physics as its official organ. Known in the field as the “red journal,” it became the official and exclusive journal of the society in 1985.

In 1983 the society adopted a new mission statement:

To advance the practice of radiation oncology by disseminating the results of scientific research, providing opportunities for education and professional development of its members, and promoting a health care environment conducive to optimal patient care.

The society adopted a vision statement which called for the pursuit of excellence in practice and in the multidisciplinary setting of cancer care. To reflect its broader mission the name of the organization was changed to the American Society for Therapeutic Radiology and Oncology (ASTRO).

Today ASTRO is the largest society of radiation oncologists in the world, with 3,157 active members, 573 associate members, 160 corresponding members, 9 affiliates, 1,009 junior members, and 35 corporate members. The annual meeting now includes extensive scientific and commercial exhibits and is attended by thousands of radiation oncologists from the United States and abroad. ASTRO sponsors a number of educational programs and is active in the work of other major radiological societies. Although its beginnings were quiet, the organization now gives a strong voice to the specialty of radiation oncology.

teaching programs. Throughout the 1930s and 1940s the AMA had continued to publish its lists of approved specialty boards and internships. In the early 1950s the AMA's CMEH sponsored conference committees in each specialty to review and evaluate graduate medical education. A system of residency review committees (RRCs) was set up, with the RRC for Radiology meeting for the first time in 1953. Representing the ABR on this committee were Kirklin, Quick, and H. Dabney Kerr, while Eugene Pendergrass, Warren Farcy, and Edward Leverett represented the AMA CMEH. The charge of the RRCs was then, as it is now, to review training programs, discuss relevant issues, and decide which programs deserved full accreditation. Accreditation from the RRC for Radiology became one of the necessary credentials for securing government research grants in cobalt and other new technologies in the 1950s. With the advent of widely funded government grants for graduate medical education in the 1960s, all RRCs were made up of broadened boards under the Liaison Committee for Graduate Medical Education (LCGME), representing five major medical groups. The move toward increasing the numbers of separately accredited programs in radiation
ASSOCIATION OF RESIDENTS IN RADIATION ONCOLOGY

The Association of Residents in Radiation Oncology (ARRO) was officially formed in October 1983 during the annual meeting of the American Society for Therapeutic Radiology and Oncology (ASTRO). Discussions for organization of such a society had begun the previous year, when an ad hoc committee of chief residents, led by Daniel Flynn, elected Francine Halberg as resident representative to the Residency Review Committee in Radiology. In the fall of 1983 radiation oncology residents across the country elected six officers to form the Executive Committee of ARRO. This committee met in March 1984 and outlined the following goals and objectives: (1) to disseminate information to all radiation oncology residents; (2) to formalize residents' input in professional organizations and committees affecting radiation oncology residents and residency training; and (3) to provide a forum for radiation oncology residents each year in conjunction with the ASTRO meeting.

ARRO Executive Committee members represent resident interests to a number of organizations, including the American College of Radiology, the Society of Chairmen of Academic Radiation Oncology Programs, the Residency Review Committee, the Intersociety Commission radiology summit, and others. ARRO provides its members with information on fellowships, sources of research funding, and elective rotations at other programs. The organization maintains an updated recommended text and journal outline and sponsors a variety of programs for residents during the annual ASTRO meeting. Results of annual ARRO questionnaires and surveys contribute to decisions made by the American Board of Radiology about examinations and are useful for other decision-making bodies in the field.

ARRO provides a strong voice for the residents who will lead the field in the future, at the same time that it provides for them an avenue of participation in the larger events and discussions that affect radiation oncology.

—David H. Hussey, M.D.

therapy was aided by the establishment and growth of the American Club of Therapeutic Radiologists (today the American Society for Therapeutic Radiology and Oncology), in the 1950s.

A picture of training in the field during the 1950s and 1960s can be gathered from the residents' program at Penrose. Although each program varied in content, scope, and aim, Penrose's program was among the best and most thorough and is well worth scrutiny today. Candidates in straight radiation therapy stayed in Colorado Springs for two years, followed by a fellowship year at other institutions in the United States or abroad. Residents served three-month rotations in anatomical pathology, surgical oncology, and nuclear medicine, as well as their regular clinical and research work in radiation therapy. del Regato targeted seven areas to be mastered for a successful education in the field:

1. Clinical manifestations of neoplasms and their pathobiology.

2. The accurate diagnosis, differential diagnosis, and staging of the various forms of cancer.

3. Indications for and technical aspects of multimodal management
of a broad spectrum of malignant neoplasms, including the side effects and late morbidity associated with each of the different modalities.

4. Continuous follow-up care of all patients regardless of type of treatment administered or even when therapeutic abstention was decided and including the terminal care of some patients.

5. The discipline of accurate and orderly record keeping and the maintenance of tumor registry systems.

6. Participation in clinical research through intramural as well as cooperative group studies.

7. Educational programs including didactic lecture, conferences, tumor boards, etc.75

Between 1949 and 1974 del Regato trained fifty-five full-time radiation therapists at Penrose—more than doubling the number of practitioners who had been in the field at the start of this period. Together with the graduates of similar programs these men and women would form the first generation of radiation oncologists.

Regular surveys revealed that the number of institutions training postgraduates in radiation therapy tripled between 1960 and 1970, reaching 66, and the number of residents in training increased more than six fold, to 150.74 By 1972 500 residency positions were being offered, but only 244 were filled. There was a clear need for more physicians in the field, a need fueled by the numbers of patients seeking radiation therapy. In 1951, for example, 1,558 new cases were treated at the Memorial Hospital Department of Radiation Therapy, with 798 patients seen for follow-ups and additional therapy.75 Ten years later these numbers had nearly doubled, but the staff remained the same. At M. D. Anderson, where some planners had worried that the term “cancer center” would alienate both the public and physicians, patients were soon writing in to refer themselves for treatment on the new cobalt machine.76

The advantages of such controlled national studies was obvious. In 1965, at the request of Dr. Kenneth Endicott, director of the National Cancer Institute, a Committee for Radiation Therapy Studies (CRTS) was formed to serve as an advisory group to the National Advisory Cancer Subcommittee for Diagnosis and Treatment. Gilbrt Fletcher served as the first chair, with del Regato, Milton Friedman, Manuel Garcia, Henry Kaplan, Morton Kligerman, Victor Marcial, Walter Murphy, and James Nickson as members. The CRTS subsequently the Committee for Radiation Oncology Studies (CROS), provided not only the means for setting national standards of practice in the field, but provided manuals, guidelines, and goals for the field.77

In 1968 CRTS launched the Radiation Therapy Oncology Group (RTOG), which received initial funding from the National Cancer Institute in 1971. Responsible for the last twenty-five years for coordinating clinical trials in radiation oncology, the RTOG has had a tremendous impact on training through government grants, through the pool of cases studied, and through the mass of significant clinical results and subsequent effects on technique.

By 1978 107 institutions offered training in straight radiotherapy, with 344 of 595 available fellowship positions filled.78 By 1982 there was cause for worry in these numbers. Only 89 institutions offered training, with 399 of 501 positions filled.79 The need for trained radiation therapists had not diminished, but the numbers of institutions willing to train specialists had dropped off. Moreover, the authors noted an increasing difficulty in persuading graduates of American medical schools to choose the field as a specialty. Six years later the numbers of institutions and positions remained virtually unchanged, but the number of residents in training had risen to 517.80

In the following year, 1988, Robert G. Parker published an assessment of current training programs and recommendations for needed changes.81 He noted that, ironically, in the short period of sixteen years the analyses of planners in the field had gone from a
perceived shortage of radiation therapists to concerns about an oversupply. While this did not diminish the need for new practitioners, it suggested that new members of the field should be of the highest quality and that areas like research, previously given less attention in training, should receive new emphasis. Parker listed the numbers of grants available for the support of residents and fellows and noted the declining federal dollars available for these positions. For the first time, Parker suggested that "the current requirements for the management of patients in the community appears to be satisfied."

Efforts at improving the quality of training continued. In 1984 the ACR administered its first in-training examination. By 1987 445 examinees took the test at 99 locations. The test covered radiation biology, physics, and clinical practice. Today the examination is required in 91 percent of radiation oncology training programs and provides a benchmark by which cognitive skills in the field can be measured in an effort to enhance both individual and institutional performance. Demographic feedback from the tests can indicate broad areas of shortfalls in clinical experience with specific aspects of the field; and these are translated back into recommendations for training standards.

Over the last twenty-five years, universities across North America have moved to establish separate departments of radiation oncology and sometimes separate institutions. For the most part this has not been a subject of debate, as both diagnostic and therapeutic radiology have each moved forward, represented at the same time by both exclusive and shared organizations. Within radiation oncology and in the ecumenical radiation community as a whole, the quest for quality training to produce able and talented practitioners has produced remarkable achievements. For one hundred years, from the early guidance of mentors in empirical essays to today's carefully planned and supervised courses of study, the goal of quality education in the use of radiation has remained the same.

REFERENCES

Dr. David Hussey, who has done extensive research on the history of education in radiation oncology, has provided numerous references and resources helpful in the preparation of this chapter.

3. Ibid., p. 29.
6. The Archives of Clinical Skeiography (later to become the British Journal of Radiology) published numerous advertisements for the earliest manufacturers of X-ray equipment, as well as stunning folio-sized sepia-tone radiographic prints that were widely used as wall art in X-ray laboratories and clinics.
10. Advertisements for Pratt's laboratory can be found in the Grigg, Grubb, and Manufacturing Collections of the Center for the American History of Radiology, Reston, Va.
11. Fuch's advertisements, photographs of his extensive clinic, and many of his large signature sepia-toned radiographs are on file at the Center for the American History of Radiology, Reston, Va.
12. A series of advertisements from Farbey and Robarts as their separate clinics and interests evolved are on file in the Grigg Collection at the Center for the American History of Radiology, Reston, Va.

14 Grubbe, X-Ray Treatment, p. 64.
15 Grubbe, X-Ray Treatment, p. 75.

16 Advertisements and early examples of the correspondence course from this school can be found at the Center for the American History of Radiology. Reston, Va.

17 Monell’s school flourished; advertisements are on file at the Center for the American History of Radiology. Reston, Va. Monell’s advertisements also show up in many early manufacturer’s catalogues.


25 Delavan, R., “X-Rays in Laryngeal Cancer,” Medical Record (1 Nov. 1902).


27 Kassabian, p. 253 through unnumbered appendices.

28 Ibid., p. iii.

29 Pusey and Caldwell, p. 219.


34 Eberhart, p. 9.

35 Freund, p. v.


37 The interested reader is referred to the two biographical anthologies of Juan del Regato, Radiological Physicists (New York: American Institute of Physics, 1985), and Radiological Oncologists (Reston, Va.: Radiology Centennial Inc., 1983).


41 For an excellent review of Ewing’s work see the chapter on his life in del Regato, Radiological Oncologists, pp. 65-76.

42 The thumbnail sketches of radiation therapists and physicists appended to del Regato’s Radiological Oncologists provide numerous examples of Americans who journeyed to Europe in these early years for instruction.

43 Burdick planned trip was reported in J.A.M.A. 39 (1902):263.

44 Numerous medical and social historians have written about the effects of the Flexner report on medical reform, about efforts to standardize and regulate drugs, and the reshaping of medical services which followed. For a summary, see Starr, pp. 116-144.


47 The progress of radiation therapy using both X rays and radium can be read in meticulous Reports of the Memorial Hospital, published under the direction of Ewing. Failla, Ianeway, Barringer, and others throughout the 1910s, 1920s, and 1930s.

48 Pancost, p. 183.


51 Case, in Glasser, p. 345.

52 Ibid., p. 350.

53 See del Regato's biography of Soliand in Radiation Oncologists, pp. 77-88.


58 Many such statistics can be found in the yearly roundups of the Yearbook of Radiology (Chicago: Yearbook Publishers). These figures are from the 1937 Yearbook.


62 Ibid.


73 Wilson and Chabazian, p. 1481.


76 Statistics for numbers of patients treated can be found in the annual Memorial Hospital Reports for these years. The reports were often summarized in the Year Books of Radiology as well.


84 Parker, p. 1248.
