A n old Arabian story: Three princes of Serendib loved the same princess. She agreed to give her hand to the one who would bring her the most wonderful gift. They set out to far countries in search of the winning trophy.

One prince found a magic glass that would show what was happening anywhere on earth. One found a magic carpet that would take the owner anywhere in an instant. The third found a magic apple that would cure any disease. Each thought he had found THE gift.

They met before returning home. When they looked into the glass, they saw the princess lying near death. Immediately they mounted the carpet and were home in an instant. Applying the apple, they restored the princess to perfect health.

Which gift was the most wonderful? Each of the princes accidentally found an element essential to the princess’s recovery. Her challenge, it turned out, had no single solution. (Incidentally, this tale gives us the word “serendipity.”)

Nuclear medicine is surely a magic glass into the most basic mysteries of the human body. But is there a single solution to the question of who should be regarded as the “father” of the field? (Except for the important early contributions of Marie Curie and, later, her daughter, Irène Curie Joliot, the formative years of the field were dominated almost entirely by men, so the search for a “mother” may be moot.)

They say it is a wise child who knows his own father. SNM Past-Historian Millard Croll, MD, approached this question in an earlier article (1). The title of Father of Nuclear Medicine has been bestowed on several individuals, each with some merit. Each has made fundamental contributions in 1 form or another and deserves recognition. Here are some of the reasons these men and others may come to share in the title of collective fathers of the field.

**Antoine-Henri Becquerel**, a French physicist, made the chance discovery in 1896 that uranium would expose a photographic plate by virtue of some as yet unidentified rays (2). He maintained for some time that the rays were a form of delayed fluorescence, but, when the Nobel Prize was offered for “the discovery of radioactivity,” he was willing to admit that radioactivity existed. This discovery was obviously central to nuclear medicine, but, because Becquerel did no work in medicine or biology, he could lay claim to being no more than the Father of Radioactivity—quite an auspicious title in itself.

**Hans Wilhelm Geiger**, a German physicist, developed a radiation detector that, unlike its predecessor the electroscope, detected individual events rather than accumulated energy deposition. The Geiger counter first appeared in 1908, followed shortly thereafter by the improved Geiger-Mueller tube. Although its sensitivity to gamma rays was low (2%), this device was the first to detect and measure extremely small quantities of radioactivity, paving the way for safe diagnostic applications. Without low-level detectors, diagnostic nuclear medicine could not have developed. Geiger may claim the title of Father of Low-Level Detectors.

**Georg Charles de Hevesy**, PhD, a Hungarian chemist, was undoubtedly the first to perform a radioactive tracer (his term was “isotopic indicator”) experiment in 1911, at a boarding house in Manchester, England. He suspected that the landlady was recycling previously served meat at dinner, which she indignantly denied. De Hevesy would recall (3):

The coming Sunday in an unguarded moment I added some active deposit to the freshly prepared pie and on the following Wednesday, with the aid of an electroscope, I demonstrated to the landlady the presence of the active deposit in the soufflé.

As far as we know, this was the first application of a radiotracer in the life (sort of) sciences, although it was never published in any peer-reviewed journal. Nor, as far as we know, has

(Continued on page 29N)
History Corner
(Continued from page 26N)
the experiment been replicated recently. De Hevesy was also the first to use a true radiotracer in chemistry ($^{210}$Pb to measure the slight solubility of lead compounds) (4) and in biology (Pb metabolism in plants (5) and $^{32}$P metabolism in rats (6)). The dynamic turnover in the plants impressed him, but in the rats it astonished him. In his 1943 speech accepting the Nobel Prize in Chemistry, he said (3):

The most remarkable result obtained in the study of the application of isotopic indicators is perhaps the discovery of the dynamic state of the body constituents. The molecules building up in the plant or animal organism are incessantly renewed...

De Hevesy clearly was the first to use radioactive tracers to investigate questions in chemistry and biology. He deserves the title of Father of Radiotracers.

Hermann Blumgart, MD, was the first to use a radioactive tracer in a human—himself. In 1926, he injected 1–6 mCi “radium-C” ($^{20}$-min $^{214}$Bi) into an arm vein and monitored the velocity of blood flow with an electroscope (7). He also examined 15 patients, 2 healthy and 13 with various disorders, finding prolonged circulation times in all patients with cardiac disease. Perhaps Blumgart can be called the Father of Diagnostic Radiotracers.

In 1934, Frédéric Joliot-Curie and Irène Curie (son-in-law and daughter of Marie) discovered artificial radioactivity when they directed a stream of α particles from a radium source against an aluminum target. The reaction was $^{27}$Al (α,n) $^{30}$P, the latter having a half-life of 2.5 min (8). This opened the door to the development of artificially produced radioactive tracers from more sophisticated devices (cyclotrons, reactors) that would come later. If we had been restricted to naturally occurring radioactive materials, our field could never have developed. The Joliot-Curies deserve recognition as the Parents of Artificial Radionuclides. (Bear with me; it isn’t easy being a genealogist.)

John H. Lawrence, MD, the brother of cyclotron inventor Ernest O. Lawrence, tried several of his brother’s newly discovered radioisotopes in animals and in humans. He was the first to apply a radioisotope to therapy, using $^{32}$P to treat a patient with leukemia in 1937, predating any other known unsealed application of radioactive materials in therapy (9). John Lawrence may be called the Father of Radioisotope Therapy.

Joseph G. Hamilton, MD, worked closely with both Lawrences and with Glenn Seaborg in the medical applications of the new radioelements. Hamilton’s seminal 1942 article on potential medical uses of radiotracers was the first indication of the medical field that was to become nuclear medicine (10). The article discussed a wide variety of diagnostic and therapeutic applications, most of them unproven at the time, but showed Hamilton’s remarkable vision in appreciating the potential of this new field. I mention Hamilton not because his work earned him any rights of paternity, but because his landmark article (well worth rereading in the light of current technology) stimulated many people to investigate the usefulness of radiotracers in medicine.

New York internist Sam Seidlin, MD, reported the complete eradication of all metastases of thyroid cancer in a patient treated with $^{131}$I. His 1946 paper and its summary in Life Magazine (October 31, 1949), caused a tremendous wave of public and government interest in this new and remarkable technique (11). As Croll pointed out, this article has been considered by some historians to be the most important medical paper published in nuclear medicine (1). As significant as this development was, however, it followed John Lawrence’s first therapy by 9 y, and so Seidlin is denied recognition of paternity (although he might be called the Father of Radioiodine Thyroid Cancer Therapy).

Benedict Cassen invented the rectilinear scanner (at the University of California at Los Angeles, 1950) and brought imaging into nuclear medicine for the first time (12). Before this, a region of interest would be divided up into a grid of small squares, with a radiation detector (usually a scintillation probe) moved systematically through the region, with the counts at each square recorded. To detect a significant increase or decrease in count rate required statistical consideration of all the numbers. Cassen’s scanner moved through the region automatically, recording counts and converting them into marks on paper that formed an image. Ben Cassen is surely the Father of Nuclear Medical Imaging.

Marshall Brucker, MD, while working as a medical physicist at Oak Ridge National Laboratories (Oak Ridge, TN) (1948–1962), foresaw the potential of radiotracers in medicine. Brucker was influenced by Hamilton’s 1942 article (10). He convinced the U.S. Atomic Energy Commission (AEC) that allowing physicians to use radiotracers in medicine would be a good thing, provided they first passed a rigorous examination after taking his own course in the medical use of radiotracers. Brucker’s course became the predecessor of the nuclear medicine residency, and his examination prefigured the American Board of Nuclear Medicine certification and AEC (now NRC) licensure. Brucer even coined the term “nuclear medicine.” Do his contributions earn him a claim to paternity in some area? Certainly the structure of nuclear medicine as we know it now (the residency, the licensure, even the name itself) owes a great deal to Brucer and his early pioneering work.

Hal Anger took the concept of imaging into a new dimension. His gamma camera (University of California, Berkeley, CA; 1957) captured an image of the distribution of radioisotopes all at once rather than point-by-point as the rectilinear scanner had done (13). His stationary device opened the way for rapid, even dynamic, imaging and soon became the worldwide standard. Nuclear medicine owes a great deal to this prolific inventor (well counter, gamma camera, tomographic scanner, whole-body scanner, positron camera). It is hard to imagine what nuclear medicine would be without the contributions of the prolific Hal Anger—
at the very least he could carry the title Father of Dynamic Imaging.

Henry N. Wagner, Jr., MD, is widely acknowledged to be the foremost spokesman for nuclear medicine and has been responsible for vigorously and successfully promoting the field throughout the world, as well as training many of its foremost leaders. He has been called the “Nestor of nuclear medicine” in tribute to his services as a wise counselor for the field (14). I believe many, if not most, nuclear physicians around the world, if asked to name a personality associated with nuclear medicine, would think of Henry Wagner.

Within subfields of nuclear medicine, several individuals have been recognized for their pivotal roles: Captain William H. Briner (Father of Radiopharmacy), Emilio Segrè, PhD (Father of Technetium), Michel Ter-Pogossian, MD, and Michael Phelps, PhD (Co-Fathers of PET), and William C. Eckelman, PhD (Father of Radiotracer Kits). There are many others, whose forgiveness I beg for not including them in what would otherwise be an unmanageable list, requiring a special printing of this journal.

Have I left anyone out? Probably—many good scientists and physicians have made major contributions to this field, and I apologize for any omissions. Paternity has been variously ascribed to several of the names mentioned. This is one situation in which being named as father would be modestly declined but secretly savored.

As Croll pointed out in his 1994 article, the growth of modern nuclear medicine required the parallel development of radiotracers, instrumentation, and radioisotope therapy (1). Radiotracers and instrumentation are the magic glass, and radioisotope therapy (in some cases) is the magic apple. (I have not figured out the carpet yet—perhaps mobile PET?) All are necessary elements. But as ingenious as our pioneers were, none succeeded in making major advances in all 3 areas. The title of Father of Nuclear Medicine—if it is to be awarded at all—must be shared by more than 1 of our pioneers, leading to a concept exceedingly rare in clinical medicine: shared paternity.

REFERENCES


—Dennis D. Patton, MD
SNM Historian
Professor of Radiology and Optical Sciences
University Medical Center
Tucson, Arizona