3. PRIORITY FOR RADIUM SELF-EXPOSURE EXPERIMENTS

3.1 Germany

The first two reports in the literature [10–12] of self-exposure experiments showing radium causing skin burns were made by two Germans, Friedrich Walkoff and Friedrich Giesel. In October 1900, Giesel described in a chemistry journal the strapping of 270 mg of radium salt to his inner forearm for a duration of 2 hours; he also wrote to inform Pierre Curie about the experiment. The Walkoff reference of 1900 consisted of just three lines in a three-page general review presented to a photographic club in Munich.

Giesel was the first to prepare radium sources in Germany for sale by the Buchler company of Braunschweig (Brunswick). In the first ten years of the twentieth century, this "German radium" competed commercially with "French radium," such as that prepared and sold by Armet de Lisle in Paris. Interestingly, both companies were able to start radium production at an early date because both were involved in quinine production. Some of the manufacturing processes for quinine and radium were similar.

3.2 France

Henri Becquerel's radium burn was accidental. He received it after he had placed a radium source inside his jacket pocket. However, he gave credit [13] for the first radium burn observations to Friedrich Walkoff and Friedrich Giesel.

Then, in June 1901, together with Pierre Curie, Becquerel reported [13] self-exposure measurements with radium using a source placed many times in "a pocket of his jacket." Those experiments have been described in detail in *Current Oncology* [12].

3.3 United States

In the very early years following the discovery of radium, most studies took place in Europe. The United States and Canada lagged behind because radium sources were scarce, and no North American supplier had yet emerged. Most of the early sources obtained in the United States were brought back from Europe by visiting doctors and scientists. However, by about 1904, the United States was starting to catch up with Europe, and in Canada, Ernest Rutherford had commenced work at McGill University in Montreal.

In the United States, the reports of self-exposure experiments in 1904 by Robert Abbé, a New York surgeon, were the most detailed. Abbé performed radiobiologic experiments in 1904 [14], and in 1907, he published [15] his answer to a friend's question, "What difference is there between the light from the stars and radium rays?"

Abbé's reply was as follows:

> Radium rays move in absolute straight lines, without deviation by atmosphere, water, lenses or prisms, and nothing is opaque to them. They would even penetrate the stone column in my garden, which light does not. Using a small glass tube containing a bit of radium about the size of a grain of rice, 60 milligram pure radium bromide, German, and an exposure time of three days this is demonstrated. This same demonstration has been made by Röntgen rays, but it is far more impressive to witness the active energy incessantly given off by the innocent looking little tube of salt.

Abbé varied the exposure to radium in his experiments and correlated it with the degree of erythema and necrosis produced, publishing his results in the *New York Medical Record* [14,16,17].

George H. Stover of Denver, Colorado, was also among the first American physicians to obtain a supply of radium, purchasing some radium chloride in August 1903 from a Paris dealer. He was therefore one of the first Americans to conduct self-exposure experiments with radium, as reported in the *Colorado Medical Journal*:

> My own experiments with this substance are as follows: The chloride of radium is enclosed in a sealed glass tube. On taking this tube between the fingers for from three to five minutes, I felt a distinct heat and tingling. Applying it to the skin of the forearm: After five to fifteen minutes the heat and tingling are felt. After half an hour this is noticed no longer, and the skin which has been directly under the tube is distinctly less sensitive to touch, pain and temperature, than the surrounding skin. After one hour to two hours there is left a slight erythema, which persists for some hours. [18]

Stover was also a pioneer in the use of X-rays for diagnosis and therapy and was the first professor of Roentgenology at the Denver and Gross College of Medicine, and then of its successor institution, the University of Colorado School of Medicine. His early death was the result of excessive radiation exposure.

4. PRIORITY FOR RADIUM BRACHYTHERAPY

4.1 France

In 1996, a display cabinet in the Physics Department at the Ecole Supérieure de Physique et de Chimie