

*Such spirits we do well to commemorate for  
they disclose to us the heroic way in which life may  
be lived when fate lays upon us a heavy hand.*

Walter Bradford Cannon

## American Martyrs to Radiology

### Clarence Madison Dally (1865–1904)

Percy Brown

During the closing year of the American Civil War, there was recorded in the small town of Woodbridge, New Jersey, the birth of Clarence Dally, a son of Charles Clarence and Isabel (Tuttle) Dally. Growing up in those post-war years, in common with other boys his youthful imagination was stirred by veterans' tales of glorious deeds of the great conflict, and it required little to develop in him the desire for adventure in the National Service. Accordingly at the age of seventeen he enlisted in the Navy, to which he gave faithful allegiance, until his honorable discharge therefrom six years later, as gunner's mate. Young Dally then returned to his native New Jersey, and during the following year, his twenty-fourth, obtained employment in the Edison Lamp Works at Harrison, where a great industry had been formed as the result of Mr. Edison's prolonged labors in the development of the incandescent lamp. Here his father was already at work, and ultimately the four sons, Theodore, Walter, Clarence and Charles formed with their parent a family group possessing the utmost dexterity and skill in the delicate art of glass-manipulation as applied to the manufacture, exhaustion and "sealing-off" of incandescent lampbulbs.

About the year 1890 Clarence Dally was transferred to the Edison Laboratory at West Orange for continued service in con-

nection with experimentation on the incandescent lamp, which was being constantly improved. His brother Charles followed him there five years later and the young men became two of Mr. Edison's most dependable assistants, quite ready for the investigation instantly commenced by Edison on receiving the cabled reports in late 1895 and early 1896 of Professor Röntgen's discovery, the news of which travelled with telegraphic speed over the world. This investigation involved especially two lines of research; the development of the source-apparatus of the roentgen-rays (the focus-tube) and an inquiry into chemical substances which possess the quality of glowing or "fluorescing" in the presence of x-rays emanating from the focus-tube. The latter quest also laid open the way for further experiments relative to the employment of fluorescent materials to produce a means of illumination, embodied in the so-called Edison "fluorescent lamp." Both researches had a distinct bearing on Clarence Dally's career at the West Orange laboratory and ultimately on his life. The part played by Clarence and Charles Dally at this laboratory in the development of the various types of the Edison x-ray focus tube was an important factor in the commercial production of these instruments.

At the West Orange laboratories, Edison was busy in his search for a substance possessing the most brilliant fluores-

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Text and figures reprinted from *American Martyrs to Science Through the Roentgen Rays* by Percy Brown (1936). Courtesy of Charles C Thomas, Publisher, Springfield, IL.

Editor's note.—This is the first in a series of 12 biographies of American pioneers in radiology who, as a result of their work with X-rays, died of complications of radiation dermatitis between 1904 and 1935. The articles are taken from chapters in a monograph by Percy Brown, *American Martyrs to Science Through the Roentgen Ray*, published by Charles C Thomas Co. in 1936.

The articles are in honor of the centennial anniversary of the discovery of X-rays by Wilhelm C. Roentgen in 1895. The purpose of republishing them now is the same as it was in 1936, when Dr. Brown wrote the monograph. Dr. Brown explained in the preface, "Above all do I hope that these pages may serve to reveal to anyone who may read, the extraordinary valor of this illustrious group of devoted pioneers in the field of scientific endeavor that just forty years ago had its memorable inception. It is for our own good and particularly for the good of future new comers to the field of Radiology that they may realize what her splendid repute in the name of the humanities has cost her."

Percy Brown, born in 1875, was a prominent radiologist in Boston. He became the first radiologist at the Boston Children's Hospital, when a department of roentgenology was established there in 1903. He served as the 11th president of the American Roentgen Ray Society in 1911 and gave the fourth Caldwell lecture of that society in 1923. Dr. Brown ultimately joined the ranks of American martyrs to radiology himself, dying of X-ray-induced carcinoma in 1950 at the age of 75.

Address correspondence to Robert N. Berk, Editor in Chief, *AJR*, Suite 103, 2223 Avenida de la Playa, La Jolla, CA 92037.



Clarence M. Dally

cence. The interesting facts concerning his investigation of a multitude of materials to this end have been repeatedly recorded elsewhere. They may be merely mentioned here as relating to the work of this faithful servant and his brother.

Edison had visions of a form of illumination practically to be derived from the fluorescence of the tungstate of calcium. Regarding his experimentation in this direction, he goes on to say: ... I also found that this tungstate could be put into a vacuum chamber of glass and fused to the inner walls of the chamber, and if the x-ray electrodes were let into the glass chamber and a proper vacuum was attained, you could get a fluorescent lamp of several candle power....

While it was asserted at the time that these "fluorescent lamps" gave off practically no x-rays sufficiently "hard" to be effective outside the walls of the chamber, the cumulative effect of their radioactivity, both primary and secondary, must have been considerable. In fact, concerning this lamp Mr. Edison concludes: ... I started in to make a number of these lamps, but I soon found that the x-ray *had affected poisonously my assistant, Mr. Dally*, so that his hair came out and his flesh commenced to ulcerate. I then concluded it would not do, and that it would not be a very popular kind of light, so I dropped it...

It is difficult to say to what extent Clarence Dally's physical injuries were furthered by his work on the "fluorescent lamp" in proportion to the damage he sustained through his efforts in the development of the x-ray tube with the frequent necessity of vacuum determination by fluoroscopic test during the process of exhaustion by mercury-pump. Suffice it to say that the cumulative exposure to which he and his brother Charles were subjected must have been enormous. With the skill born of their long experience as glass-blowers, these two young men

continued to be of the utmost value to Mr. Edison throughout his brief but intensive experimentation with roentgen-rays. Aside from their daily laboratory activities in the course of this work, the assistance of at least one of them was essential whenever Crookes tubes were to be transported and manipulated in process of demonstration or practical use. This is historically illustrated by two important instances.

The first occasion was that of Edison's renowned fluoroscopic demonstration in connection with the exhibition of the National Electric Light Association held in New York City in May, 1896. Clarence Dally was an indispensable member of the "team" of highly-trained men that conducted the demonstration. Many there are today who recall the profound public sensation created by this extraordinary revelation, to say nothing of their own emotions when, passing in single file before the open fluorescent screen or gazing into the hood of the fluoroscope, they "saw their bones" for the first time. The Crookes tubes of that day were wont to manifest annoying vagaries under prolonged excitation, which, at this exhibition, it was Clarence Dally's duty to recognize and to control as far as possible by manipulation of the output of the induction-coil used to excite them. It was four years later that urgent need again arose for the services of the indispensable Dallys. This time it was Charles who responded to the call. In describing the "x-ray room" of the Edison plant at Orange, one of Mr. Edison's biographers, Mr. Francis Arthur Jones, mentions as a part of its furniture, ... the identical [x-ray] machine which Edison sent to Buffalo at the time of President McKinley's assassination, in order to locate the bullet. Curiously enough it was never used and by a combination of circumstances its errand of mercy was rendered futile. ...Almost directly after the President was shot, a telephone message was received at the Edison laboratory asking if a machine might be held in readiness should it be considered desirable to send one to Buffalo. Edison himself was consulted and replied that the instrument could be forwarded at a moments notice; and on the Saturday afternoon, about two-thirty, another message was received asking for the apparatus to be forwarded at once. Two young men from the laboratory accompanied it—Charles W. Luhr and Charles T. Dally. They arrived in Buffalo Sunday morning and were busy installing the plant in the Millburn house, when a message came to say that the machine would not be required for at least a week, as it was considered unwise to search for the bullet just then owing to the condition of the patient. As a matter of fact, the doctors had come to the conclusion that the spent missile was located in a spot where it might safely be allowed to remain without danger of decreasing the President's change of recovery. A few days later, Mr. McKinley had so far rallied that the Vice-President (Mr. Roosevelt) rejoined his family, Senator Hanna left for Cleveland and two of the doctors took the train for New York. Luhr returned to the laboratory, and only Dally was left with the machine. Everyone was hopeful, and the President continued to improve for some days when there was a sudden and alarming change for the worse. One of the doctors took it upon himself to inform Dally that neither he or his machine would be needed, *but the young operator continued at his post waiting for a possible summons*. Finally the end came and apparently the x-ray was destined to take no part in the tragedy....

By 1900 it was becoming more and more apparent that the degenerative skin changes in the hand and face of Clarence Dally were increasing in severity. The distribution of these lesions was typical of those that have always been observed in persons engaged in x-ray tube manufacture by the older methods—"burns" of the face involving the early loss of the hair of the anterior scalp, eyebrows and eyelashes as well as the backs of the fingers and hands. Since the onset of his symptoms during the year he had commenced his work on the focus-tube and the fluorescent lamp, Dally had periodically relinquished this occupation for a few days, when the acute manifestations were at their height, only to resume it after the pain and swelling had subsided. As has been almost invariably the case in right-handed individuals, his *left* hand was the first to be affected, becoming reddened, swollen and extremely painful. This by no means deterred him from his work for any length of time: it merely compelled him forthwith to use his *right* hand in testing tubes fluoroscopically.

By 1902, Dally had practically exhausted all orthodox modes of treatment for burns of the skin; they seemed of no avail in this strange affection, never before seen and almost sinister in its persistent progress. The inflammatory infiltration of the dorsal skin of the left hand and wrist was followed by vesiculation which soon broke down into local ulceration. The pain in this hand that had already existed in varying degree for *nearly six years* now became intolerable in the presence of ulceration, and Dally was forced to seek more radical means of alleviation. For over two months prior to June of 1902 a raised ulcerative lesion measuring 3 1/2 by 2 1/2 inches had

occupied the dorsum of the left wrist; accordingly, multiple (144) skin-grafts from the leg were applied to this surface, but the tissues lacked the vitality necessary to promote their growth. In view of this and the fact that an ulcer at the base of the little finger revealed microscopical evidence of carcinoma, the left hand was amputated above the wrist.

In the meantime an area of rather deep ulceration had developed in the right hand; its extent and characteristics necessitated the loss of four fingers and a portion of the metacarpus, as the early signs of improvement in this hand did not long obtain.

These major operative procedures did not, however, suffice to stay the progress of the invasion of carcinoma, since somewhat later it became necessary again to amputate both arms simultaneously, one at the shoulder-joint, the other above the elbow. All efforts were in vain, and death followed from mediastinal recurrence in October of 1904.

Through eight years of physical torment this life approached its end—the life of the first American martyr to Science through one of the greatest gifts of Science to Humanity, the x-rays of Röntgen. A life, first, of honorable endeavor in patriotic service; then, of continuous devotion as the indispensable auxiliary of the "modern Olympian" of American invention and industry; a life, finally, of constant self-abnegation, to be crowned at the end of its short span with the diadem of heroism.

"He was a most lovable man," writes Clarence Dally's physician and friend of many years. How frequently and how spontaneously may this be said of these devotees to a noble cause. How often their lovable traits—generosity, loyalty and forgetfulness of self—have shaped their ends?