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Mihran Krikor Kassabian (1870–1910) Textbook author & X-ray martyr

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The life of the American radiologist and electrotherapist Mihran Kassabian (1870–1910) is reviewed and provides a useful insight into the early work with X-rays in the first decade of the 20th century. Much material is drawn from Kassabian's textbook [1]. Commentary is given on his radiation injuries which were eventually to prove fatal when he was only 40 years of age. A bibliography of his publications shows how wide a spectrum was studied by Kassabian. The two quotations below were chosen by Kassabian to be placed before the Preface of his book and clearly show that his interests were not limited to radiology but also encompassed literature.

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"You go not till I set you up a glass,
Where you may see the inmost parts of you."
Hamlet, Act III, Scene IV

"In wonder all philosophy began, in wonder
it ends, and admiration fills up the interspace; but
the first wonder is the offspring of ignorance, the
last is the parent of adoration."
Coleridge

Introduction

Mihran Krikor Kassabian (1870–1910) Director of the Röntgen Ray Laboratory in the Philadelphia Hospital, was one of the foremost American radiologists in the first decade of the 20th century and the author of one of the most extensive textbooks of this period: a volume of 545 pages in length when published in 1907 [1]. The only other lengthy textbook of this period which I have been able to find which covers the same wide range of topics as Kassabian was published in 1910. It was written by Sinclair Tousey (1864–1937), Consulting Surgeon to St. Bartholomew's Clinic, New York City [2]. Both authors covered Röntgen rays, electrotherapy, radium and phototherapy.

Early life: from Armenia to the USA & the Spanish-American War of 1898

Kasabian's life as a schoolboy and student is described by Percy Brown (1875–1950), a Boston radiologist and the author of the definitive textbook summarising the lives of 26 American martyrs to radiation [3], Figure 1. This was the major source of Del Regato's 1993 brief biography of Kassabian [4] which was published to mark the centenary

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of the discovery of X-rays by Röntgen in November 1995. It is mentioned here since it is more readily available than the Brown reference.

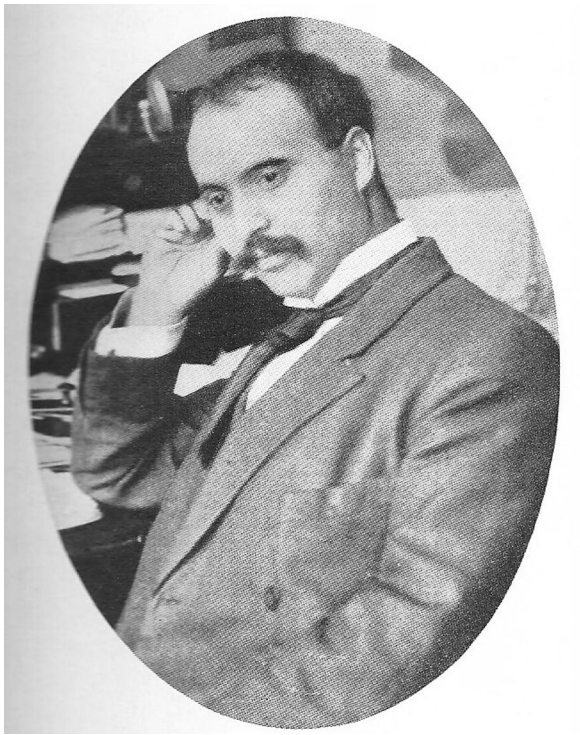

Figure 1. Mihran Kassabian [3]

He was born in 1870 in Caesarea (Kaisarich) in the province of Cappadocia in Asia Minor. His primary education was at the American Missionary Institute where he eventually became an *Instructor*. He intended this to lead to his eventually becoming a medical missionary. To further his career he travelled to London in 1893 where he became interested in photography was well as medicine. On completing theological studies in London he emigrated to Philadelphia and at the end of 1895 when Röntgen discovered X-rays, Kassabian matriculated at the Medico-Chirurgical College of Philadelphia.

By 1898 he had obtained American naturalisation and in that year enlisted in the United States Army Hospital Corps gaining experience of X-ray practice. He was discharged from the army at the end of the Spanish-American War, which only lasted April–December 1898, and received his medical degree.

Medico-Chirurgical College of Philadelphia

Soon after graduation he was appointed as *Skiagrapher & Instructor in Electrotherapeutics* at the Medico-Chirurgical College of Philadelphia. His practice therefore included both X-ray work and electrotherapy. This dual practical clinical interest was typical of the early radiologists with electrotherapeutics often initially considered more important than X-ray diagnostics and therapeutics, because there was initially available no extensive body of knowledge of X-ray technique or of results of clinical X-ray work [5–7]. 122/545 pages of Kassabian's 1903 textbook [1] were devoted to electrotherapeutics. These included several diagrams of electrotherapeutic technique including, for example, Figure 2, the Schnée four-celled Galvanic battery for hydroelectric treatment. An advantage of this technique was stated to be that 'the patient's extremities are alone exposed without additional disrobing'. A current of 5 mA–30 mA is regulated by a switchboard and treatment lasted 10––15 minutes per session.

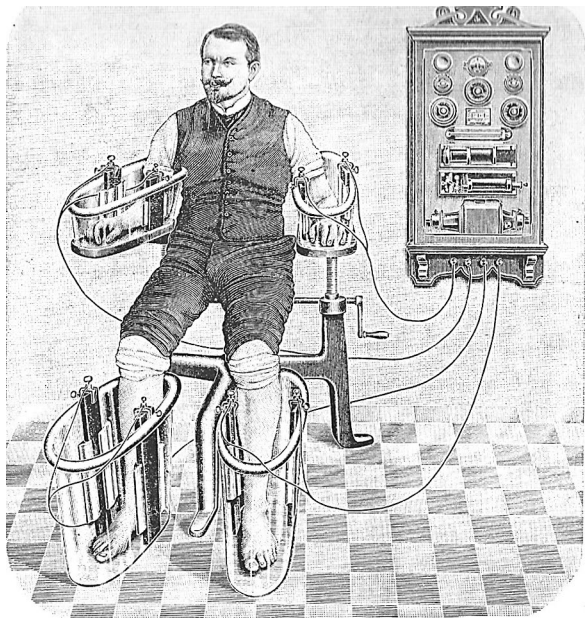

Figure 2. Example of a hydroelectric bath, 1903. Kassabian stated that such a bath is useful for its stimulating and tonic effects and is applicable in anaemia, rickets, rheumatism, gout and sciatica [1]

Roentgen-Ray Laboratory, Philadelphia Hospital

In 1903 Kassabian was appointed Director of the Roentgen-Ray Laboratory at Philadelphia Hospital. Figure 3 shows him fluoroscoping in his hospital laboratory, circa 1903. Example radiographs decorate the walls, including a snake, vesical calculus, arterial vein injection (probably of a cadaver), tubercular lung, normal lung, and what appears to be a whole-body radiograph (which would probably have consisted of several radiographic sections joined together).

X-ray tubes

Kassabian described in his 1907 textbook [1] many X-ray tubes, separating them into two types (a) stationary vacuum tubes and (b) self-regulating and regenerative tubes. The

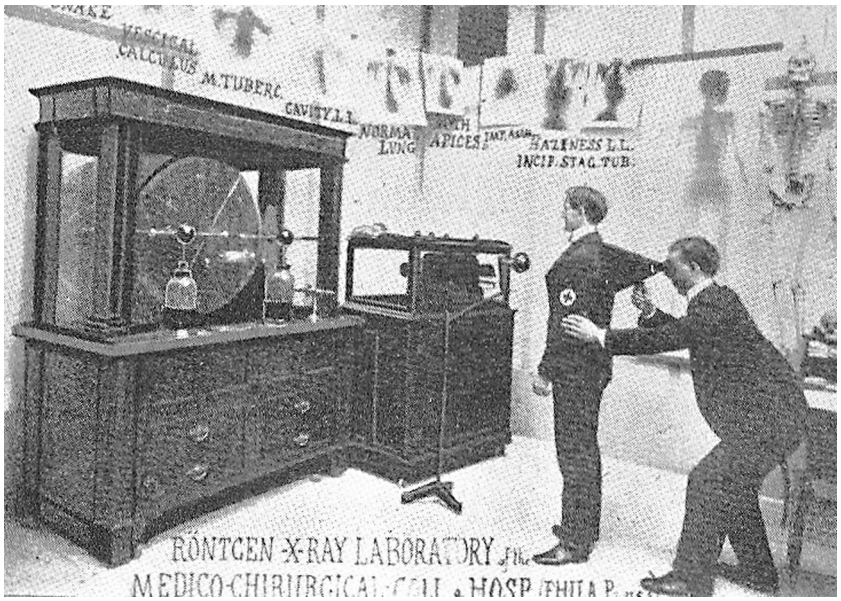

Figure 3. Kassabian's Roentgen-Ray Laboratory [3]

stationary vacuum tube (a) is one whose vacuum cannot be altered during its period of usefulness of which the Crookes' tube is one example, and that used by Herbert Jackson to demonstrate his focus tube with a curved cathode, another. The vacuum altered depending on its use or disuse. When the tube was too hard (high vacuum) there is a danger of puncture and the impossibility of X-ray production. Whereas when the tube was too soft (low vacuum) the X-rays lacked the required penetrability. By the time Kassabian was writing his textbook the stationary vacuum tubes (a) had been superceded by type (b) tubes and for example the following inventors of such tubes were mentioned and the operation of their tubes described. Sayen of Philadelphia (the Queen & Company tube), Müller of Hamburg, Ducretet of Paris, Hirschmann of Berlin (the Monopol tube), Gundelach of Thüringen.

Figure 4 is the example of one of the X-Ray tubes referred to by Kassabian, the Monopol X-ray tube. The following operational description shows how carefully the X-ray operator had to become when using such equipment in order to obtain the best results. "The vacuum may be altered during the process by the generation of air through the disconnection of the moveable conductor "Z", or by the absorption of air through the disconnections of the moveable conduction "H". The flexible wire "Z" is raised for some seconds by means of an isolated rod until a spark leaps over to the auxiliary cathode at "B", by means of which air is generated and the resistance of the tube lowered. Tubes in which the degree of generation has become excessive are modified by raising the moveable conductor "H" as shown in the sketch. Air is generated by the disconnection of the flexible conductor "Z" and the leaping over of sparks to "B", and accordingly the

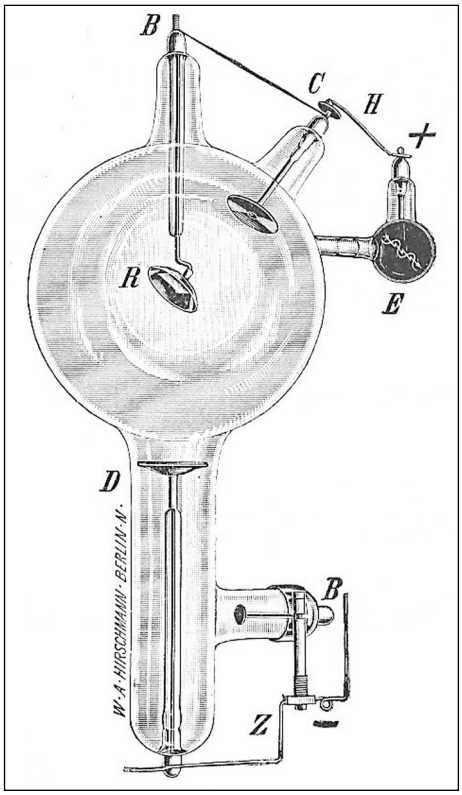

Figure 4. Sketch of the Monopol X-ray tube designed by Hirschmann of Berlin [1]

degree of the vacuum in the tube is lowered. Air is absorbed by disconnecting the flexible conductor "H", and the resistance of the tube is increased."

This X-ray tube was especially devised for easy regulation of the vacuum without interruption of the X-rays. It is

a bianodal tube with a separate bulk at the cathode end for lowering and another at the anode end for raising the vacuum. Either of these may be caused to operate by simply pulling its moveable arm with an insulated hook. This may be done while the tube in operation [1].

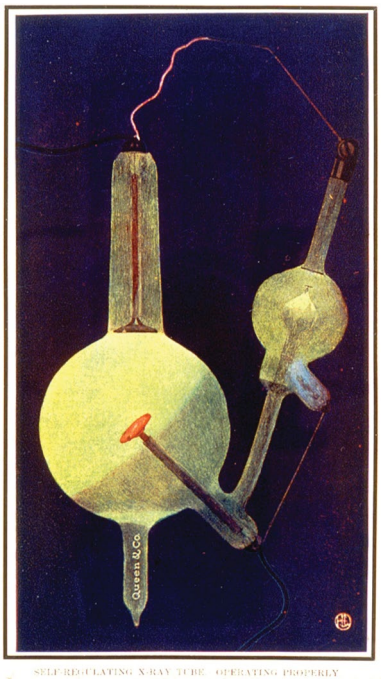

Figure 5. Self-regulating X-ray tube operating properly [1, 2]

A series of four colour images of a Queen & Company (Philadelphia) self-regulating X-ray tube is to be found in two textbooks [1, 2]. Figure 5 is the situation of the tube operating properly. The other images are of the tube when the current is running in the wrong direction (green with striations); when there is a low vacuum (a darker green than in Figure 5); and when the tube is punctured or cracked and the glass bulb is partially filled with air (a rose-red colour). In the very early years after the discovery of X-rays the tube operator would judge whether or not the tube was working properly by looking at the colour and pattern of the tube's bulb. Such a method was extremely hazardous although this was not originally realised. However, by 1907 [1] the recommendation was generally accepted that "for his own protection, the operator should never use his hand to test the intensity of the rays". Kassabian's first published paper, October 1900, was on "X-ray as an irritant" [8]

Also by 1907 the original practice of using the same X-ray tube for both diagnostics and therapeutics had been abandoned and in his chapter [1] entitled *Technic of Röntgen Ray Therapy*, Kassabian illustrates example of X-ray tubes for therapeutics. Protective features were often included and for example the Piffard Treatment Tube, sold by W & B Manufacturing Company of New York was described as follows. "The whole tube is made of lead glass, except at the lower opening, to permit the passage of the rays for therapeutic purposes. This is a protective measure for the operator, and also limits the area irradiated."

Fluoroscopy

Kassabian states the advantages and disadvantages of fluoroscopy. The former included the facts that the fluoroscope is simple to use; inexpensive; and rapid. Another advantage is when body parts being examined are inconstant motion, e.g., heart, diaphragm and thorax. Disadvantages are that the record is not permanent and with prolonged X-ray exposures the patient is liable to be "burnt" and the same injury may befall the operator's hands and eyes [1], Figure 6.

Figure 6. Kassabian's hands in 1903 showing the results of chronic X-ray dermatitis. Kassabian first used X-rays in 1899 [1]

X-ray injuries

In the period 1899–1900 (which includes the era of the unshielded fluoroscopy) Kassabian examined more than 3,000 medical and surgical cases and made more than 800 radiographs [8]. This included his work during the Spanish--American war. The demand of the surgeon was for a fluoroscopic examination to effect a quick diagnosis, whereas the radiologist preferred demonstration by radiograph. However, Percy Brown [3] records that Kassabian subsequently admitted making a preliminary screen examination in every case. His justification was that he used it to show the patients before he began the application of the X-rays, as this tended to prevent the patient becoming emotional or excited. He later stated "I would have stopped the use of the fluoroscope then (before 1900) but they (surgeons?) would not let me". Kassabian, like many early X-ray martyrs, recorded his X-ray injuries over time.

By April 1900 the fingers, knuckles and dorsum of Kassabian's left hand exhibited general erythema which lasted for a about one month. The itching became intense, the skin became tough, glossy, oedematous and yellow. On his right hand it was less marked, occurring only on the fingers. This he attributed to the fact that he held the fluoroscope with this hand. He also put his left hand over in front of the fluoroscope and exposed it directly to the X-rays. His X-ray injuries were suffered over a period of eight years and in April 1908 some of his fingers were amputated. This procedure failed and his axillary glands were surgically removed. He died on 10 July 1910.

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In addition to his famous textbook [1] of which the 1st edition was published in 1907 and the 2nd edition in 1910, Kassabian was the author of 16 papers [8–23]. His earliest papers were published in the *American X-Ray Journal* which had been founded in May 1897 (it ceased publication in 1908) and was one of the three earliest X-ray journals. The others were the *Archives of Clinical Skiagraphy* (May 1896) and the *Fortschritte auf dem Gebiete der Röntgenstrahlen* (May 1897). The *American X-Ray Journal* became the official journal of the American Roentgen Ray Society which was founded in March 1900 (initially it was called the Roentgen Society of the United States). The first meeting was held at the Grand Central Palace, New York City in December 1900.

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