# DESCRIPTION OF AN ANTIQUE RADIUM-GOBLET; A DANGEROUS CURIOSITY

by

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In the years 1903 and 1904, shortly after the discovery of radium, small amounts of radioactivity were discovered in the water of the health springs of the spas of Germany and France. It was found that this radioactivity was due to radon, a gaseous daughter-product of radium. The supposed medicinal benefit from drinking of, or bathing in natural springwater was ascribed to the radon. A medical article in the journal *Radium* of 1916 reflects contemporary opinion: "Radium is absolutely not poisonous, it is absorbed by the body as readily as sunlight is by the plant".[16] The rationale for the use of radioactivity internally was based on the belief that it activated enzymes, relieved pain and reduced blood pressure.[15] The drinking of radioactive spa waters was advised as a therapy for liver diseases, rheumatic sicknesses, etc.[14,18] Consequently radon-containing water was increasingly prescribed, and, in addition, people started to prepare it artificially using various equipment. The Radium Ore Revicator Company in New York advertised that 155,400 people were using their products. Also in Europe a large number of radium-goblets were put on the market and could be obtained without consulting a physician. Brand names included Fontano, Aktivator, Erko, Bahr, and Radium A.G. These goblets, which could be filled with water, were provided with a radium-containing and thus radioactive compound. By radioactive decay of radium, radon (half-life 382 days) is formed, which in this case is absorbed by the water. It emits $\alpha$- and $\gamma$-rays. Generally the patients would drink this water after equilibrium times of twelve to twenty-four hours. The radioactive source consisted of a small amount of radium-containing ore, which was covered with a thin layer of paraffin wax, gelatine or something similar and packed in a silver gauze. A small package was obtained of the size of about 15 x 8 x 2 mm.[6] In the radium-goblet under consideration such a package was actually found. Since the radioactive decay of radium is very slow (half-life 1600 years) it remains practically unchanged for unlimited periods.

Since it was supposed that radium had a positive medicinal effect it was used not only in drinking cures, but also in the form of radium packs, slippers, bandages and even diet-bread.[3] Radium was even injected into patients in order to act as a constant source of radon and its daughter-products in the human body. Radium was given orally and intravenously in the treatment of such diseases as hypertension, arthritis,

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neuritis, diabetes, anaemia and leukaemia during the period 1915–1930.[1] The application of another radioactive material, thorotrast (a colloidal suspension of thorium dioxide), which was utilized as a contrast medium in diagnostic radiology from about 1930 to 1945, was also well known.[12,19]

At that time the danger of direct internal radium contamination was not known. Very little care was taken in the packing of the radium sources, which sometimes crumbled so that small radium particles could get into the drinking water.[8] Many workers did not seem to realize the danger of X-rays and radium and were careless in their handling of radioactive materials. This continued for about twenty-five years after the discovery of radium. This careless attitude was probably due to the long period between the intake of the radioactive material and the occurrence of the symptoms.

But even in those early days, some warnings were given. As early as 1904 a textbook written by Beck stressed the radiation dangers to the skin.[2] In the same year Pierre Curie performed experiments in which laboratory animals had to inhale radon gas; the animals died four to nine hours later.[4]

During the 1914–1918 war the X-ray committee of the War Office issued instructions on radiation protection, and in 1921 sufficient support was forthcoming for the formation of the British X-ray and Radium Protection Committee.[17] It is now known that almost all of the radium is excreted shortly after its entrance into the body. The radium retained is deposited in the skeleton in small areas of high focal concentration (so-called "hot spots"). Due to the destructive action of radium, small areas of decreased density, as seen in radiographs, are formed in the shafts of the long bones and skull. Increased fragility of the skeleton occurs as a result of the destructive effect of the deposited radium, which even after a minimal trauma creates fractures.[11] Aseptic necroses are also occasionally found.[13]

The greatest danger, however, is the development of malignant tumours of the skeleton after protracted periods of time. Looney[12] found thirteen tumours in twenty-eight former luminous-dial workers and fifty other patients who had ingested radium tens of years earlier. The average time from administration of the radium medically or ingestion of the luminous material until death was about twenty-five years. The time from the onset of symptoms at the site of tumour origin until death varied from about one to four years. From a group of 268 women, who painted luminous dialplates, it was found that twenty-five had malignant tumours of, or associated with the skeleton. X-ray examination showed that these tumours arose in areas of bone which showed minimal necrosis from radium as judged radiographically. Multiple primary sites of bone tumour formation were found in two patients. No malignant tumours have been found in patients bearing less than 0.6 microcurie $^{226}$Ra.[7]

The characteristic tumour in man following the administration of relatively large amounts of bone-seeking radio-nuclides is an osteosarcoma or a squamous carcinoma. The time of onset for sarcomas was seven to forty-three years (average twenty-three years) after first exposure; for carcinomas it was nineteen to fifty-one years (average thirty-nine years) after first exposure.[9] Concerning radium-induced carcinoma it has been suggested that, in addition to the alpha radiation from the deposited radium in



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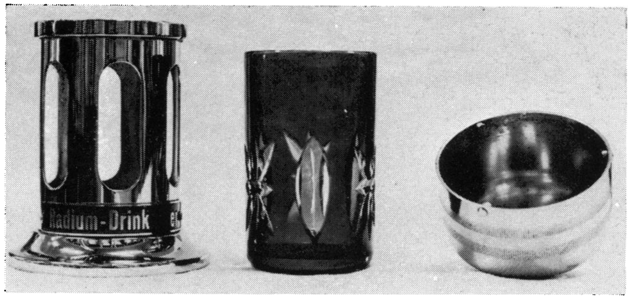


Figure 1.
Radium-goblet: metal container, glass goblet and metal lid.

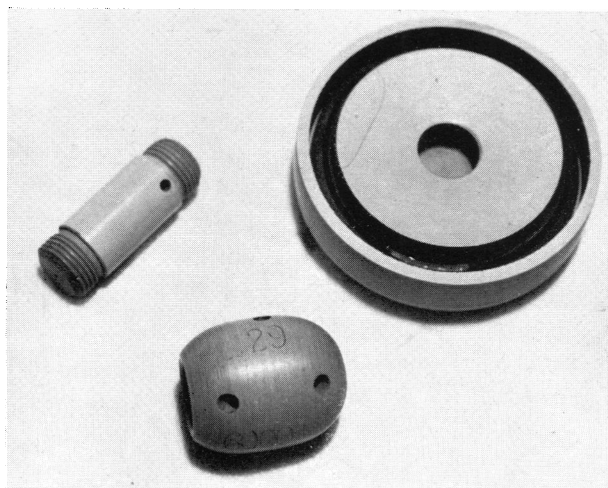

Figure 2.
Radium-goblet: horn source-holder in three parts.

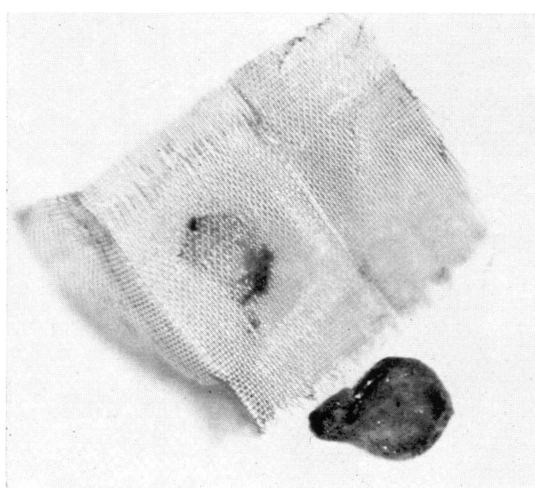

Figure 3.
Radium-goblet: drop-shaped radium source with gauze.

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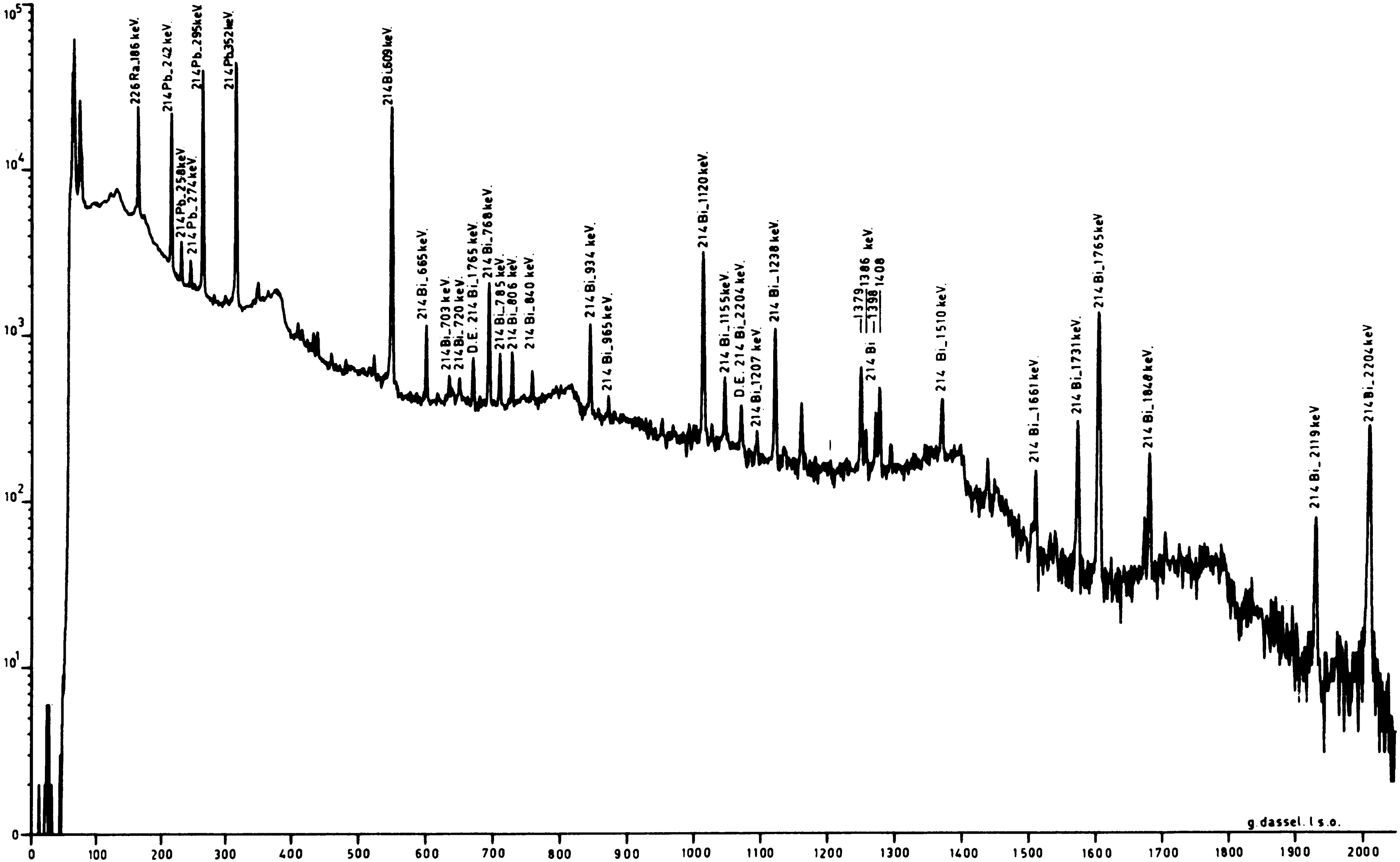


Figure 4.
Radium gamma-spectrum.

bone, radon may be trapped in the air cells so giving rise to an additional hazard to the epithelium.[5] The recorded occurrence of leukaemia is much less common.[9]

Diagnosis of the deposition of radioactive isotopes in the skeleton may be difficult. Because of the long interval between the deposition of the radionuclide and the occurrence of symptoms, the patient may even have forgotten the use of the radioactive materials. Bizarre changes may develop, which may be similar to many other skeletal disorders. Therefore previous radio-element administration should be considered in the differential diagnosis of bone lesions of the middle and older age groups. External measurement of gamma radiation from the body or radiochemical analysis of the excreta can establish the presence of radioactivity.

## THE RADIUM-GOBLET

By chance a radium-goblet, most probably dating from the 1920s, was discovered in an antique shop. It appeared to contain an open radium source.

*A. General description.*

1. A chromium-plated brass container with 6 excisions. The container is 88 mm. high and the inner and outer diameters are 50.6 and 58.3 mm. respectively (fig. 1).
2. A glass goblet with 6 decorations, fitting behind the excisions of the brass container. The glass goblet is 78 mm. high, inner and outer diameters are 44.0 and 49.8 mm. respectively (fig. 1).
3. A horn source-holder in three parts, which also functions as lid for the glass goblet with a rubber O-ring. The complete source-holder-lid is 61.5 mm. high, inner and outer diameters of the source-holder are 11.3 and 22.4 mm. respectively (fig.2).
4. A drop-shaped radium source with a diameter of about 6 mm. and a thickness of 2 to 3 mm. (fig.3).
5. A chromium-plated brass lid that fits with a bayonet catch on to the brass container and thereby presses the horn source-holder-lid on to the glass goblet.
   The lid is 37.8 mm. high, inner and outer diameters are 59.2 and 61.8 mm. respectively (fig. 1).

The construction of this goblet seems to be less refined than the one described by Jelliffe in 1969.[10] The difference is that in this case the radon-containing water is obtained by unlocking the brass lid and taking off the horn source-holder. The radium source-holder in the goblet described by Jelliffe was never removed, as a valve was used in replacing the radon-containing water by fresh water.

*B. Description of the radium source.*

In the source-holder a silver gauze is folded around the radium source. The source has a grey metallic appearance, and is surrounded by a kind of paraffin wax (fig. 3). At the surface of the complete goblet with the source in its proper position, the gamma radiation proved to be 3 milliroentgen per hour. The radiation values on the surface of the source-holder and directly on the unpacked source were 20 and 50 milliroentgen per hour respectively. From comparative gamma measurements with a standard $^{226}$Ra source, containing $0.18 \pm 10\%$ microcurie $^{226}$Ra, it was deduced that the source of the



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radium goblet contained 23±3 microcurie $^{226}Ra$. As is seen in fig. 4 the gamma spectrum, detected with a Ge/Li crystal, shows the peaks of the $^{226}Ra$ and its daughter-products.

When the silver gauze was removed, a part of the paraffin layer was stuck on the gauze. The bare source crumbled within a short period of time. It can be assumed that most sources without a protecting paraffin layer crumble in a couple of months.

*C. Control on internal contamination.*

Two persons who had been in contact with the goblet during a short period of time without knowing that it was a contaminated object, were measured in a whole-body-counter. Both individuals were contaminated with $^{226}Ra$, in one there was 0.005± 0.003 microcurie and in the other 0.007±0.003 microcurie of $^{226}Ra$. These measurements were calculated optimally for an internal $^{226}Ra$ contamination. In comparison it can be mentioned that according to the recommendations of the International Commission on Radiological Protection[8] the maximum permissible burden in the whole body of $^{226}Ra$ for radiological workers is 0.1 microcurie. This means that the measured amounts were much lower than the values mentioned in the I.C.R.P. recommendations.

The former owner of the goblet, an elderly lady, was found. She had never used the goblet herself, but as far as she remembered her father did. He had bought the goblet at a demonstration of medical equipment around 1920. He died without specific symptoms at the age of seventy-eight.

## SUMMARY AND CONCLUSIONS

A radium-goblet dating from about 1920 is described. It was found that the goblet had a relatively high radiation level and both source-holder and goblet were heavily alpha-contaminated. Therefore such a goblet should be handled with great care. Due to the crumbling of the source, drinking-cures can lead to internal radium-contamination and thereby to bone damage and tumour induction. From the literature it is shown that people are still occasionally treated for radiation damage caused by the use of radium-containing domestic remedies, of which the radium goblet is an example. It is well known that in spite of official information and warnings, potentially dangerous radium-containing equipment is still owned and used by private persons.

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# *News, Notes and Queries*

## NEW FILM ON THE HISTORY OF MEDICINE

A new historical motion picture, *Ambroise Paré, military surgeon* (19 minutes), has recently been produced at the Yale School of Medicine. The 16 mm. sound film, in colour, considers sixteenth-century French wound surgery, describes Paré's important innovations in the treatment of battle injuries as well as in diet and rehabilitation, and presents a detailed case history. Contemporary pictures of surgical procedures, instruments, and injuries and of battle scenes illustrate the narration.

The film is especially designed to interest medical and nursing students, members of the health professions, biologists, and medical historians. Made under a grant from Teledyne Aqua Tec, the motion picture was produced by Dr. Thomas R. Forbes, Department of Anatomy, and directed by Miss Susan Wheeler, Communications Media Group, Yale University School of Medicine, New Haven, Connecticut 06510. Prints at $105 each may be ordered from the Communications Media Group.

Two other films in sound and colour, *John Hunter—Enlightened Empiricist* (12 minutes, $60) and *Vesalius, Founder of Modern Anatomy* (14 minutes, $70) are also available from the same source.