NIST
UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-0001

January 27, 1995
February 7, 1995

MEMORANDUM FOR The Record:

Re: International "1911 Curie" and "1934 Hönigschmid" Radium Standards

From: R. Collé, Radioactivity Group

Distribution: Bert Coursey
Tom Hobbs
Robin Hutchinson
JT Weaver

1. The above-referenced standards have identifying labels of "No. 6", "No. XV", and "No. XIV"; and contain approximately 15, 20, and 38 mg of radium, respectively. Photocopies of the original certificates from the *Commission International des Étalons de Radium* are attached. The ^{226}Ra activity contents (with decay to 1995) thereby correspond to 565 MBq, 745 MBq, and 1390 MBq. Each source consists of radium chloride crystals flame sealed into a right-circular cylinder glass tube (3.2 to 3.3 mm outside diameter; 22 to 37 mm in length) with a thin platinum wire sealed in at one end of the glass.

2. The following comments are largely based on a visual inspection of the standard sources that I made on 26 Jan. 1995. I was accompanied by Bert Coursey (Division Director), J.T. Weaver (Dosimetry), and B.R. Webber (Health Physics).

3. The three standard sources are located in three individual specially-constructed containers. These three containers are in a lead-shielded well inside room B165 of Building 245 (Radiation Physics). The well is on top of a sturdy, steel-legged table in the corner of the room. The lead well has a welded-seam aluminum housing. A port opening to the well (hinged) is "pad locked". The key is in the possession of J.T. Weaver.

4. Some of the following information on the containers is based on a telephone conversation that I had with Tom Loftus (formerly of the NIST Dosimetry Group) on 26 Jan. 1995. The containers were fabricated at the Gaithersburg NIST campus, which would date the placing of the sources inside them at sometime around (or after) 1966. Schematic drawings of the containers have not been located. The containers are brass right-circular cylinders with a glass window on the upper circular face. [I didn't measure the dimensions, but they are roughly 8-cm diameter by maybe 10-cm high.] The identification numbers for the sources are engraved into the brass walls. The containers are sealed with a threaded "screw-cap" brass lid which also holds the window in place. The glass is sealed to the brass lip of the cylinder with "conventional" O-rings. Each container has a small port opening on the cylinder wall that is closed with a gas ball-cock valve. The sampling port and valve was incorporated into the design to allow sampling of the contained air to test for radon, and thereby check the integrity of the sources. There is no evidence to support that the containers were ever sampled and tested. I suspect they never were tested (at least not since 1974).

last used Lab 1956

5. The external gamma-radiation exposure rate on the outside (side) surfaces of the well range from 0.8 to 1.3 $mR \cdot hr^{-1}$. The exposure rate on the outside top surface ranges from 50 mR hr^{-1} (near the edge) to 220 mR hr^{-1} (directly over the hinged port door). With the port opened, the unshielded rate at the opening is 1.5 $R \cdot hr^{-1}$.

6. Surface smears of the following were taken:

- on the top surface of the closed well (covered with a layer of dust)
- on the inside surface of the well
- around the valves on two of the containers
- along the threaded window seals on all three cylinders

Based on 1-min screening counts, Health Physics reported no detectable contamination on three of the four smears. (the background corrected net counts were negative). The fourth smear from the inner wall of the well had net rates of 2.5 "dpm" for alpha activity and 15 "dpm" for beta activity (*sic*). [It should be noted that these rates correspond to actually detecting only 1 alpha count and 6 beta counts.] The smear analysis from HP is attached.

7. The glass windows of the containers are seriously discolored -- to a brackish yellow-brown to black color. The relative degree of darkening of the glass on the three appears to be proportional to the three source strengths. The glass on No. XIV is so darkened that it is impossible to see through it to ascertain if the glass source tube is still intact. No. XV and No. 6 are visible, and seemed intact -- at least the tubes were not in pieces or shattered.

8. The glass tubes in the brass containers are lying loosely on an absorbent material that looks like some type of cellulose-based batting (i.e., a paper, which I suspect is very deteriorated).

9. The location of the contained sources in the present well on the present table is adequate PROVIDED THAT SOME TYPE OF BARRIER IS BUILT AROUND THE AREA to prevent accidental bumping of the table.

10. The containers inside the well should be more firmly secured with some padding to prevent their bumping into each other or into the well wall should the well be jarred. This should be relatively easy to achieve. A piece of styrofoam precut to the exact dimensions of the well and containers would do nicely.

11. Re-packaging of the sources or further evaluations of the present containers does not appear to require urgent action. There are however a number of burning questions that remain unanswered:

    (i) Is source No. XIV (not seen behind the darkened glass) as intact as No. 6 and No. XV? Is it substantially more darkened because the radium is on the glass window?
    (ii) Are the sources leaking either radon and/or radium? The seals at the glass to platinum junctions might be most suspect?
    (iii) What are the conditions of the O-rings?
    (iv) Would the present valves adequately seal the source contents should one of the glass tubes break inside the brass container?
    (v) How would one quantitatively recover the total radium content of a source (if desired for future possible scientific and historic interest) if it broke inside the present container? Extracting the radium from the present mix of glass, paper, and brass would not be pleasant.
    (vi) What is the ultimate disposition of a source if we learn that it is broken, or if it is leaking, or if it is deemed to be not of interest for us to safeguard any longer?

12. Several options can be considered in addressing the questions.

OPTION A

Do nothing beyond building a barrier around the well and padding the containers inside the well. This of course answers none of the questions, and postpones addressing them to a later date. If we chose ~~this~~ the testing option, then we had better be prepared to address what we do if we see radon! !

OPTION B

Test all three sources for radon leakage by sampling the containers. A proposal on how to do this is given in item 13. If all the sources are intact, then do nothing further with their present containers -- i.e., put off some of the remaining questions to a later date. If one or more is found to be leaking (or broke) then one needs to address the ultimate disposition question immediately.

OPTION C

Repackage the sources (after the same testing as given in Option B; and assuming all sources are intact) using the existing containers. A proposal on how to do this is given in item 14.

OPTION D

Repackage the sources using all new containers. Again, this would occur only if the sources are found to be intact on testing the extant containers. A proposal on how to do this is given in item 15.

13. OPTION B -- Testing Protocol:

(i) The source containers would be removed from the well and handled one at a time.

(ii) The testing should probably be done in a lead-shielded hood --- e.g., that in Room B156. One could probably organize things with Dan Golas *et al.* so that it is not disruptive to their schedule or program. It might be possible to organize something in another location, but would require more effort.

(iii) Any transport of the containers to any other rooms would be done by placing the containers on lead-shielded dollies.

(iv) Thorough contamination smears would be taken throughout the operations.

(v) The containers (inside the shielded hood) would be worked on inside a large plastic bag to contain any activity should there be a regrettable accident.

(vi) Sampling of the containers would be performed with the small (nominal 35 mL) glass spherical sampling bulbs used with our calibrated NaI(Tl)-well counting system.

(vii) The sampling bulb would be partially executed to around 0.5 atm and connected to the sampling port on the container with low-diffusion tubing. The sampling bulbs have capillary tubing, so that the change in pressure inside the container (once the valves are opened) should be somewhat gradual. It typically takes several minutes to transfer a gas sample even when the bulbs are evacuated to a nearly complete vacuum. One would wait a sufficiently long time (perhaps an hour) to insure that the transfer was complete.

(viii) If the bulb had been completely evacuated, any radon present in the source container would be proportionately volume shared with the sample volume. The volume differences between the containers and sample bulbs are perhaps about a factor of ten, so that the sample should contain about one tenth of the total radon activity in the container (if one started with a near complete vacuum in the sample bulb). Starting with a sampling pressure of about 0.5 atm would reduce this by another factor of two. Needless to say, these calculations will be performed a bit more exactingly once the exact volumes (from dimensional measurements) and pressures are known.

(ix) The sample bulb will be assayed on our NaI(Tl) system.

(x) If no activity (or a very, very small amount) is detected, the sample bulb will be assayed with our primary, pulse ionization chamber system which requires a transfer of the sample bulb contents.

(xi) Following the sample collection, the source container will be returned to its shielded well.

(xii) This procedure (excluding the assays) would be done on three separate days for each of the three sources.

(xiii) All of the above presumes there will be no accidents or obvious damage to the sources during sampling. Should either occur, the container will be immediately sealed in the surrounding plastic bag. Further steps in contaminated and disposal will depend on an assessment of the situation.

14. OPTION C -- Repackaging in Extant Containers:

(i) Again, the sources would be treated one at a time on separate days.

(ii) This procedure would follow the sampling protocol given in item 13.

(iii) After sampling, the container would be opened by unscrewing the screw cap lid.

(iv) The source would be gingerly picked up and visually inspected.

(v) The source would be placed in a small glass sample jar that contains glass wool as a shock absorbent and provided with a ground glass lid.

(vi) The source in the jar would be temporarily stored in a lead shield while the container is worked on.

(vii) The o-rings would be inspected (replaced if possible).

(viii) The valves will be tested for their ability to hold a partial vacuum. If they are not very adequate, it may be difficult to be fully prepared to replace the valves immediately. In which case, one may want to store the source until new valves can be located and fitted onto the container.

(ix) The source and container would be re-assembled by placing the entire ground glass sample jar (with source and glass wool) into the container and sealing the container by replacing the lid. Extra glass wool would be used as a shock absorbent between the jar and container wall.

(x) Again, it might be worthwhile to replace the darkened glass windows of the containers, but this most assuredly would require keeping the sources in temporary storage until the containers could be completely worked on (new o-rings, new valves, new window).

15. OPTION D -- Repackaging in New Containers:

(i) I didn't do detailed schematics for the design of new containers since it seemed premature unless this option is definitely chosen.

(ii) The new packaging of the sources would consist of a thick-walled glass sleeve (about 1 cm i.d.) that is flame sealed at one end. The other end of the sleeve would be sealed (after insertion of the source) with an o-ring compression ball and socket joint that is secured with a screw clamp. This seal will act as a type of pressure relief valve at pressures

exceeding 2-3 atm. Glass wool at both ends of the sleeve would prevent movement of the source in the sleeve. A crude illustrative schematic is attached.

(iii) The sealed sleeves would be placed into a new box-like metal container. This is also illustrated in an attached crude schematic. The box has three separate cells (for the three sources). Two sampling valves (mini, high vacuum, toggle-action NUPRO) would be located on each cell. Each cell would also have a glass window permanently cemented onto the cell top. The cell lid (containing the windows and sampling valves) would seal to the box by an o-ring and quick-close clamps.

(vi) Again, the sources would be handled one at a time on separate days, and would incorporate the same source handling and testing procedures given in items 13 and 14.

16. Should we choose to do no testing or repackaging of the sources at the present time, it will probably be a good idea to keep a copy of these notes inside the shielded well (for reference by future archaeologists!).

LB5100W Low Background Counting System -- Smear Analysis

Surveyor Name: _____ Batch ID: Encapsulated radium sources

High Voltage Setting: 1387.5 Alpha activity action level (DPM): 20.00 Alpha Efficiency 36.67%
Alpha Background (CPM): 0.0784 Beta activity action level (DPM): 200.00 Beta Efficiency 29.69%
Beta Background (CPM): 1.4448 Filename: C:\LBXL\UNIT1\SME1A006.XLS

Count	Alpha	Beta	Completion	
Game:	time (min)	DPM	DPM	TOD	SMEAR LOCATION:
1	1.00	-0.21	-4.87	1/26/95 10:47	top of shield
2	1.00	-0.21	-1.50	1/26/95 10:49	2 round valves,
3	1.00	-0.21	-4.87	1/26/95 10:50	series of windows
4	1.00	2.51	15.34	1/26/95 10:52	inside well

$$\left(\frac{\text{counts}}{1\ \text{min}} - 0.0784\right) \div .3667 = 2.51$$

$$\alpha = (2.51)(.3667) + .0784$$

$$= 0.9988$$

"1 count"

$$\beta \quad 15.34\,(.2969) + 1.4448 = 6 \text{ counts}$$

COMMISSION INTERNATIONALE DES ÉTALONS DE RADIUM.

CERTIFICAT.

Das als Chlorid dargestellte Radiumpräparat Nr. 6 entstammt St. Joachimstaler Uranpechblende und ist demnach praktisch frei von Mesothor.

Es enthält 21·50 Milligramm Salz.

Es wurde am 1. Juli 1913 eingeschlossen in ein Glasröhrchen (Thüringer Glas) von 0·27 mm Wandstärke, äußerem Durchmesser 3·2 mm, Länge 42 mm, an dessen Ende ein feiner Platindraht eingeschmolzen ist.

Dasselbe wurde als **Secundärer Standard** an den Wiener Etalons und an dem internationalen Standard in Paris nach mehreren γ-Strahlungsmethoden unabhängig voneinander geeicht.

Der γ-Strahlung nach ist es im Jahre 1913 äquivalent 20·28 mg $RaCl_2$. (Die jährliche Abnahme beträgt etwa 0·4 Promille.)

Unter Zugrundelegung der Atomgewichte von

226	für Radium
35·457	für Chlor
79·916	für Brom

entspricht dies

15·44 mg Ra-Element,
20·28 mg $RaCl_2$,
26·36 mg $RaBr_2$.

Die Genauigkeit dieser Angabe wird auf 0·2 % für gesichert gehalten.

Für die Wiener Eichung:

Stefan Meyer

La Préparation de Chlorure de Radium contenue dans l'ampoule Nr. 6 provient de la pechblende de St. Joachimsthal. Elle est donc pratiquement exempte de Mésothorium.

Elle contient 21·50 Milligrammes de sel.

Le sel a été enfermé le 1/VII 1913 dans un tube de verre (Verre de Thuringe.) Epaisseur du verre 0·27 mm; Diamètre extérieur 3·2 mm; Longueur 42 mm. Un fil de platine fin a été soudé à l'extrémité du tube.

En qualité d'**Étalon secondaire** l'ampoule a été comparée à l'Étalon de Vienne et à l'Étalon International de Paris, au moyen de méthodes de mesures basées sur le rayonnement γ. La comparaison a été faite indépendamment à Vienne et à Paris.

D'après son rayonnement γ, la [illegible]ration équivaut en l'année 1913 à 20·28 mg. $RaCl_2$. (La diminution annuelle est de 0·4 pour mille.)

En adoptant les poids atomiques suivants:

Radium	226
Chlore	35·457
Brome	79·916

on déduit la teneur correspondante en Radium élément et en Bromure de Radium:

Ra. 15·44 mg,
$RaCl_2$. 20·28 mg,
$RaBr_2$. 26·36 mg.

La précision de ces résultats est considérée comme assurée à une approximation de 0·2 %.

Pour les mesures faites à Paris:

M. Curie

Specimen No. 6 of Radium is prepared as chloride from pitchblende of St. Joachimstal and is consequently practically free from Mesothorium.

It contains 21·50 Milligrammes of salt.

It was enclosed the 1/VII 1913 in a glass tube (Thuringian glass) of 0·27 mm thickness, exterior diameter 3·2 mm, length 42 mm, a thin platinum wire being fused into the end of the tube.

It is calibrated as **Secondary Standard** by comparison with the Vienna-Standard and with the International Standard at Paris, several independent γ-raymethods being used.

Measured by the γ-radiation, it is in the year 1913 equivalent to 20·28 mg. $RaCl_2$. (The yearly decay is about 0·4 per mille.)

Taking the atomic weights

226	for Radium
35·457	for Chlorine
79·916	for Bromine

this corresponds to

15·44 mg Ra-element,
20·28 mg $RaCl_2$,
26·36 mg $RaBr_2$.

These statements are considered correct to 0·2 %.

President of the Commission

E. Rutherford

CERTIFICAT.

Das als Chlorid hergestellte Radiumpräparat Nr. XIV entstammt Uranerzen von Katanga, belgisch Kongo, und ist demnach praktisch frei von Mesothor.

Es wurde am 2. Juni 1934 von Prof. Hönigschmid in München ausgewogen und in ein Glasröhrchen von 3 mm lichter Weite und 0·27 mm Wandstärke und einer Länge von 36 mm eingebracht, an dessen Ende ein feiner Platindraht eingeschmolzen ist.

Es ist gekennzeichnet durch die Nr. 5937 des Schutzrohres, sowie durch sein Bruttogewicht von 323·93 mg und enthielt damals 50·22 mg reines, wasserfreies Salz, gewichtsmäßig entsprechend 38·23 mg Radiumelement.

Der Reinheitsgrad des verwendeten Radiumchlorids ist sichergestellt durch die von Prof. Hönigschmid ausgeführte Atomgewichtsbestimmung, die Ra zu dem Werte 226·05 führte, sowie durch die von Prof. W. Gerlach durchgeführte spektroskopische Untersuchung, welche einen Bariumgehalt von maximal 0·002 — 0·003 Atomprozent Barium ergab.

Das Radiumpräparat wurde zum letztenmal am 25. Mai 1934 durch eine Fällung mit Schwefelwasserstoff von RaD befreit.

Das Präparat wurde mit den primären Etalons von 1911 in Wien und Paris nach mehreren γ-Strahlungsmethoden unabhängig von einander geeicht.

Der γ-Strahlung nach ist es Ende 1936 äquivalent 38·10 mg Ra-Element. Für eine mittlere Lebensdauer des Radiums von 2295 Jahren beträgt der jährliche Abgang 0·436 Promille.

Unter Zugrundelegung der Atomgewichte

226·05	für Radium
35·457	für Chlor
79·916	für Brom

entspricht dies bezogen auf die primären Etalons von 1911 für die Jahreswende 1936/1937

8·10 mg Ra-Element,
50·05 mg $RaCl_2$,
65·04 mg $RaBr_2$.

Die Genauigkeit dieser Angaben wird auf 0·3 % für gesichert gehalten.

Für die Wiener Messungen:

Stefan Meyer

La préparation de Radium No. XIV est un chlorure qui provient de la pechblende du Katanga, Congo Belge, et est, par conséquent, pratiquement exempt de Mésothorium.

Cette préparation a été pesée le 2 Juin 1934 par le Pr. Hönigschmid a Munich et a été introduite dans un tube en verre de 3 mm de diamètre intérieur, de 0·27 mm d'épaisseur des parois et de 36 mm de longueur, sur l'extrémité duquel un fil fin de platine a été scellé.

Elle est identifiée par le No 5937 du tube protecteur, de même que par son poids brut de 323·93 mg et elle contenait alors 50·22 mg de sel pur anhydre correspondant au poids de 38·23 mg de Radium élément.

Le degré de pureté du chlorure de Radium est mis en évidence par les mesures du poids atomique faites par le Pr. Hönigschmid, qui conduisent pour le Radium au nombre 226·05, ainsi que par les essais spectroscopiques faits par le Pr. W. Gerlach, qui donnent une teneur en Baryum au maximum de 0·002 — 0·003 pour cent d'atomes de Baryum.

La préparation de Radium a été purifiée pour la dernière fois du RaD le 25 Mai 1934 par une précipitation par l'hydrogène sulfuré.

La préparation a été comparée en rayons γ aux étalons primaires de 1911 par diverses méthodes, indépendamment à Vienne et à Paris.

Par son rayonnement γ elle est équivalente fin 1936 à 38·10 mg de Radium élément.

Pour une vie moyenne du Radium de 2295 ans, la décroissance annuelle est de 0·436 pour mille.

Prenant pour base le poids atomique

de 226·05	pour le radium
de 35·457	pour le chlore
de 79·916	pour le brome

il vient pour fin 1936, début 1937

par rapport aux étalons primaires de 1911:

38·10 mg Ra-élément,
50·05 mg $RaCl_2$,
65·04 mg $RaBr_2$.

La précision de ces données est exacte à 0·3 %.

Pour les mesures faites à Paris:

J. Joliot Curie

The Radium-preparation Nr. XIV has been prepared as chloride from uranium ores from Katanga, Belgian Kongo, and is therefore practically free from Mesothorium.

It was weighed on June 2nd, 1934 by Prof. Hönigschmid in Munich and transfered to a glass tube of 3 mm inner diameter, 0·27 mm thickness of wall and 36 mm length, with a thin platinum wire sealed in at one end.

It is characterised by the Nr. 5937 on the protection tube, as well as the gross weight of 323·93 mg and contained at the date given above 50·22 mg of pure salt free from water corresponding in weight to 38·23 mg radium-element.

The degree of purity of the radium-chloride used is warranted by the determination of the atomic weight carried out by Prof. Hönigschmid, which gave for radium the value 226·05, and the spectroscopic investigation by Prof. W. Gerlach, which showed that the barium-content was 0·002 — 0·003 per cent atoms at most.

RadiumD was separated from the radium-preparation for the last time on May 25th, 1934, by precipitation with hydrogen sulphide.

The preparation has been compared with the primary standards of 1911 in Vienna and Paris independently by several γ-ray-methods.

According to its γ-rays it was towards the end 1936 equivalent to 38·10 mg Radium-element. For an average life of radium of 2295 years the loss per year is 0·436 per mille.

Taking the atomic weights:

226·05	for radium
35·457	for chlorine
79·916	for bromine

as a basis this corresponds for the end of 1936 and the beginning of 1937 compared with the primary standards of 1911 to:

38·10 mg Ra-element,
50·05 mg $RaCl_2$,
65·04 mg $RaBr_2$.

These statements are considered correct to 0·3 %.

The President:

Rutherford

CERTIFICAT.

Das als Chlorid dargestellte Radiumpräparat Nr. XV entstammt Uranerzen von Katanga, belgisch Kongo, und ist demnach praktisch frei von Mesothor.

Es wurde am 2. Juni 1934 von Prof. Hönigschmid in München ausgewogen und in ein Glasröhrchen von 3 mm lichter Weite und 0·27 mm Wandstärke und einer Länge von 37 mm eingebracht, an dessen Ende ein feiner Platindraht eingeschmolzen ist.

Es ist gekennzeichnet durch die Nr. 5770 des Schutzrohres, sowie durch sein Bruttogewicht von 16776 mg und enthielt damals 1636 mg reines, wasserfreies Salz, gewichtsmäßig entsprechend 20·95 mg Radiumelement.

Der Reinheitsgrad des verwendeten Radiumchlorids ist sichergestellt durch die von Prof. Hönigschmid ausgeführte Atomgewichtsbestimmung, die für Ra zu dem Werte 226·05 führte, sowie durch die von Prof. W. Gerlach durchgeführte spektroskopische Untersuchung, welche einen Bariumgehalt von maximal 0·002 — 0·003 Atomprozent Barium ergab.

Das Radiumpräparat wurde zum letztenmal am 25. Mai 1934 durch eine Fällung mit Schwefelwasserstoff von RaD befreit.

Das Präparat wurde mit den primären Étalons von 1911 in Wien und Paris nach mehreren Strahlungsmethoden unabhängig von einander geeicht.

Der γ-Strahlung nach ist es Ende 1936 äquivalent 20,36 mg Ra-Element. Für eine mittlere Lebensdauer des Radiums von 2295 Jahren beträgt der jährliche Abgang 0·436 Promille.

Unter Zugrundelegung der Atomgewichte

226·05	für Radium
35·457	für Chlor
79·916	für Brom

entspricht dies bezogen auf die primären Étalons von 1911 für die Jahreswende 1936/1937

20·36 mg Ra-Element,
26·74 mg $RaCl_2$,
34·75 mg $RaBr_2$.

Die Genauigkeit dieser Angaben wird auf 0·3 % für gesichert gehalten.

Für die Wiener Messungen:

Stefan Meyer

La préparation de Radium No. XV est un chlorure qui provient de la pechblende du Katanga, Congo Belge, et est, par conséquent, pratiquement exempt de Mésothorium.

Cette préparation a été pesée le 2 Juin 1934 par le Pr. Hönigschmid a Munich et a été introduite dans un tube en verre de 3 mm de diamètre intérieur, de 0·27 mm d'épaisseur des parois et de 37 mm de longueur, sur l'extrémité duquel un fil fin de platine a été scellé.

Elle est identifiée par le No. 5770 du tube protecteur, de même que par son poids brut de 16776 mg et elle contenait alors 1636 mg de sel pur anhydre correspondant au poids de 20·95 mg de Radium élément.

Le degré de pureté du chlorure de Radium est mis en évidence par les mesures du poids atomique faites par le Pr. Hönigschmid, qui conduisent pour le Radium au nombre 226·05, ainsi que par les essais spectroscopiques faits par le Pr. W. Gerlach, qui donnent une teneur en Baryum au maximum de 0·002 — 0·003 pour cent d'atomes de Baryum.

La préparation de Radium a été purifiée pour la dernière fois du RaD le 25 Mai 1934 par une précipitation par l'hydrogène sulfuré.

La préparation a été comparée en rayons γ aux étalons primaires de 1911 par diverses méthodes, indépendamment à Vienne et à Paris.

Par son rayonnement γ elle est équivalente fin 1936 à 20,36 mg de Radium élément.

Pour une vie moyenne du Radium de 2295 ans, la décroissance annuelle est de 0·436 pour mille.

Prenant pour base les poids atomique

de 226·05	pour le radium
de 35·457	pour le chlore
de 79·916	pour le brome

vient pour fin 1936, début 1937

par rapport aux étalons primaires 1911:

20·36 mg Ra-élément,
26·74 mg $RaCl_2$,
34·75 mg $RaBr_2$.

La précision de ces données est exacte à 0·3 %.

Pour les mesures faites à Paris:

F. Joliot Curie

The Radium-preparation Nr. XV has been prepared as chloride from uranium ores from Katanga, Belgian Kongo, and is therefore practically free from Mesothorium.

It was weighed on June 2nd, 1934 by Prof. Hönigschmid in Munich and transfered to a glass tube of 3 mm inner diameter, 0·27 mm thickness of wall and 37 mm length, with a thin platinum wire sealed in at one end.

It is characterised by the Nr. 5770 on the protection tube, as well as the gross weight of 16776 mg and contained at the date given above 1636 mg of pure salt free from water corresponding in weight to 20·95 mg radium-element.

The degree of purity of the radium-chloride used is warranted by the determination of the atomic weight carried out by Prof. Hönigschmid, which gave for radium the value 226·05, and the spectroscopic investigation by Prof. W. Gerlach, which showed that the barium-content was 0·002 — 0·003 per cent atoms at most.

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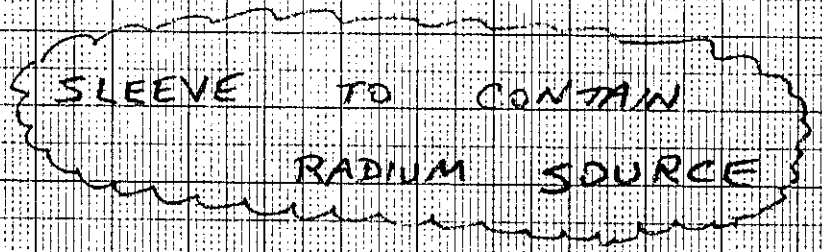
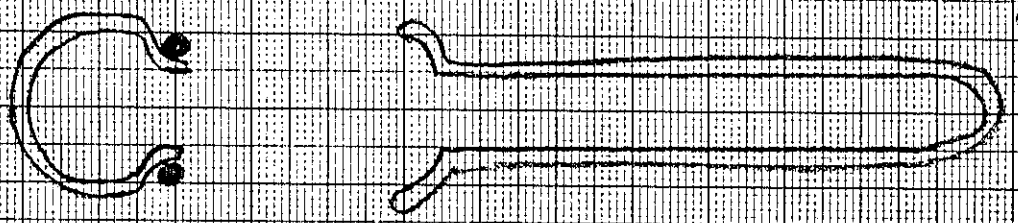
The President:

Rutherford





FLAME-SEALED END

O-RING BALL & SOCKET JOINT HELD W/ SCREW CLAMP

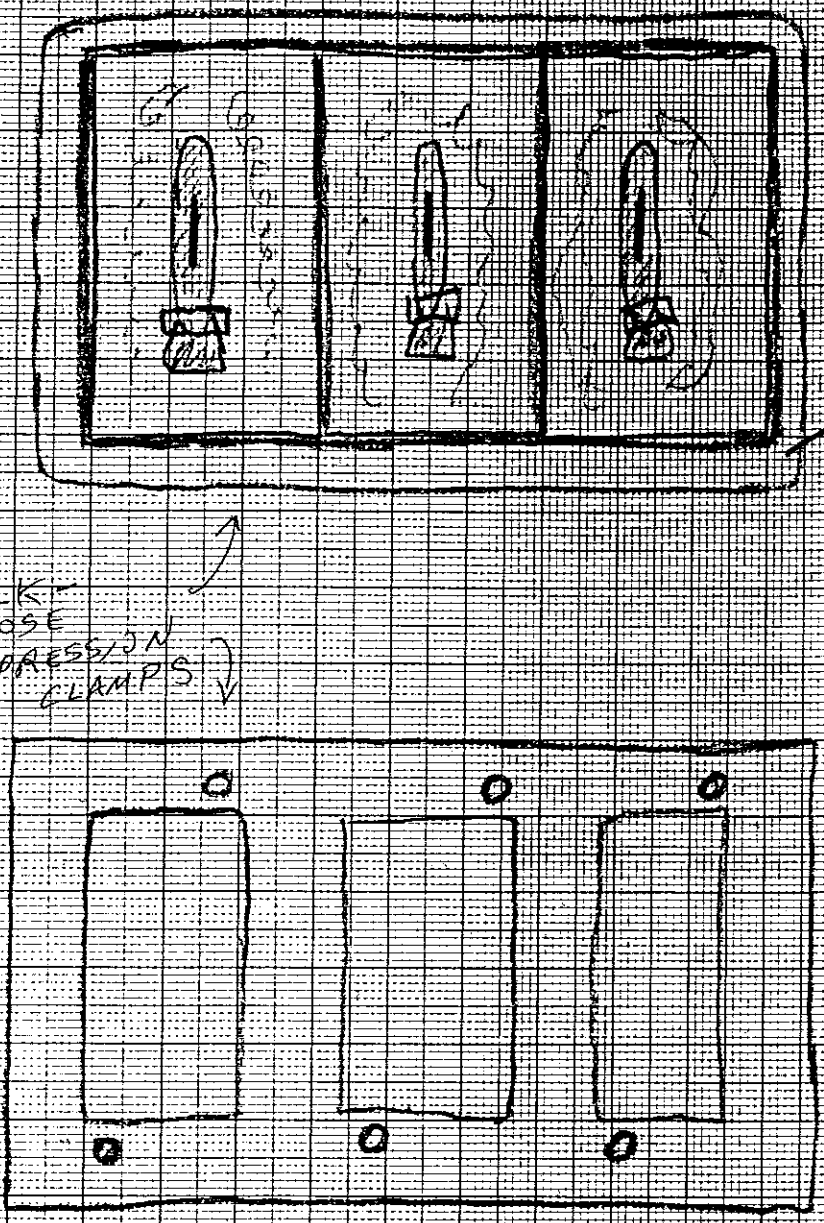
THICK-WALLED GLASS TUBING

SOURCE INSERTED WITH GLASS WOOL PADDING AT BOTH ENDS

NOT TO SCALE

COLLÉ
6 FEB. 1995

CONTAINER TO HOLD NEW SLEEVES FOR RADIUM SOURCES



NOT TO SCALE

COLLE
6 FEB, 1995