

# Uranium: its uses and dangers

a brief account prepared by  
Dr. Gordon Edwards

presented at Wendake, Quebec, on September 25, 2014  
for the Assembly of First Nations of Quebec & Labrador

*with photos and graphics by Robert Del Tredici*

*Canadian Coalition for Nuclear Responsibility*  
[www.ccnr.org](http://www.ccnr.org)

# PART 1

## Uses for Uranium

1. Nuclear Weapons
2. Fuel for Nuclear Reactors

**A Model of the  
Uranium Atom**



*Photo: Robert Del Tredici*

*Every atom has a tiny “nucleus” at the centre, with electrons in orbit around it.*

Uranium is special. It is the key element behind all nuclear technology, whether military or civilian.

*A Monument to the  
Splitting of the Atom*



When the uranium nucleus is “split” enormous energy is released. And the broken pieces of uranium atoms are extremely radioactive.

*Photo: Robert Del Tredici*

# Canadian Uranium for Bombs

1941-1965

The Quebec Accord  
CANADA – USA - UK

Quebec City  
1943

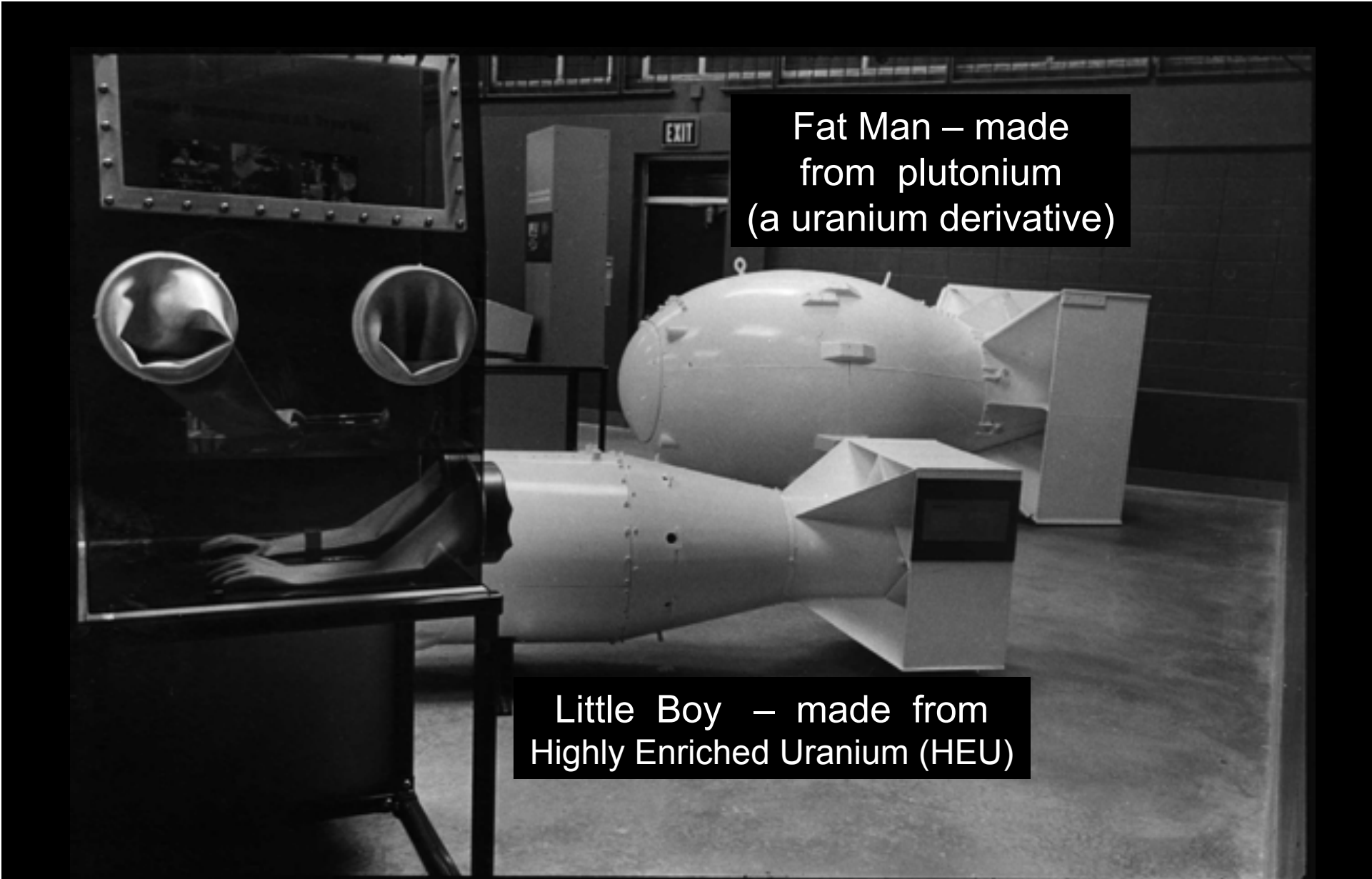
*Prime  
Minister  
of Canada*

*President  
of the U.S.A.*

*Prime  
Minister  
of Britain*



Uranium from Canada to be used in WWII Atomic Bomb Project



Fat Man – made  
from plutonium  
(a uranium derivative)

Little Boy – made from  
Highly Enriched Uranium (HEU)

**Models of the two Atomic Bombs dropped on Japan in 1945**

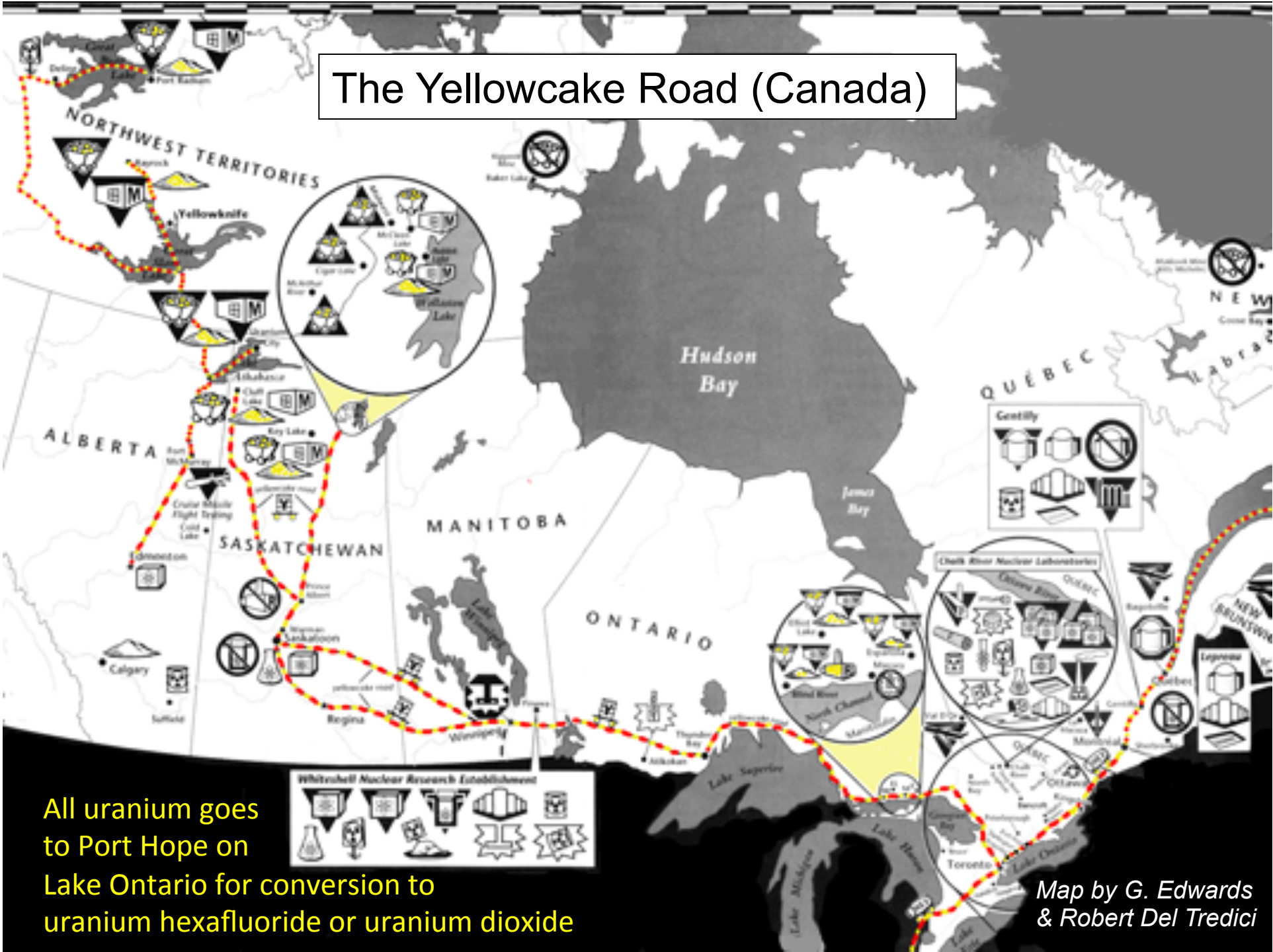
*Photo: Robert Del Tredici*



**Destruction of the City of Hiroshima caused by Little Boy, August 6, 1945**








































# The Yellowcake Road (Canada)






All uranium goes to Port Hope on Lake Ontario for conversion to uranium hexafluoride or uranium dioxide

Map by G. Edwards & Robert Del Tredici

# USES OF CANADIAN URANIUM

MILL SITE	URANIUM USE	MILL SITE	URANIUM USE
▼ PORT RADIUM. NWT		ELLIOT LAKE. ONT.	
▼ RAYROCK. NWT		▼ LACNOR	
URANIUM CITY. SASK.		▼ NORDIC	
▼ BEAVERLODGE	 	▼ STANROCK	
▼ GUNNAR		▼ SPANISH-AMERICAN	 
▼ LARADO		▼ MILLIKEN	 
OTHER SASKATCHEWAN		▼ STANLEIGH	 
CLUFF LAKE	 	▼ QUIRKE	 
RABBIT LAKE	 	▼ PANEL	 
KEY LAKE	 	▼ DENISON	  
▲ MCCLEAN LAKE	 	BANCROFT. ONT.	
OTHER ONTARIO		▼ DYNO	
▼ AGNEW LAKE. ESPANOLA		▼ BICROFT	
▼ PRONTO. BLIND RIVER		▼ FARADAY	
		▼ MADAWASKA	 

 uranium for bombs (1941-1968)	 ... for export (from 1968)	 ... for CANDU (from 1968)
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Until 1965, all Canadian uranium was sold to the US military for Bombs. Although military sales ended in 1965, deliveries continued for a few more years.

Over 85% of Canada's uranium is exported to other countries.

# Canadian Plutonium for Bombs

1945-1965

## Creation of plutonium in a nuclear reactor...



when an atom of uranium-238 absorbs a neutron . . .



the atom of uranium-238 . . .

. . . is transformed into an atom of plutonium-239



This glass paperweight is the exact size of the plutonium ball that was used as a nuclear explosive in the Nagasaki bomb.

*Photo: Robert Del Tredici*

*Howard Morland  
with a model of  
a hydrogen bomb*

*Photo: Robert Del Tredici*



An H-Bomb is 50 to 100 times more powerful than the Hiroshima Bomb

All H-bombs use a plutonium “trigger” (at the top) to raise the temperature to 50 million degrees.

When an H-bomb is dismantled, the plutonium is removed – thus making the bomb harmless.

## Bronze Plaque at Chalk River Visitors' Centre



### THE ZEEP REACTOR

A nuclear chain reaction was first initiated in Canada on September 5, 1945, when the ZEEP reactor went into operation here at Chalk River. Originally part of an effort to produce plutonium for nuclear weapons, the reactor was designed by a team of Canadian, British and French scientists and engineers assembled in Montreal and in Ottawa in 1942-43 under the administration of the National Research Council. Named Zero Energy Experimental Pile because it was developed to produce only one watt of heat, the ZEEP reactor was used to provide data for the design of the powerful NRX (National Research Experimental) reactor. In 1952 the project was transferred from NRC to Atomic Energy of Canada Limited.

Errected by the  
Archaeological and Historic Sites Board of Ontario,  
Faculty of College and University

### LE RÉACTEUR ZEEP

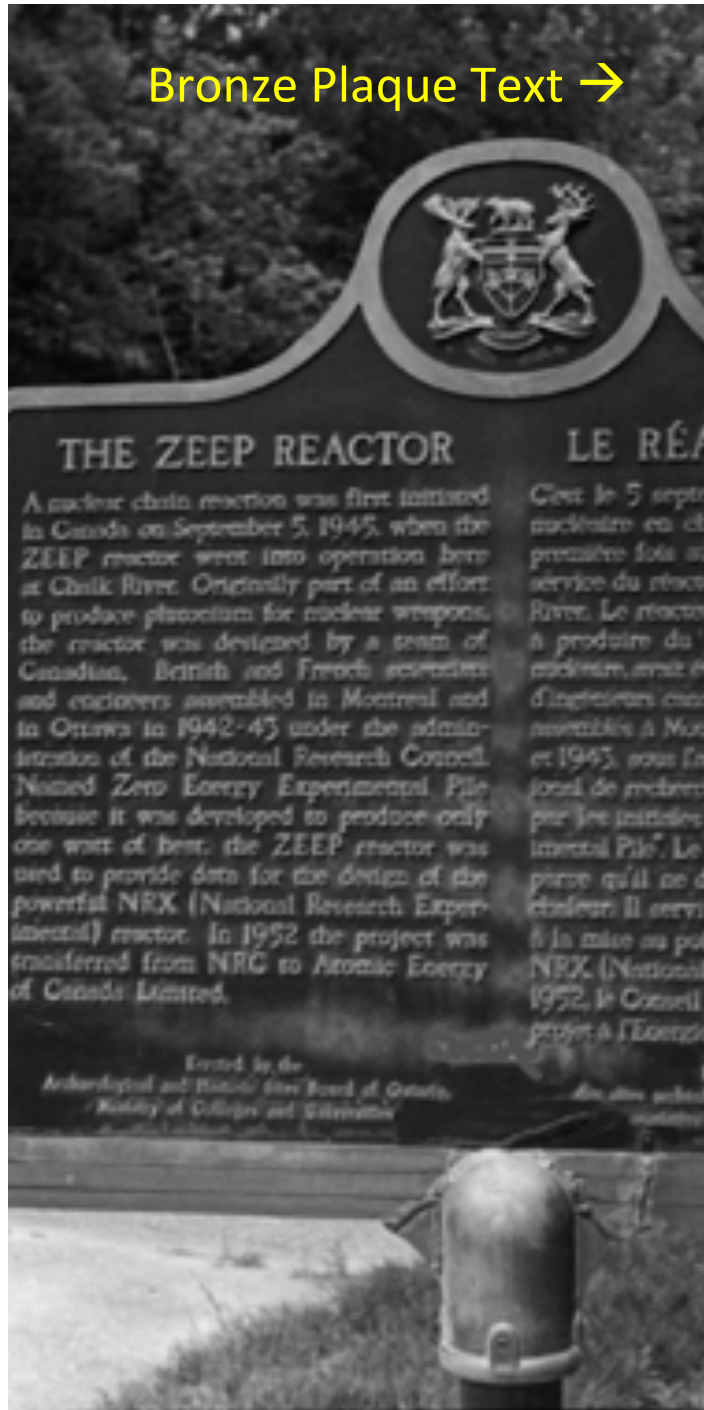
C'est le 5 septembre 1945 qu'une réaction nucléaire en chaîne a été réalisée pour la première fois au Canada, lors de la mise en service du réacteur ZEEP, ici-même à Chalk River. Le réacteur, qui était destiné à l'origine à produire du plutonium pour l'armement nucléaire, avait été mis au point par une équipe d'ingénieurs canadiens, britanniques, et français assemblés à Montréal et à Ottawa entre 1942 et 1943, sous l'administration du Conseil national de recherches. Le nom ZEEP est formé par les initiales de l'acronyme "Zero Energy Experimental Pile". Le réacteur avait été ainsi baptisé parce qu'il ne devait produire qu'un watt de chaleur. Il servit à fournir des données utiles à la mise au point du réacteur expérimental NRX (National Research Experimental). En 1952, le Conseil national de recherches céda le projet à l'Énergie atomique du Canada Limited.

Érigé par le Conseil  
des sites archéologiques et historiques & éducatifs  
de la Faculté des Collèges et Universités

Photo: Robert Del Tredici



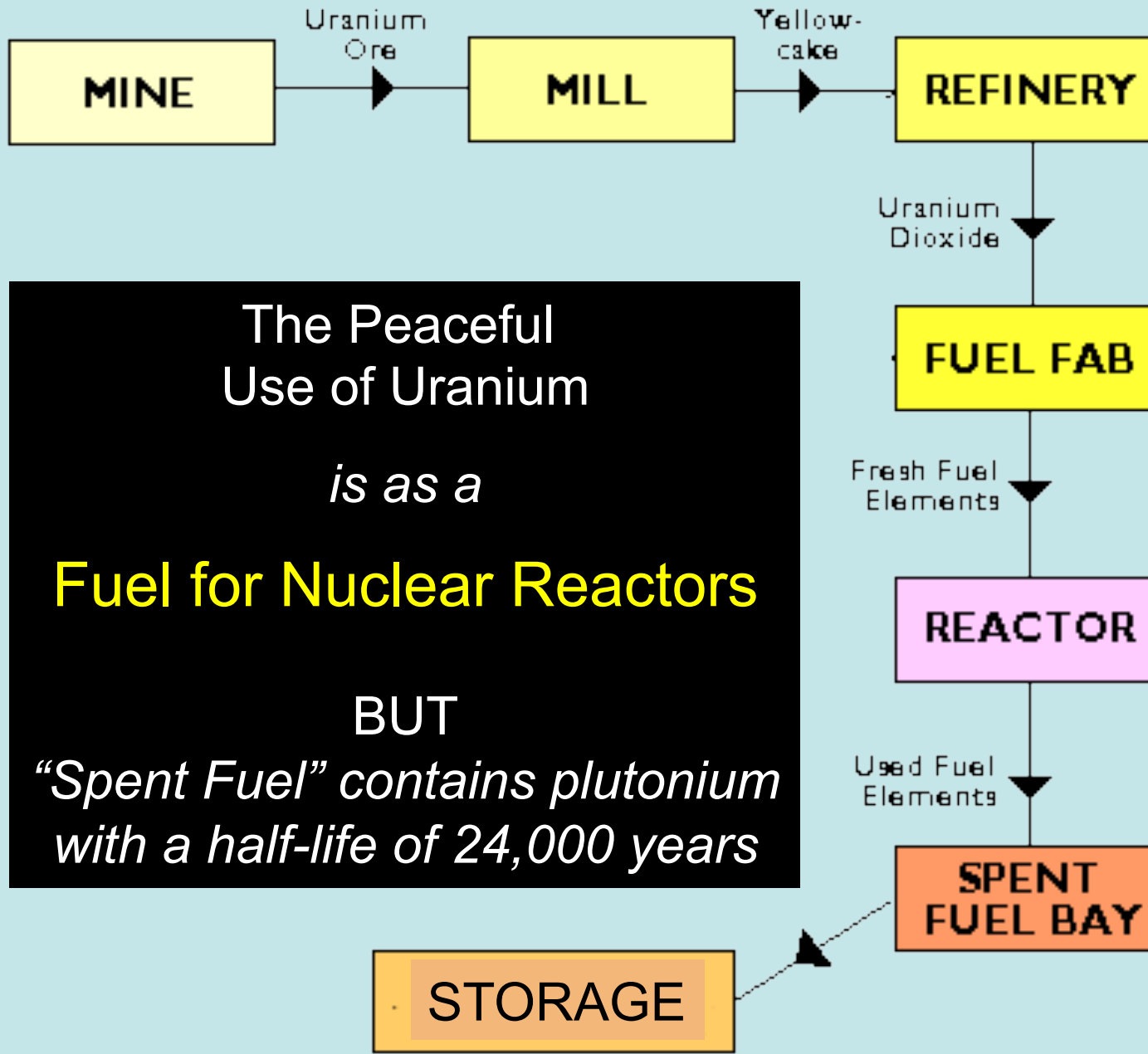
Bronze Plaque Text →



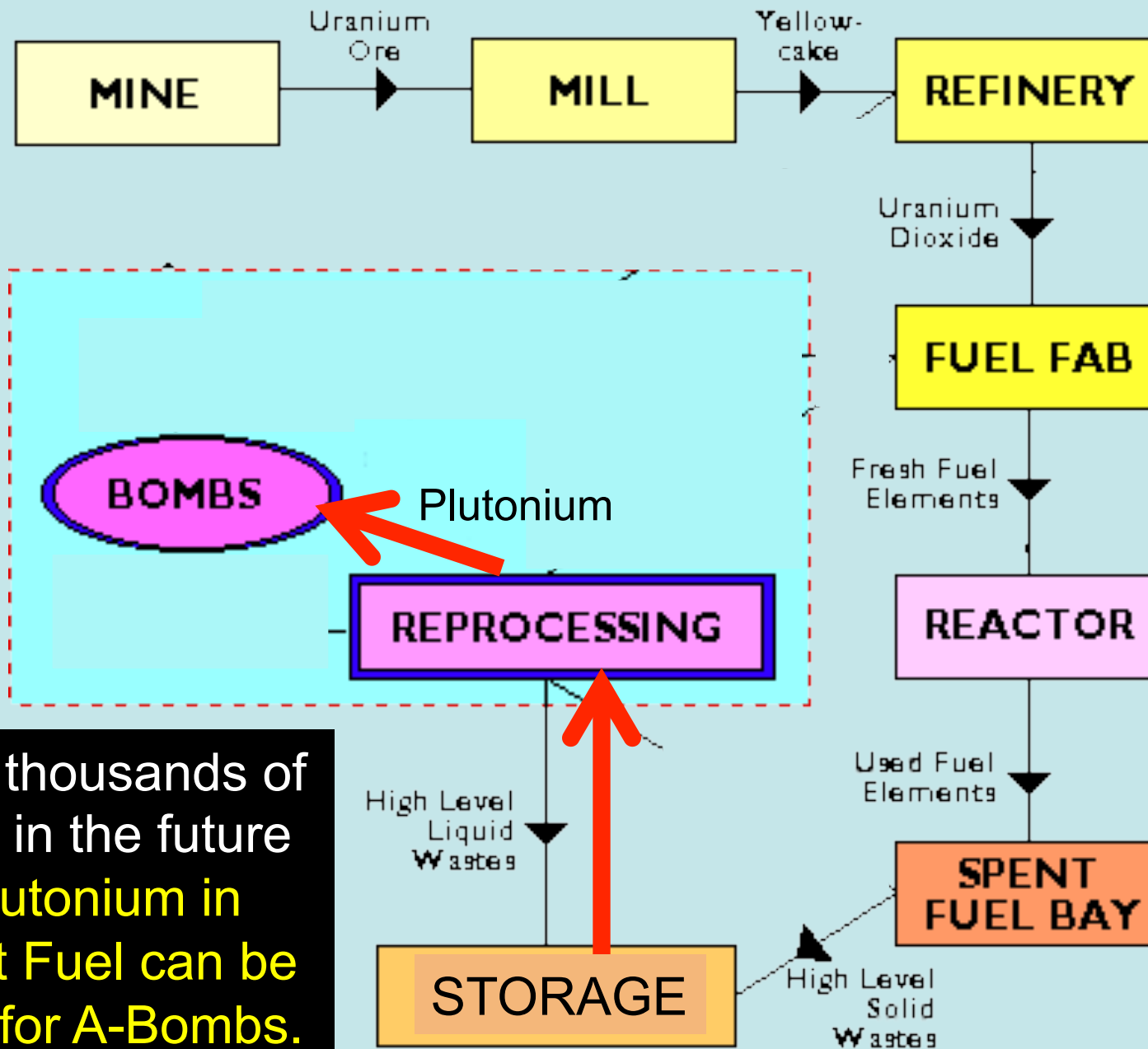
# THE ZEEP REACTOR

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High Level Nuclear Waste



Even thousands of years in the future the plutonium in Spent Fuel can be used for A-Bombs.

## Summary:

Uranium can be used for nuclear weapons.  
Or, it can be used for peaceful purposes.

Canada no longer sells uranium for Bombs.

But when uranium is used for peaceful purposes,  
plutonium is always created as a byproduct.

Plutonium is a powerful nuclear explosive.  
And it has a half-life of 24,000 years.

So thousands of years from now, someone  
can take the leftovers of the peaceful atom  
and use the man-made plutonium to make Bombs.

## PART 2

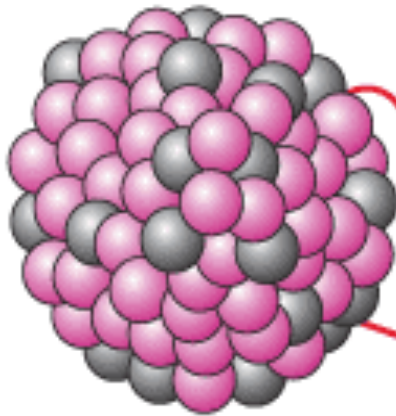
# Uranium Mining Legacy

## Radioactive Mill Residues

# What is Radioactivity?

- Most materials have stable atoms (they *never* change).
- Radioactive materials have unstable atoms (they *will* change).
- Unstable atoms **disintegrate** (suddenly and violently).
- The moment of disintegration is when biological harm is done.
- One “becquerel” indicates one disintegration per second.

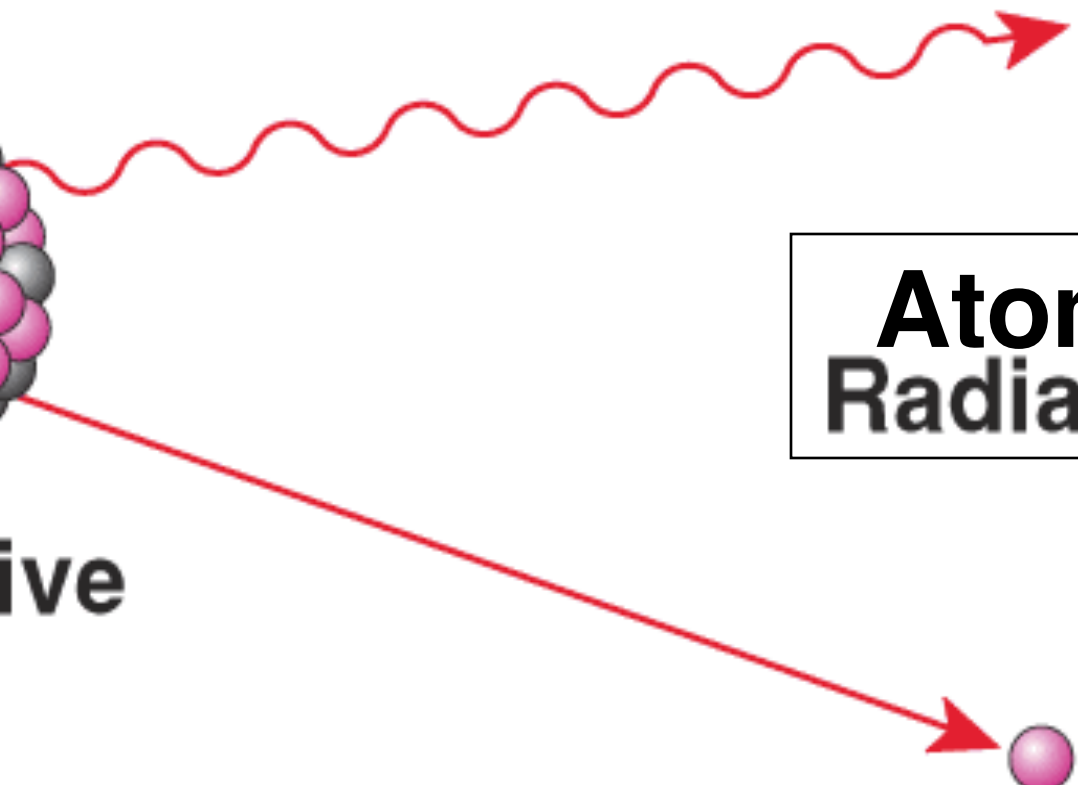
**Energy**

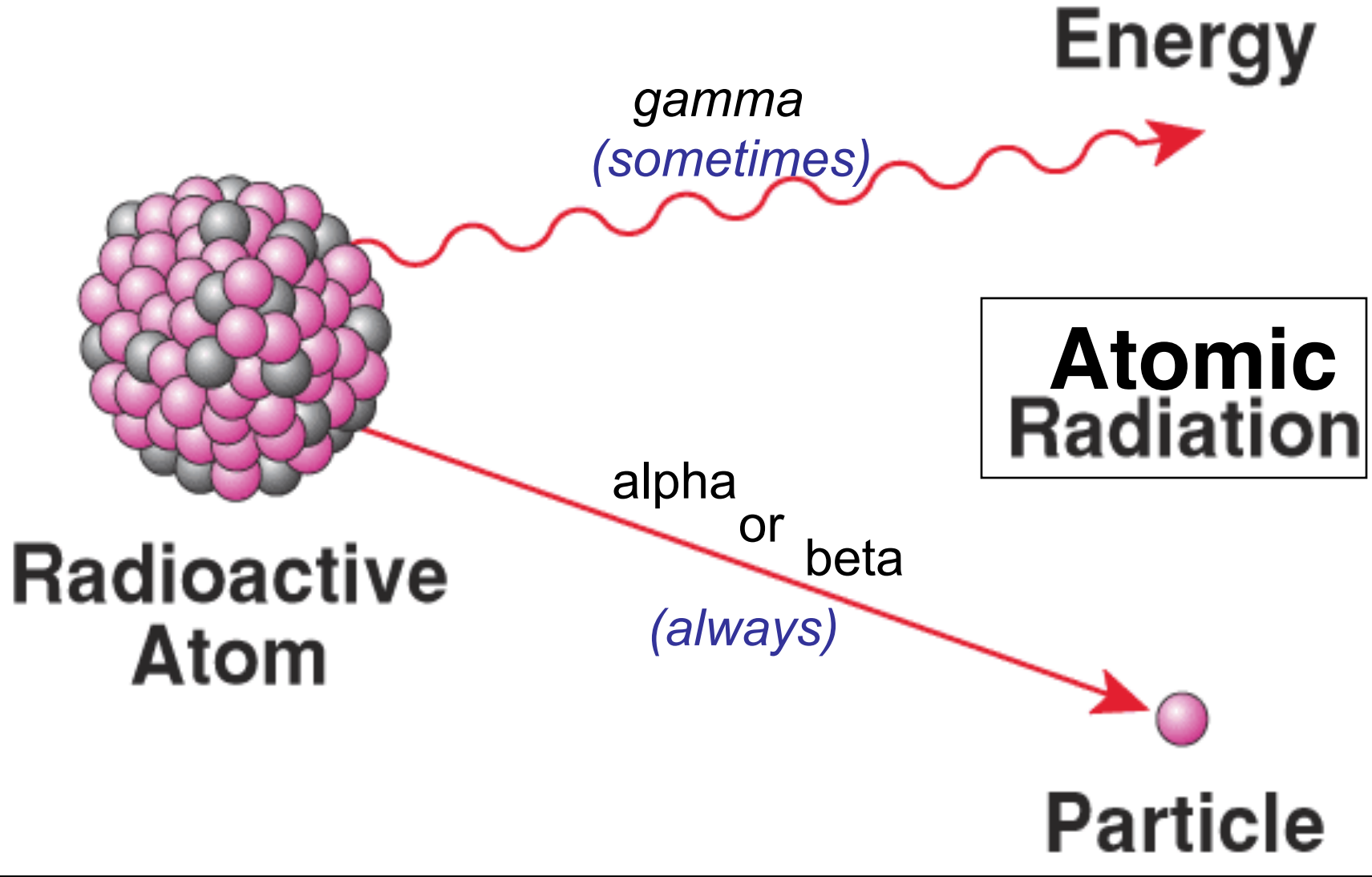


**Radioactive  
Atom**

**Atomic  
Radiation**

**Particle**







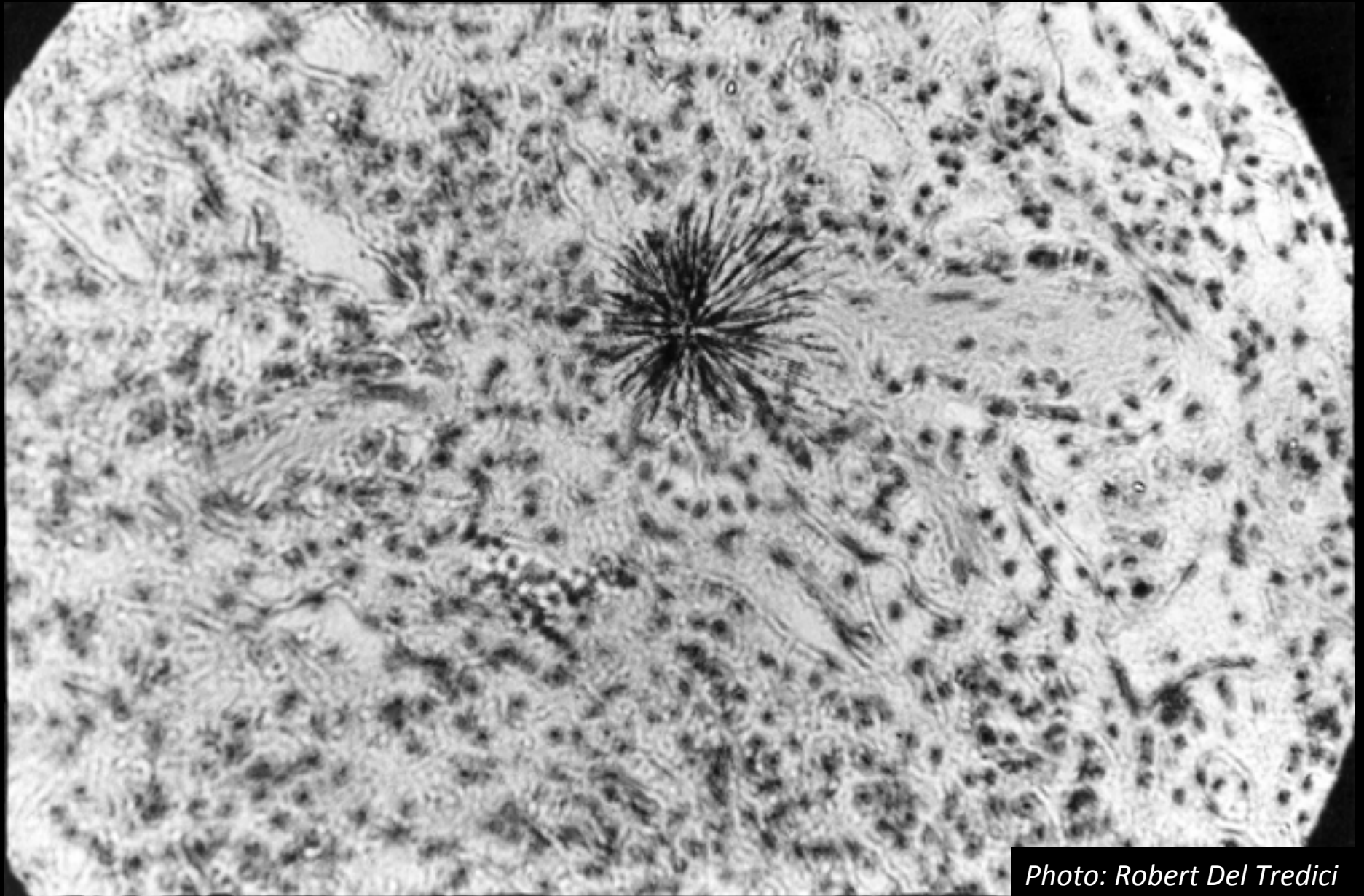
A gamma ray is like an x-ray, but more powerful.  
*highly penetrating*

A beta particle is like a sub-atomic bullet.  
*moderately penetrating*

An alpha particle is like a subatomic cannon ball.  
*not very penetrating*  
*~ but extremely damaging! ~*

*Alpha and Beta particles are INTERNAL hazards.*

Alpha radiation ~ harmless outside the body, deadly inside.



*Photo: Robert Del Tredici*

Radium, Radon, Polonium, Thorium, Uranium, Plutonium ~ all alpha emitters

## Alpha radiation ~ harmless outside the body, deadly inside.

*The lung tissue of an experimental animal seen through a microscope over a period of 48 hours. At the centre of the “star” is a tiny radioactive particle of plutonium.*

*Each “spike” is the track of an alpha particle given off during that 48 hour period. These radioactive emissions do not travel very far.*

*But some of the cells that are damaged may be able to reproduce with defective genes – these cells could be the beginning of cancer.*

Radium, Radon, Polonium, Thorium, Uranium, Plutonium ~ all alpha emitters



Henri Becquerel 1896  
*accidentally discovered that uranium ore is radioactive*



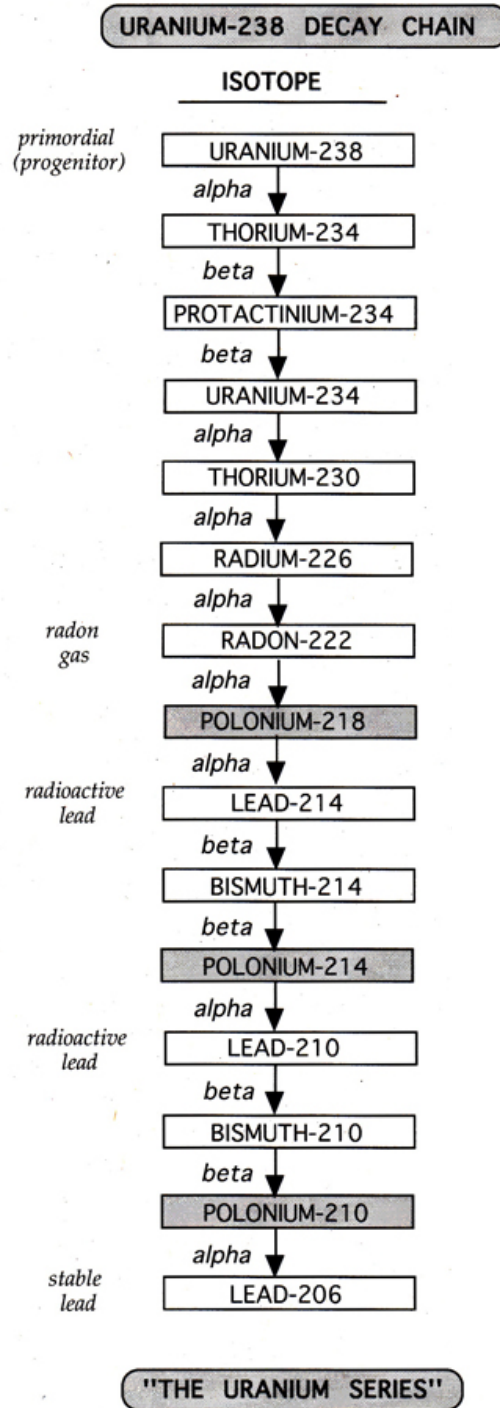
Marie Curie 1898

*discovered radium and polonium,  
two “decay products” of uranium*

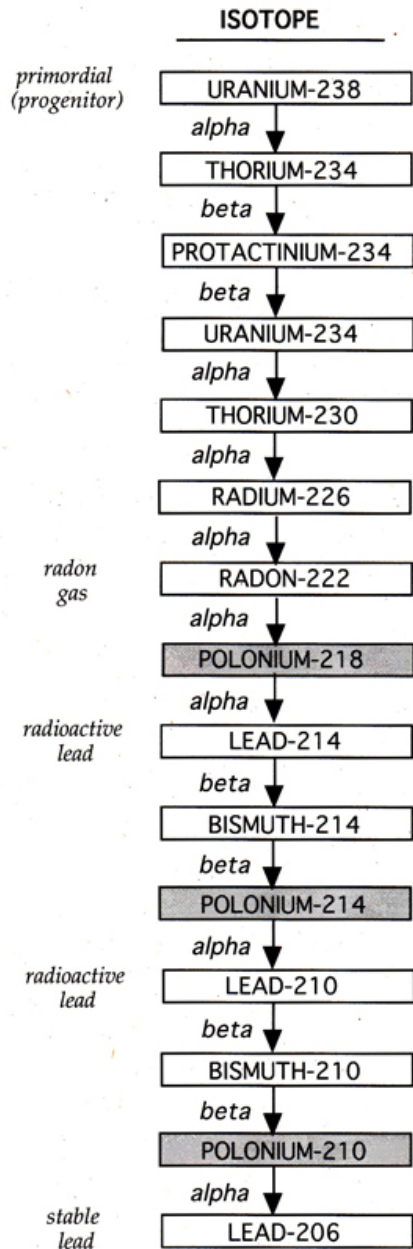
# What is a Decay Product?

- When disintegration occurs, *a radioactive atom is fundamentally altered – it becomes a new kind of atom.*
- So in any radioactive material, new atoms are created, called *“decay products”* or “progeny”.
- If a given decay product is also radioactive, then it will have its own decay products, and so on and so on . . .  
 . . . this gives rise to a *“decay chain”* or “decay series”.

Here is the decay chain of uranium-238, the most common type of uranium found in nature



URANIUM-238 DECAY CHAIN



"THE URANIUM SERIES"

On a weight-by-weight basis, all of the uranium decay products are much more radioactive and much more dangerous than uranium itself.

The 3 types of polonium are the most dangerous of all.





deaths from  
*Fatal anemia*  
*Bone cancer*  
*Head cancer*

Dial Painters 1920

**Radium-226**



## Polonium-210

*... billions of times  
more toxic than  
cyanide*

*... causes 90% of  
smoking deaths*

Alexander Litvinenko 2006

*murdered with*

**Polonium-210**



Underground Miners

Radon Gas

This Navajo uranium miner has lung cancer

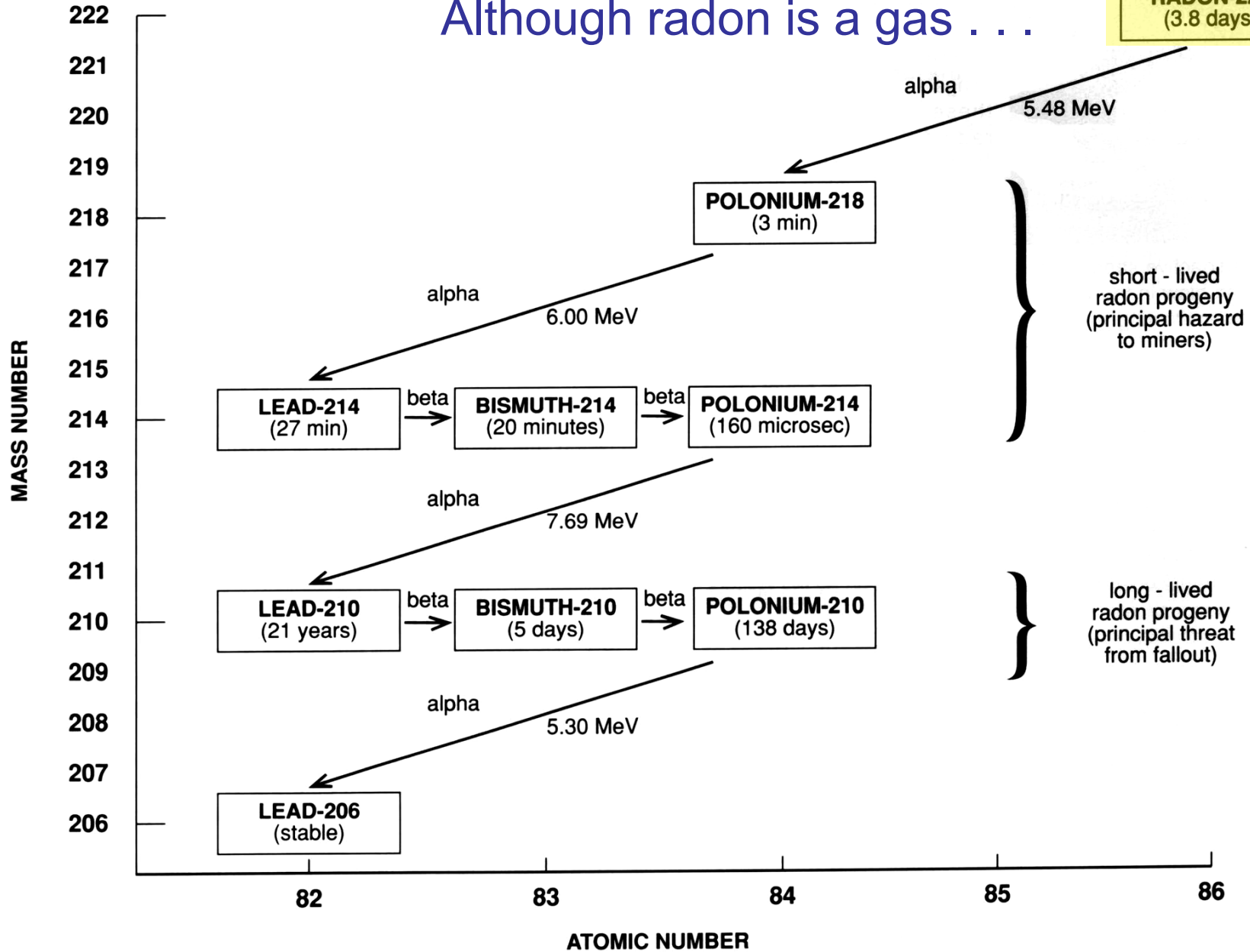
## Radon

. . . kills 20-30 thousand Americans every year  
- US EPA

. . . is the leading cause of lung cancer among non-smokers

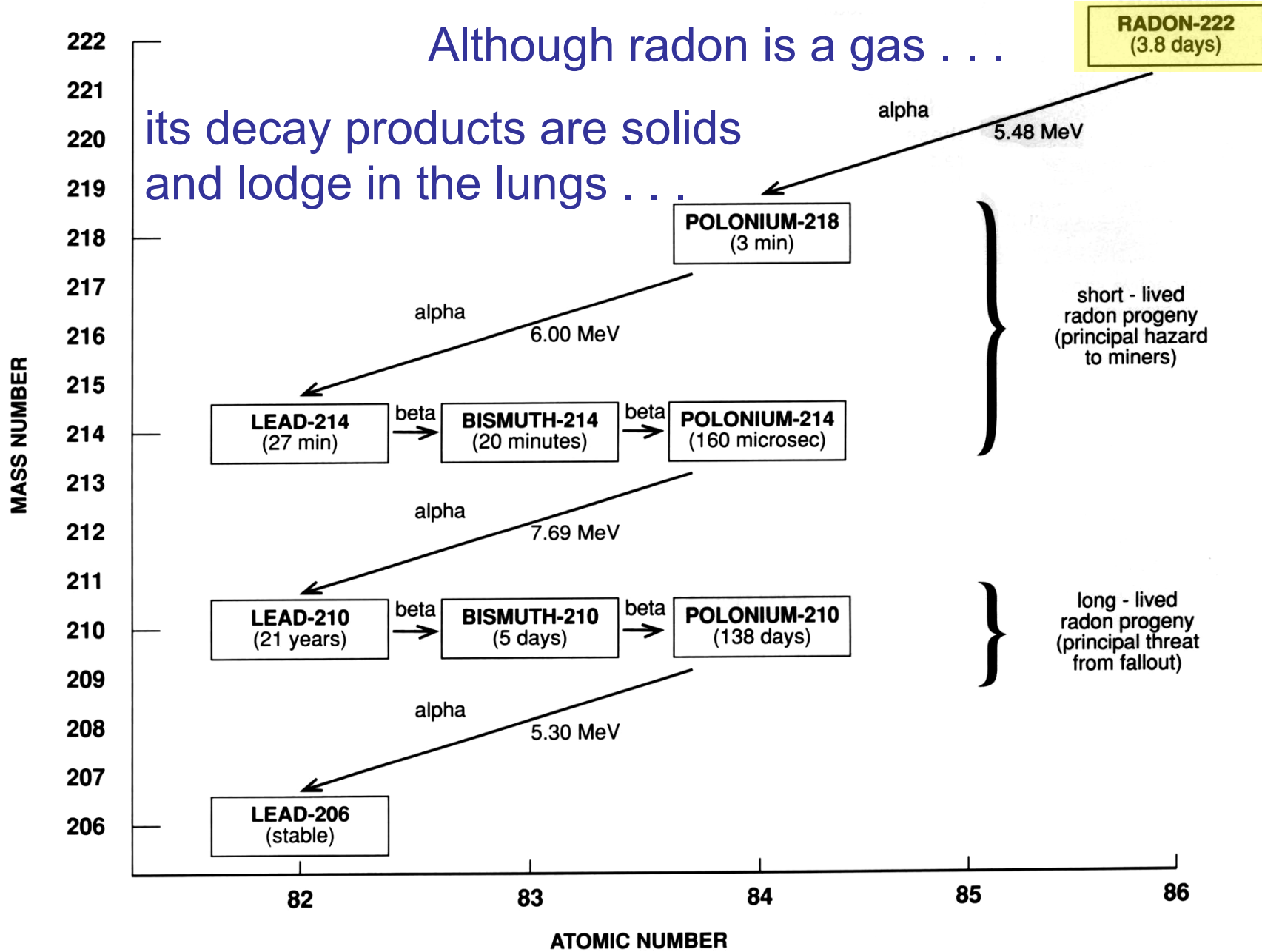
Although radon is a gas . . .

**RADON-222**  
(3.8 days)



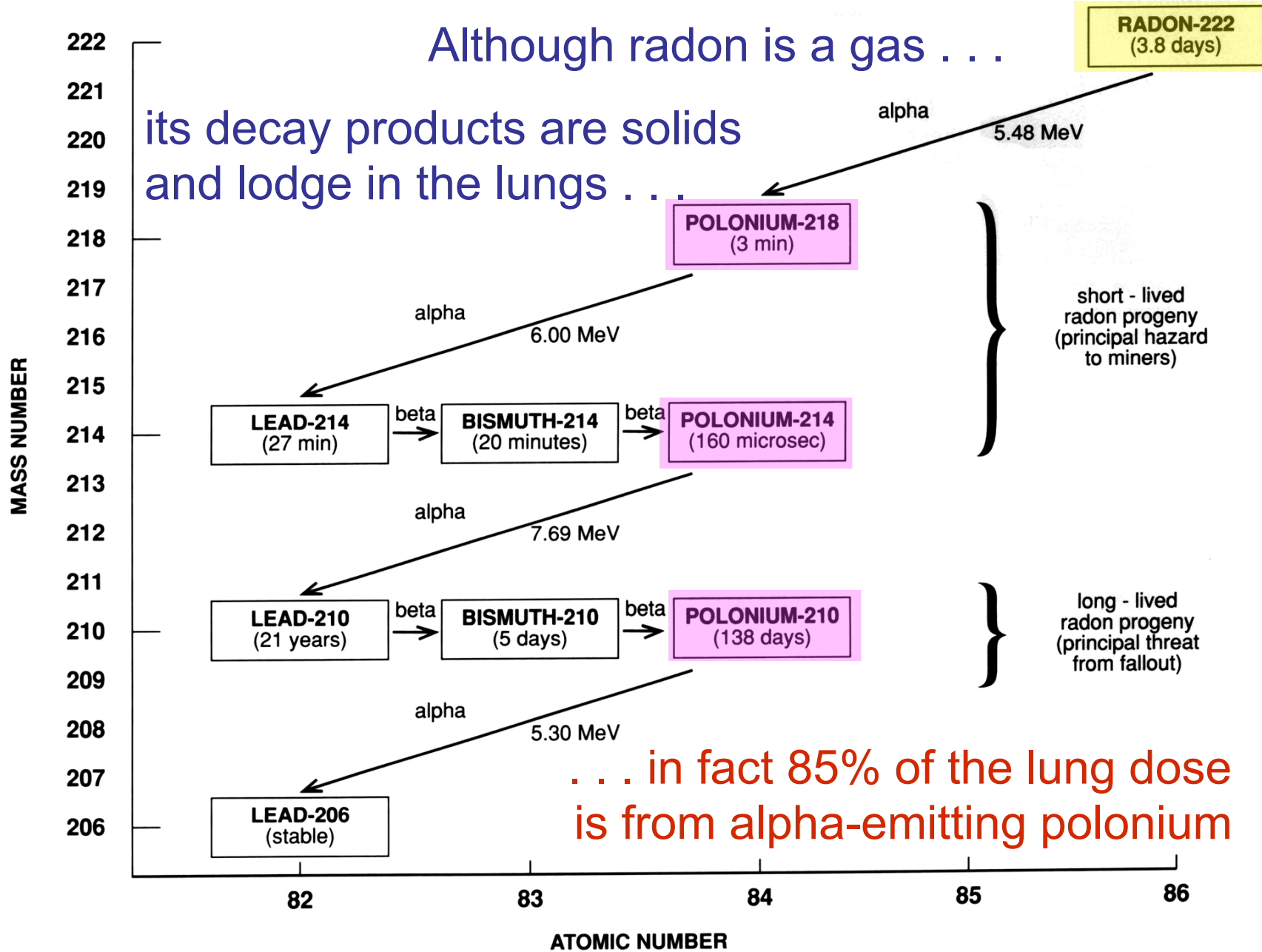
Although radon is a gas . . .

its decay products are solids  
and lodge in the lungs . . .



Although radon is a gas . . .

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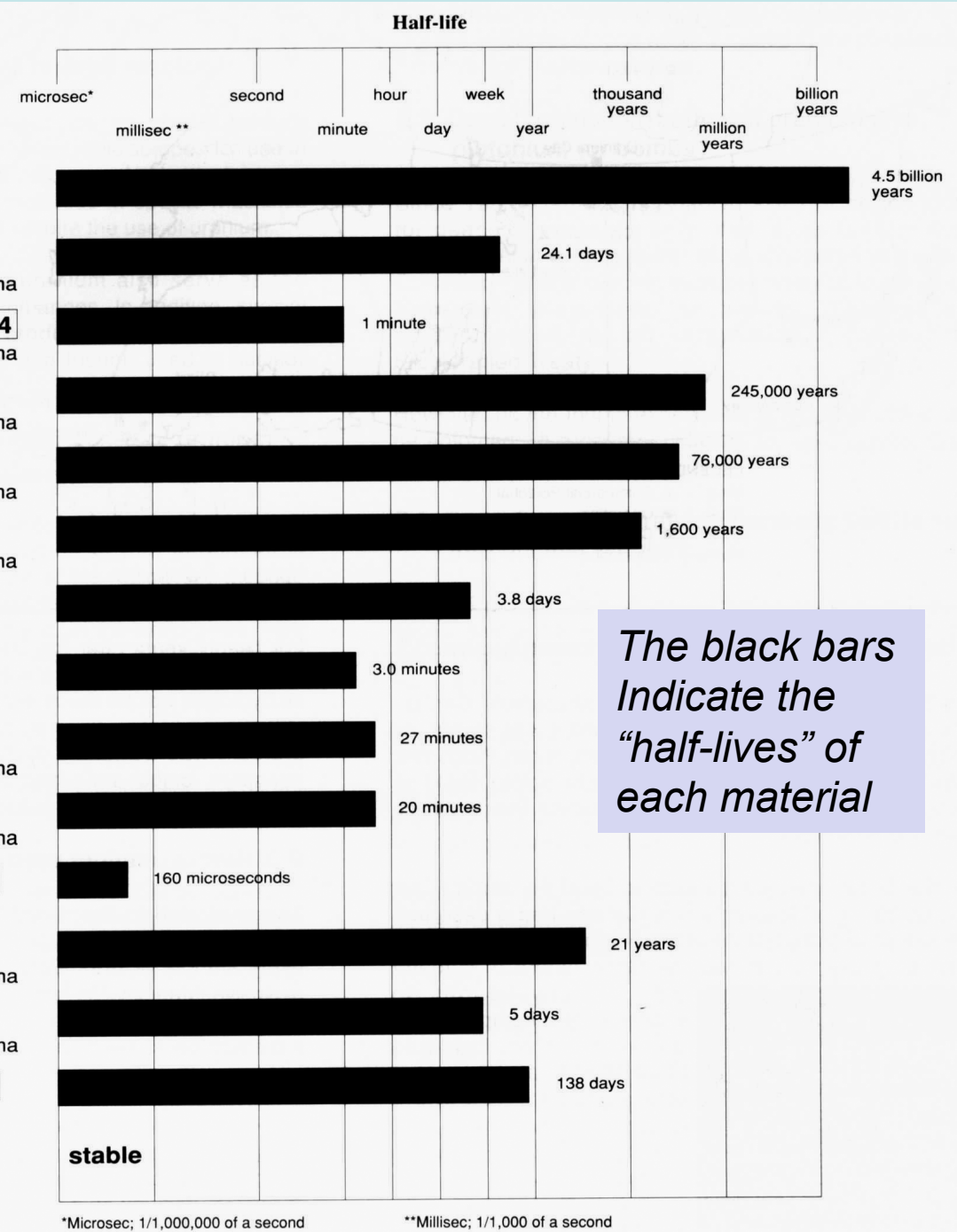
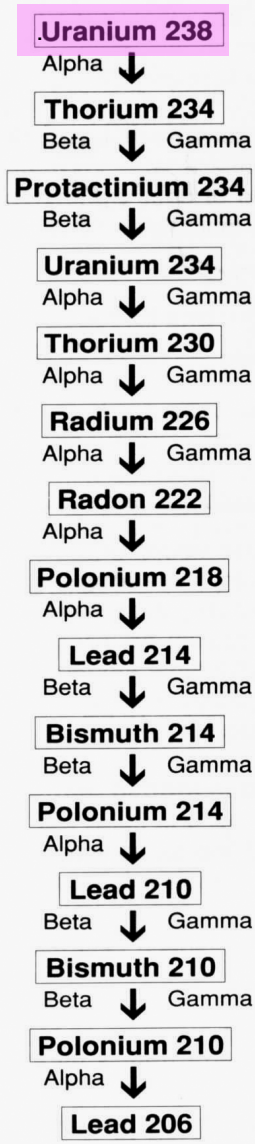
# What is a Half-Life?

- The **time it takes for HALF of the radioactive atoms to disintegrate** is called the HALF-LIFE of the material.
- Each radioactive element has **its own half-life** – for radon gas it is 3.8 days; for radium-226 it is 1600 years.
- If you wait long enough for TWO half-lives to occur, there will still be **one quarter of the material left**.
- If you wait long enough for TEN half-lives to occur, there will be **ONE THOUSANDTH of the material left**.

# URANIUM

When uranium atoms disintegrate they change into more dangerous radioactive elements.

This is the “decay chain” of U-238. There is a similar decay chain for U-235.



The black bars indicate the “half-lives” of each material

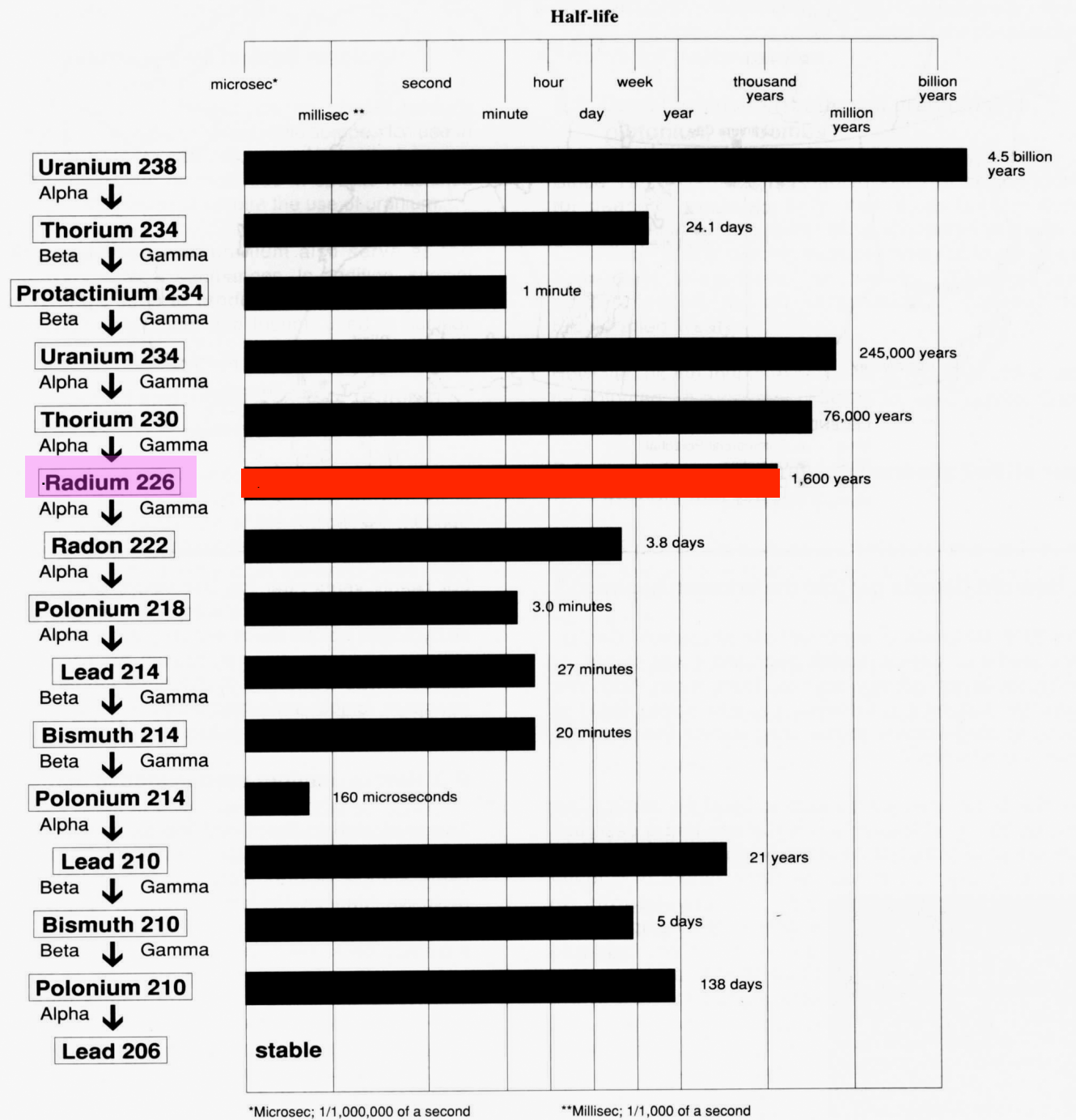
\*Microsec; 1/1,000,000 of a second      \*\*Millisc; 1/1,000 of a second



# RADIUM

In the first half of The 20<sup>th</sup> century, Radium-226 killed people with fatal anemia, bone cancer, and head cancer.

Radium is called a “superb carcinogen” by British Columbia Medical Association.

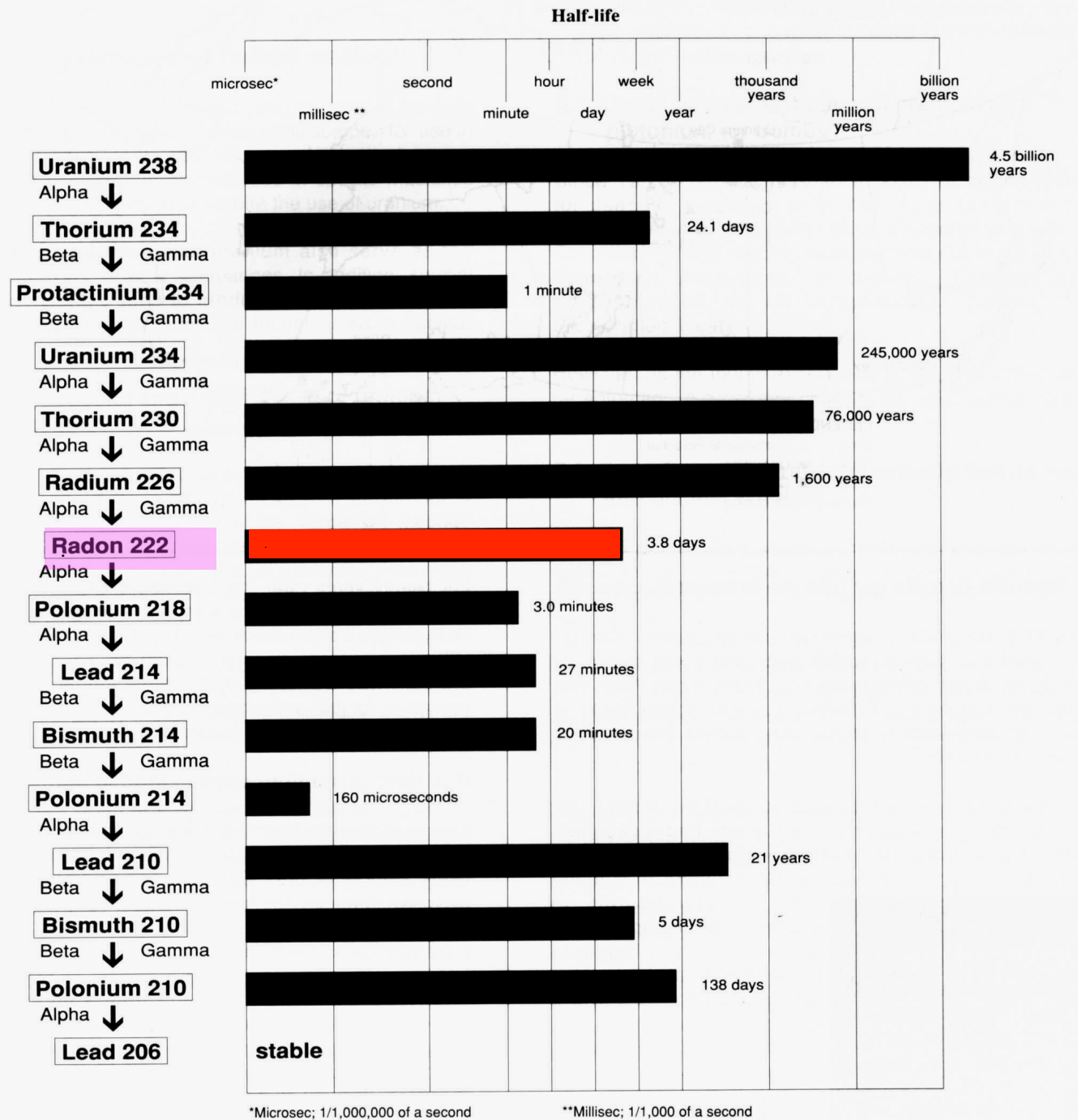


# RADON GAS

Radon-222 (known as radon gas) has killed thousands of underground miners for centuries.

It is the leading cause of lung cancer among non-smokers.

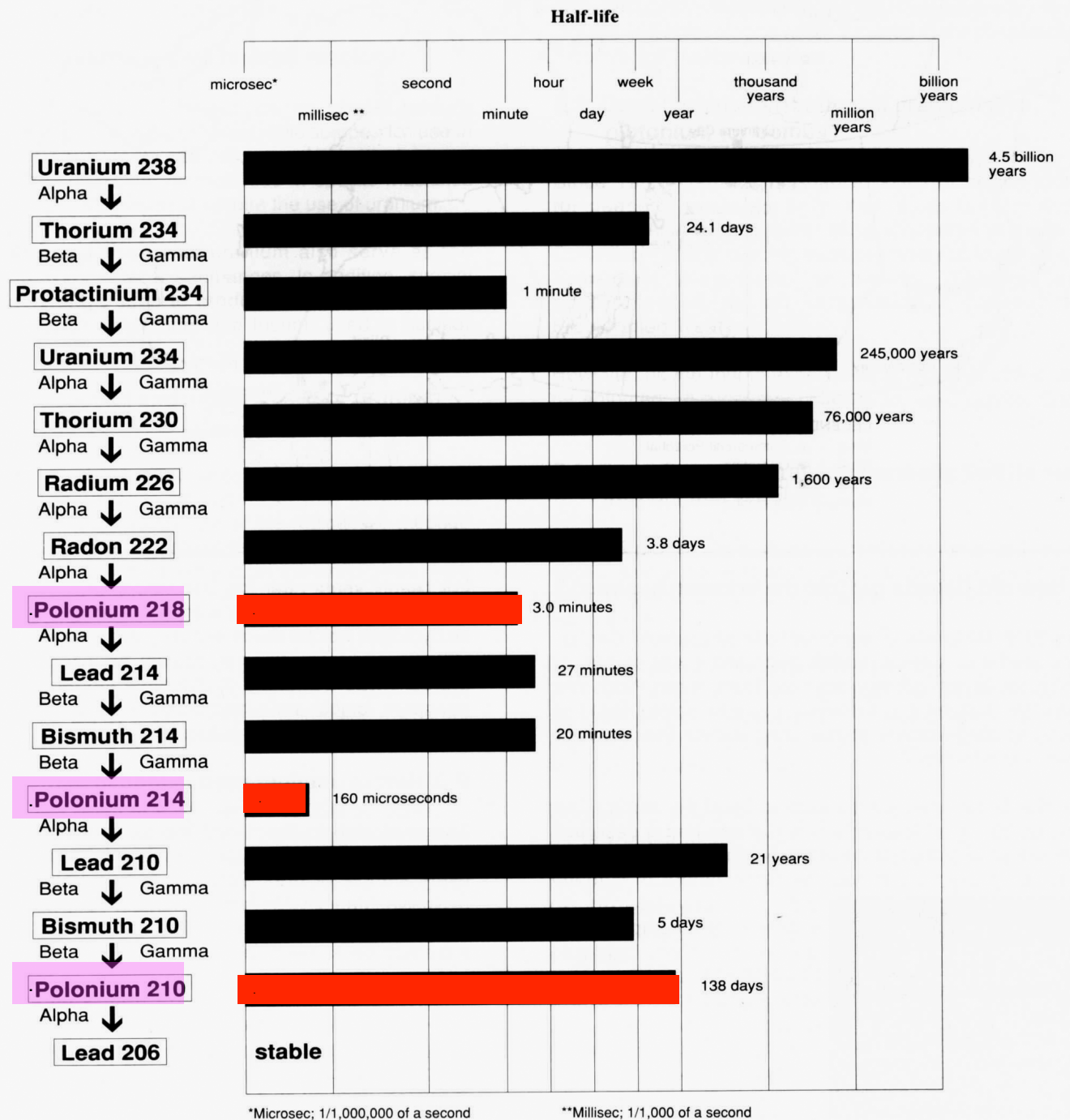
Indoor radon kills tens of thousands of American citizens every year according to the US EPA.



# POLONIUM

Polonium is millions of times more toxic than cyanide. It was used to murder Alexandre Litvinenko.

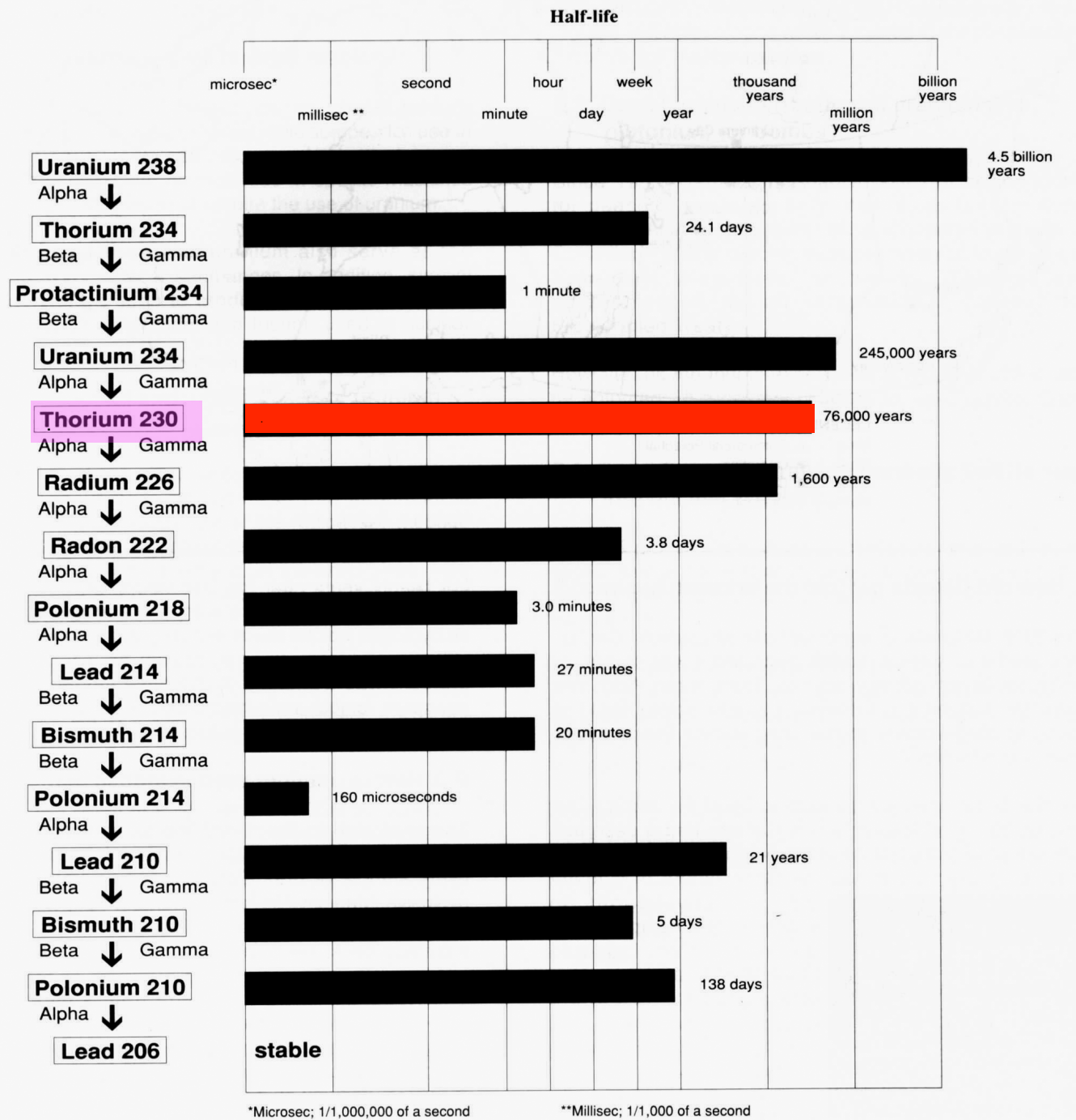
The American Health Physics Society states that up to 90 percent of deaths attributed to smoking are due to polonium-210.



# THORIUM-230

Thorium-230 has a 76,000 year half life.

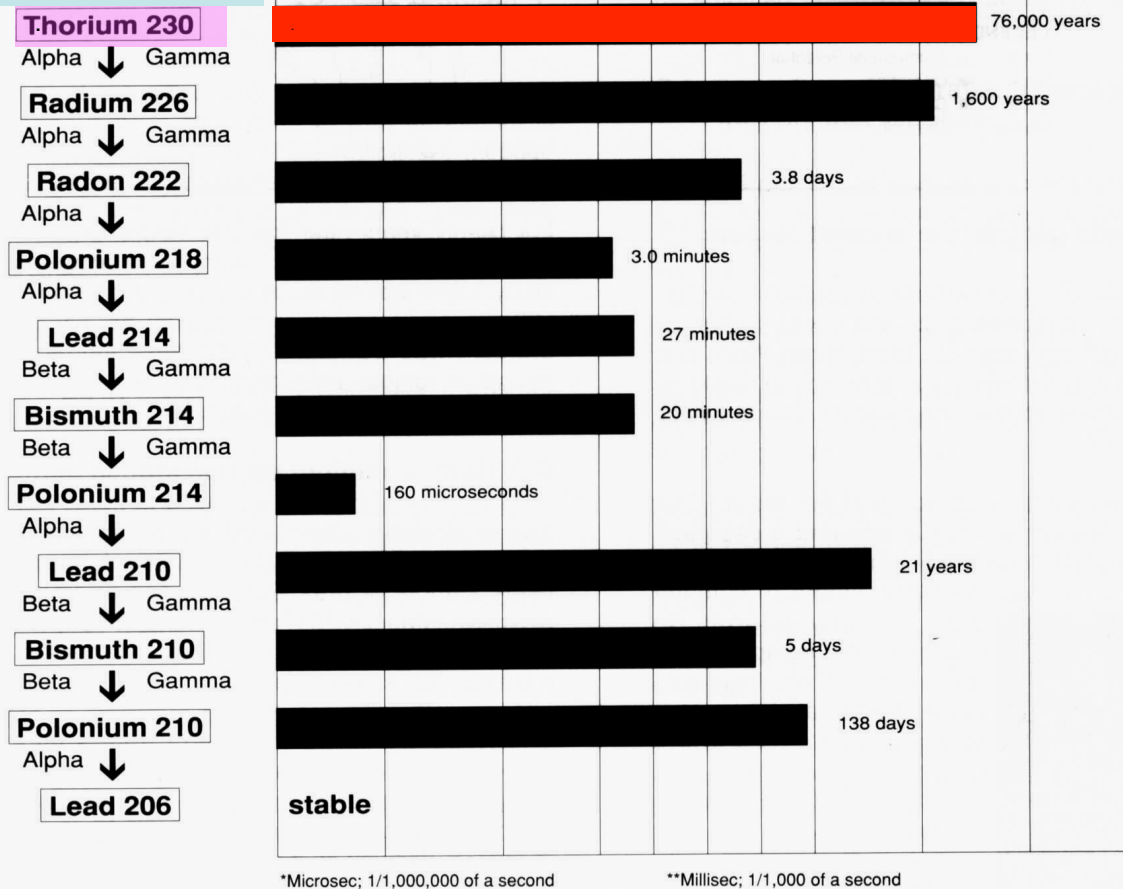
It remains dangerous for at least a million years.



When uranium is extracted, the radioactive decay products are left in the mill tailings as radioactive wastes.

As thorium-230 atoms disintegrate, they continually replenish the supply of radium, radon, and polonium in the tailings.

Thus ALL of these radioactive poisons will remain present for hundreds of thousands of years.



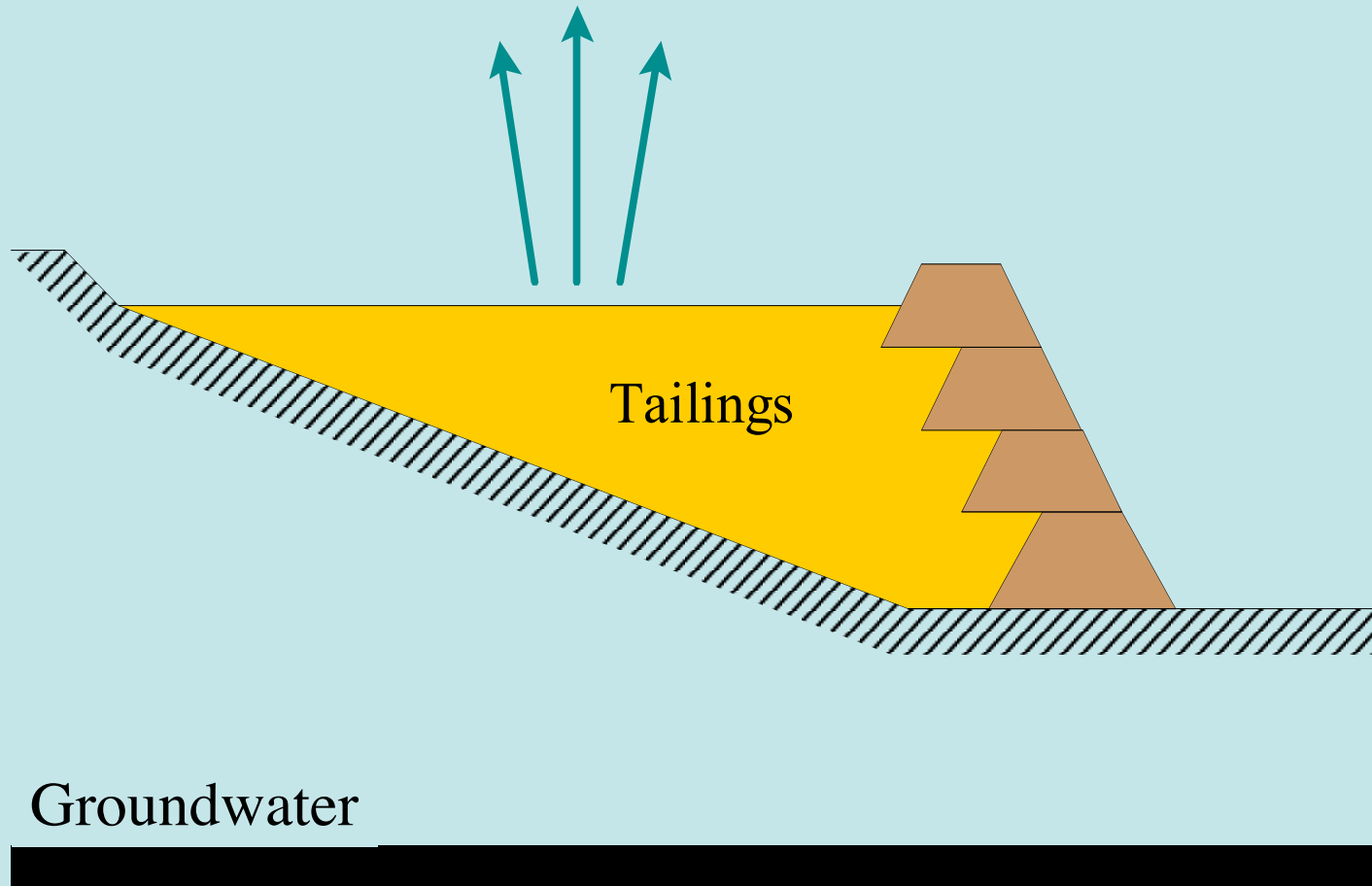


This 10-metre high wall is part of a deposit of 70 million tonnes of U tailings in Elliot Lake area.

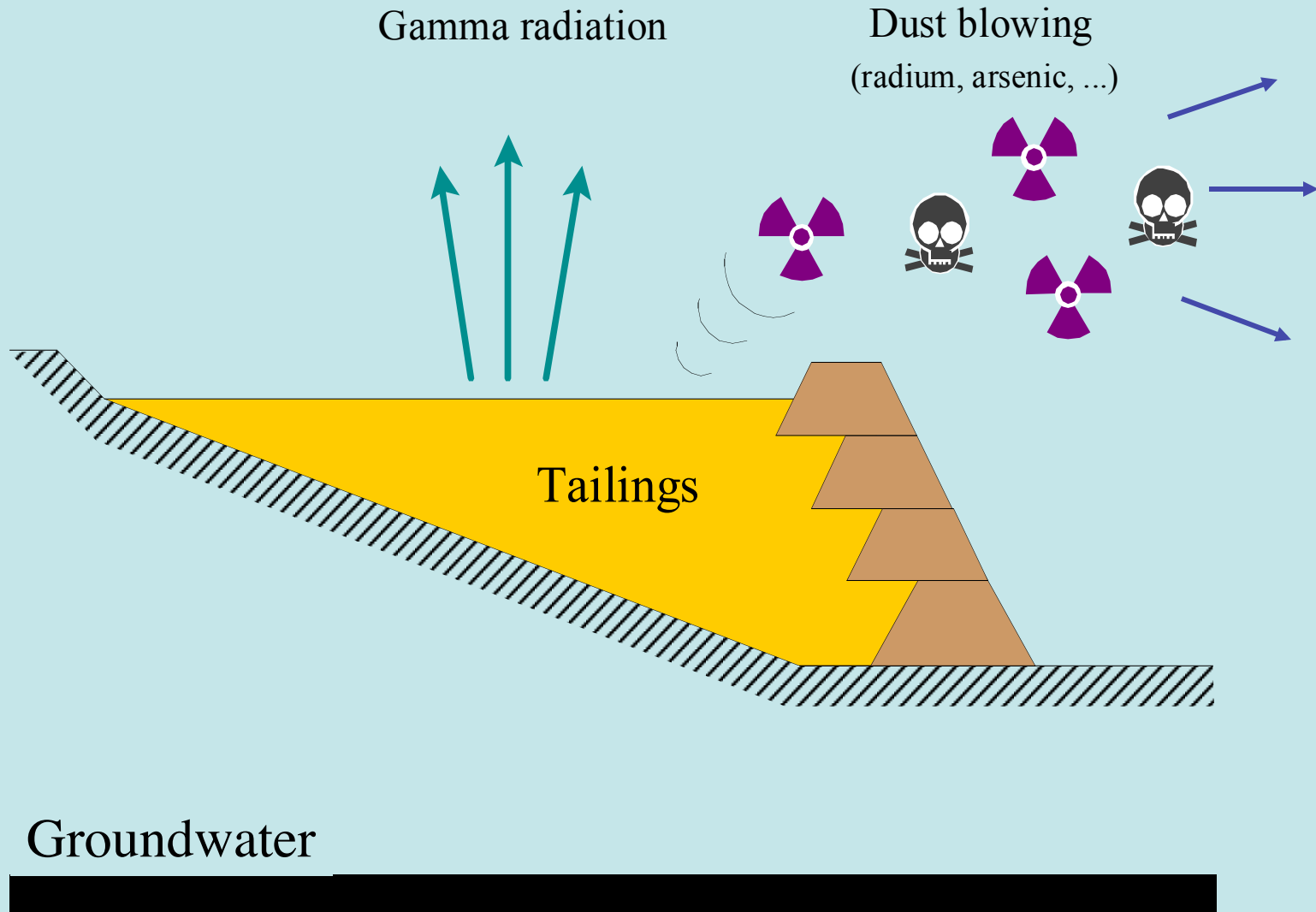
*Photo: Robert Del Tredici*

# Uranium Mill Tailings Hazards

Gamma radiation

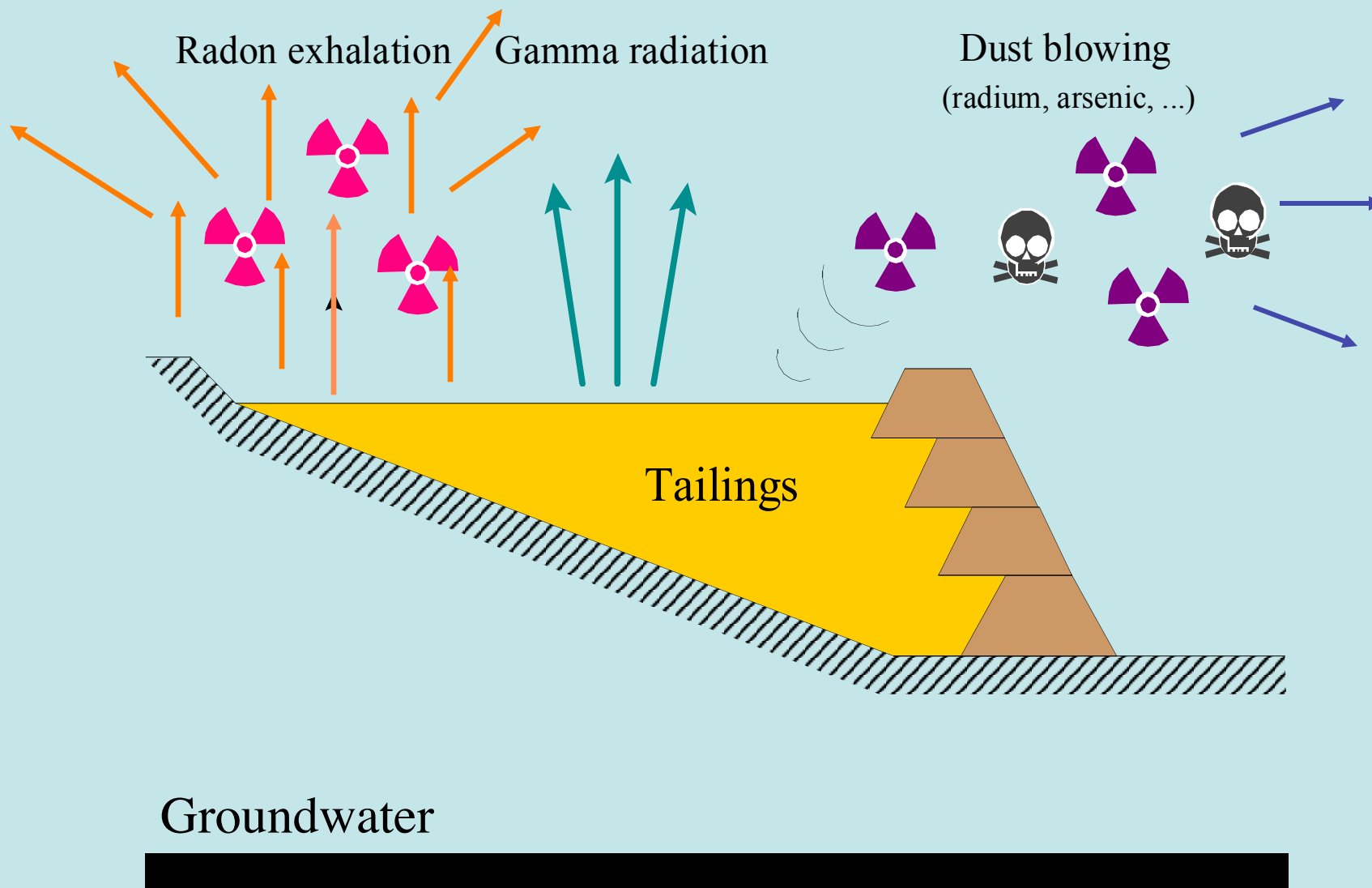


# Uranium Mill Tailings Hazards

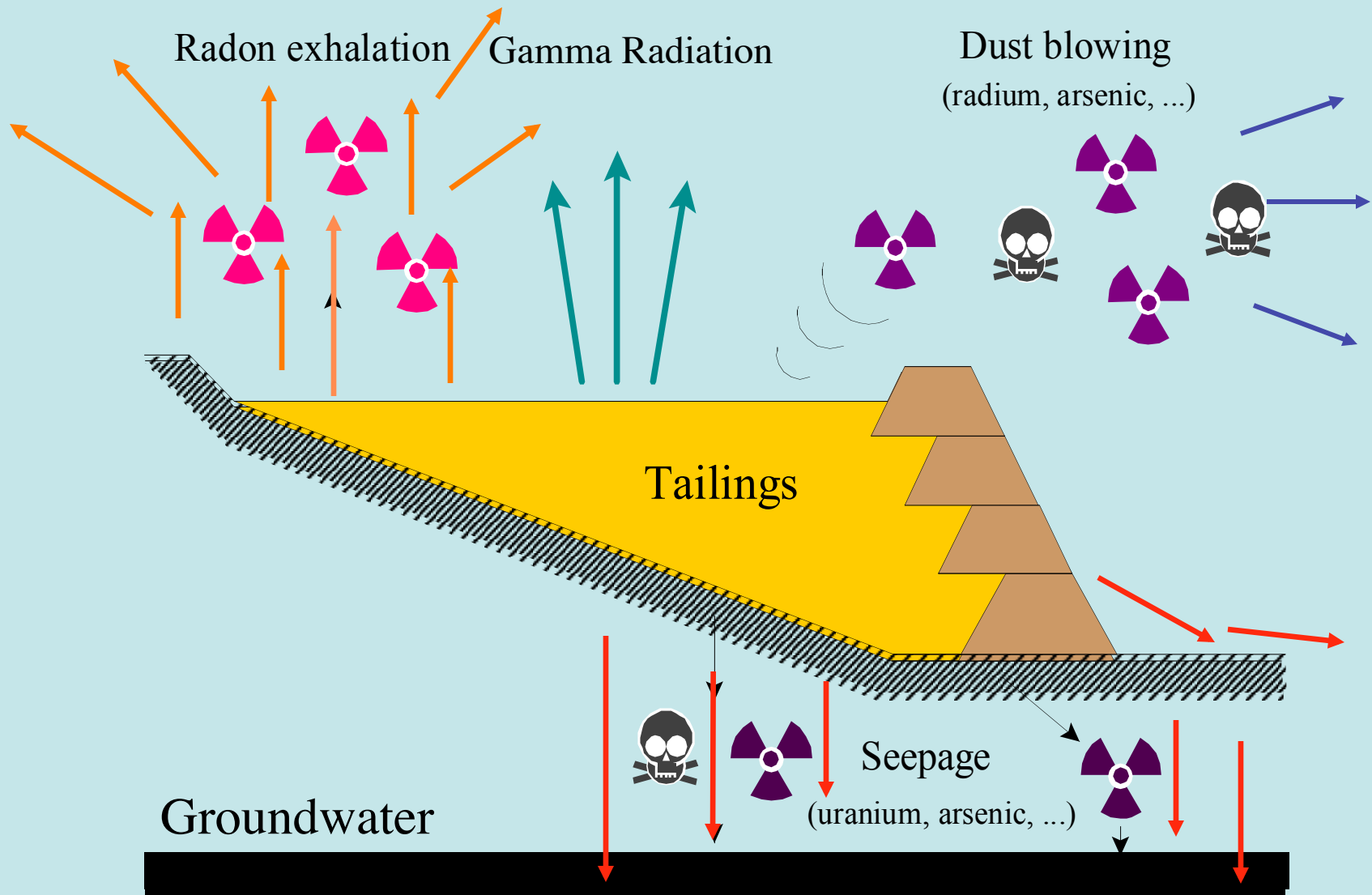




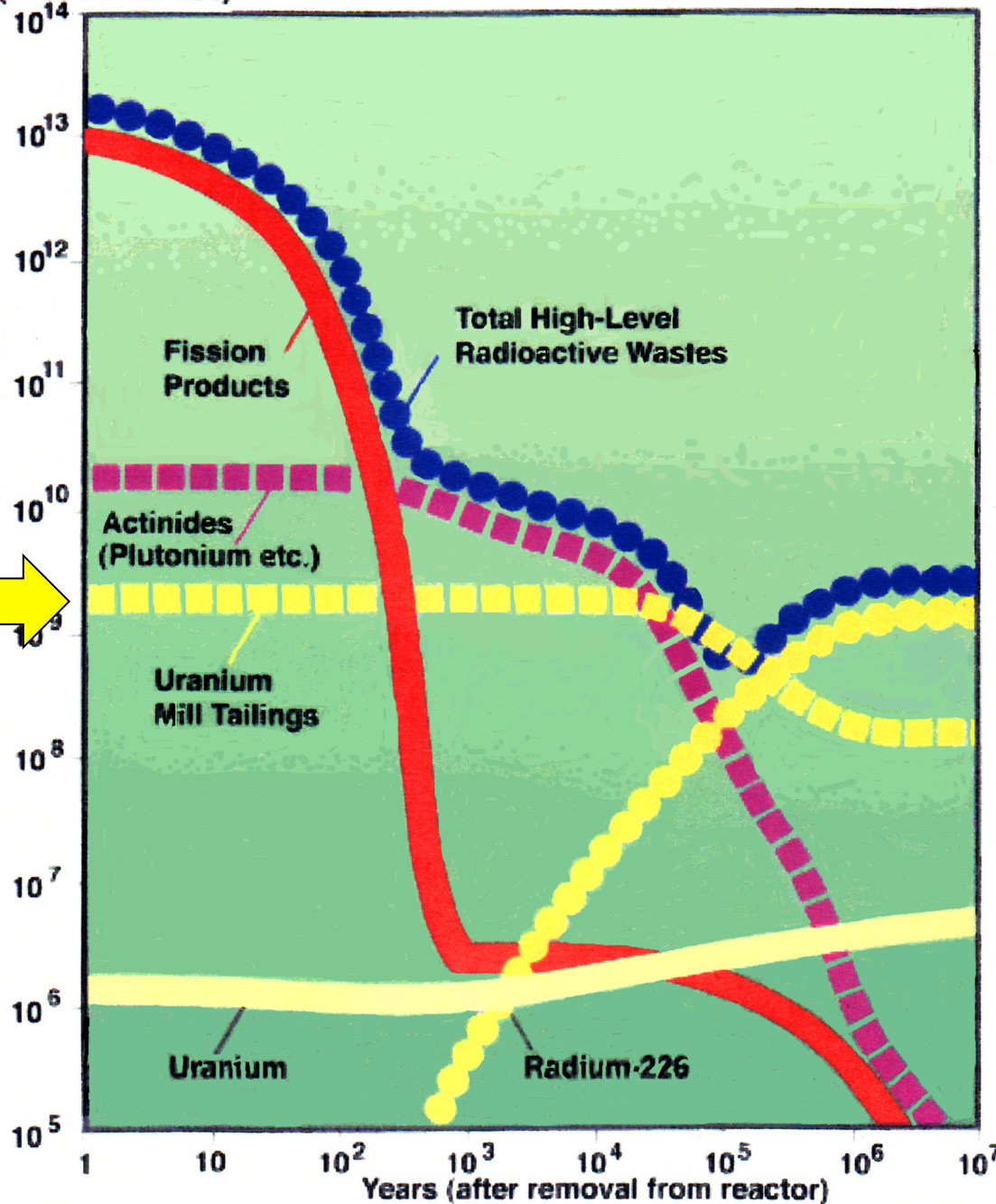
# Uranium Mill Tailings Hazards



# Uranium Mill Tailings Hazards



Volume of Water  
(in cubic metres)



**NOTE:**

In the long term,  
U mill tailings are  
about as toxic as  
high level waste

The toxicity of uranium  
mill tailings is indicated  
by the middle yellow line.

The red and blue lines  
represent the toxicity  
of spent nuclear fuel  
over 10 million years.

from "A Race Against Time",  
Royal Commission Report, 1978

*Health Effects Depend On  
The POPULATION Dose*



At low levels of exposure, harmful biological effects like cancer do not occur until many years after exposure.



Radioactive materials enter into the air, water and soil.  
They get into fish, plants, animals, and humans.



A small fraction of the population will develop cancer, years later. Infants and children are especially vulnerable.

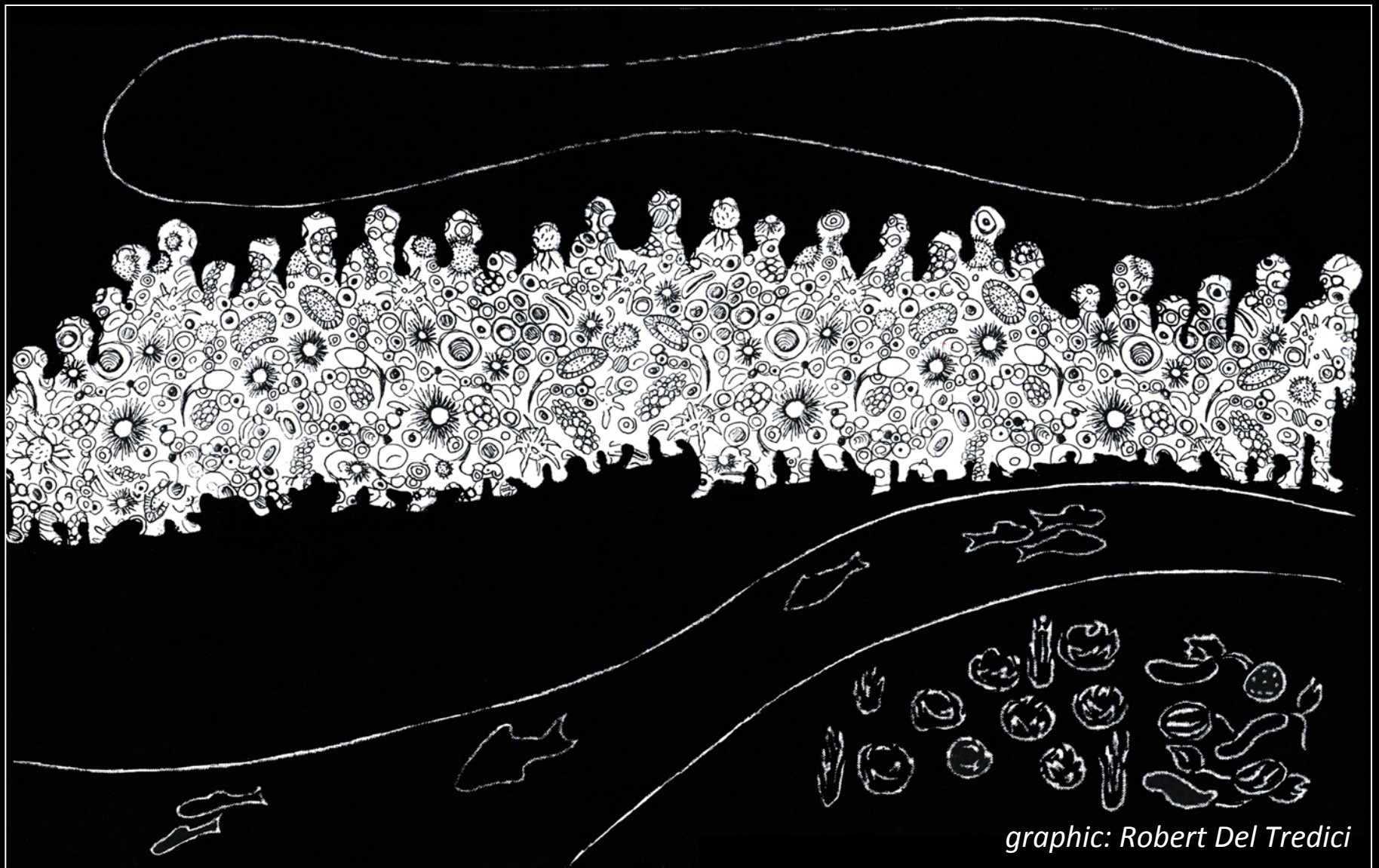


If a larger population is exposed to the **same** level of contamination, we say that **the “population dose” is greater.**



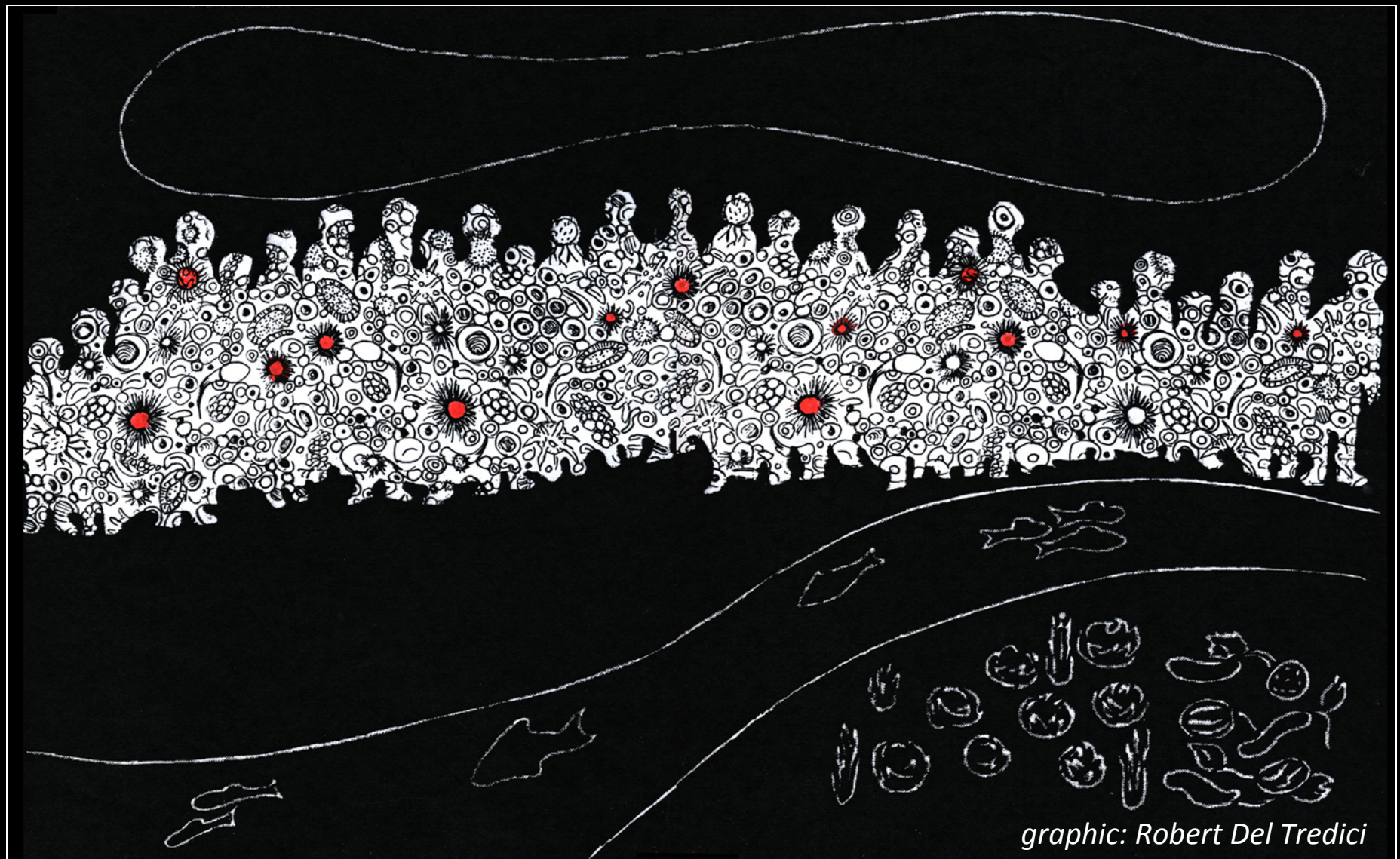


The greater the population dose, the more cases of adverse health effects – like cancer – will be seen.



*graphic: Robert Del Tredici*

At low levels, radioactivity does not attack humans directly  
– it damages cells. A population is like an ocean of cells.



*graphic: Robert Del Tredici*

A fraction of those cells will develop into cancers.  
It is largely a matter of chance whose body the cancer is in.

## Summary:

Uranium has many dangerous decay products.

When uranium is mined, the decay products stay.

Once locked safely in a hard rock formation, decay products are now crushed to a fine sand.

This makes them much more available to enter the environment of living things – the food chain.

Radon gas travels thousands of miles in a light wind, and deposits radioactive solids on the earth below.

If unsuspecting humans use this sand for building purposes, it can cause a lot of sickness and death.

## Challenges for our grandchildren's grandchildren:

Using uranium for **nuclear weapons** threatens the survival of all life – farewell to sustainable creation!

Using uranium for peaceful purposes plants seeds of future destruction by creating **plutonium deposits** – something that never existed on earth before humans.

**That's where uranium goes; where does it come from?**

You can't get uranium out of the ground without bringing to the surface the **dangerous decay products**.

*Do scientists know how to **keep 300 million tonnes of radioactive sand out of the environment – forever?***

The End

*Gordon Edwards, Ph.D., President,  
Canadian Coalition for Nuclear Responsibility.*

*E-mail: [CCNR@WEB.CA](mailto:CCNR@WEB.CA)*

*Phone: (514) 489 5118*