

# Airborne Radiation Underreported

Robert I. Price

OLLI at SOU

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and many accomplishments: We owe our existence to  
a six inch layer of topsoil and the fact that it rains.*

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*We shall just have to live with the reality:  
Without  $\alpha$ ,  $\beta$ , and  $\gamma$  radiation **we** might not have  
evolved.*

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2. Detail the **real reasons** (sans hyperbole) we should be concerned.
3. Delineate what the EPA (providing it survives) should do about this.

# This Study Was Made Possible By:

Dr. Michael Larsen<sup>1</sup>

Nathan Brady

Jeff Brittenham

Kayla M<sup>c</sup>Mahon

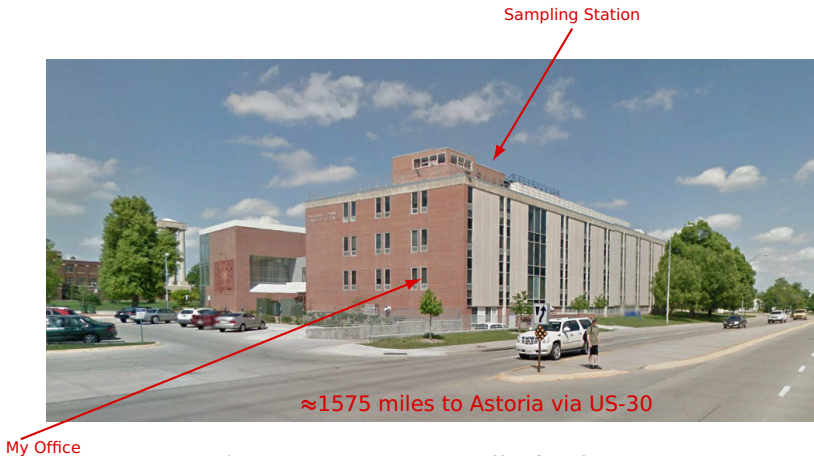
Joshua Moravec

Adrián Sanabría-Díaz

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<sup>1</sup>2007 - 2010 from <http://larsenml.people.cofc.edu/bio.html>

# Typical RadNet Site Location



**Figure 1 :** Bruner Hall of Science  
Midway City

An old railroad route: Boston ↔ 1733 miles ↔ Kearney ↔ 1733 miles ↔ San Francisco.

# An Extremely Expensive Vacuum Cleaner



Figure 2 : One Cubic Meter per Minute



# Instrument Package



Figure 3 : Near Realtime [NaI(Tl)]  $\gamma$  - Detector

## User Friendly “BlackBox” Laboratory

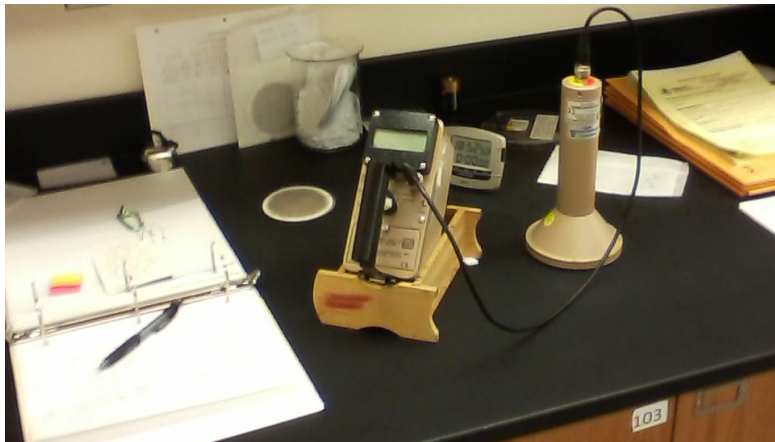


Figure 4 : Field Screening Equipment

# ZnS(Ag)

Distinguish  $\alpha$  from  $\beta$  reasonably well.

- ▶ Visible–light tight. Thin enough to allow  $x$ – and  $\gamma$ – photons through with little effect while  $\beta$  particles generate a flash of visible photons.
- ▶ Thick enough to stop  $\alpha$  particles that therefore generate a brighter flash of visible photons.

Calibrated by EPA staff scientists.

Twice a Week as per EPA's SOP (a procedure of little interest)

- ▶ Place retrieved dirty filter in sample holder.
- ▶ Let filter sit for five hours.
- ▶ Determine  $\alpha$  and  $\beta$  activity.
- ▶ Complete a report containing a few calculations.

## A Brief History

Spring 2010, I reluctantly became the operator of the Kearney site.

One of the students asked “Why do we record a  $\frac{\beta - \text{activity}}{\alpha - \text{activity}}$  ratio?”

By 2014, the RadNet monitoring network grew to 134 stationary monitors distributed across the country.

≈ 22 July 2015, An awkward conversation with an EPA technician.

The EPA recalled all onsite field screening equipment, and simplified the operating protocol announced via a memorandum dated 20 July 2015.

(Arrived in my “eMailBox” 27 July 2015 1:37 PM)

## Creating a SOP Doc

Do not ~ in anyway ~ compromise the EPA's existing Protocol.

### Radiological "Dosimetry" (Counting Particles)

- A : Proof of Concept Phase (Completed)
- B : Design Phase (Completed)
- C : Implementation Phase (Aborted)

### Radiological "Assay" (Identifying Particles)

- A : Proof of Concept (Rough Draft = my PhD thesis)
- B : Zip, Zilch, Nada ... Crickets

# Radon's Daughter's : ${}_{92}\text{U}^{238}$ ( $\alpha, \beta, \beta, \alpha, \alpha$ ) ${}_{88}\text{Ra}^{226}$

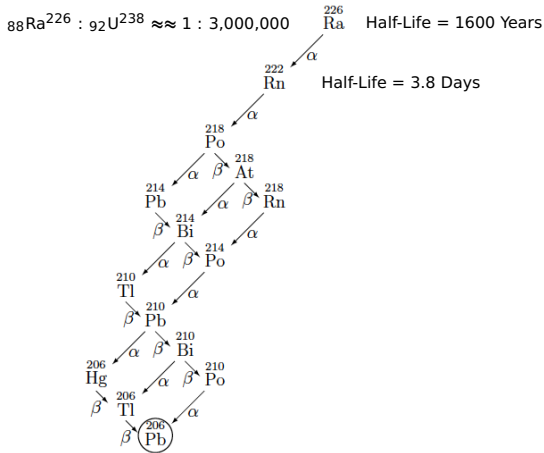


Figure 5 : Radon Decay Chain

## EPA's Rational (inferred)

During proof of concept and design phases EPA scientists notice that after  $\approx$  five hours  $\alpha$  and  $\beta$  activity is nil.

Transient therefore innocuous, right?  $\neg_{\text{}}(\text{ツ})_{\text{}}/\text{}$

Radon is a noble gas therefore ...  $\text{?} \neg_{\text{}}(\text{ツ})_{\text{}}/\text{}$

$\alpha$  and  $\beta$  particles don't travel very far  $\text{?} \neg_{\text{}}(\text{ツ})_{\text{}}/\text{}$

Why be concerned  $\text{?} \neg_{\text{}}(\text{ツ})_{\text{}}/\text{}$

What  $\text{?}$ , me worry  $\text{?} \neg_{\text{}}(\text{ツ})_{\text{}}/\text{}$

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At 1.5 meters from the sample the detector was swamped.  
(I sent them away.)

## $\alpha$ - Data, 02 Nov 2012

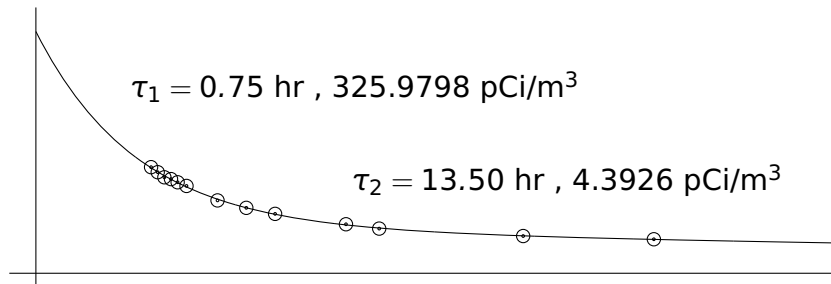


Figure 6 :  $\alpha$  Activity versus Time

## $\beta$ - Data, 02 Nov 2012

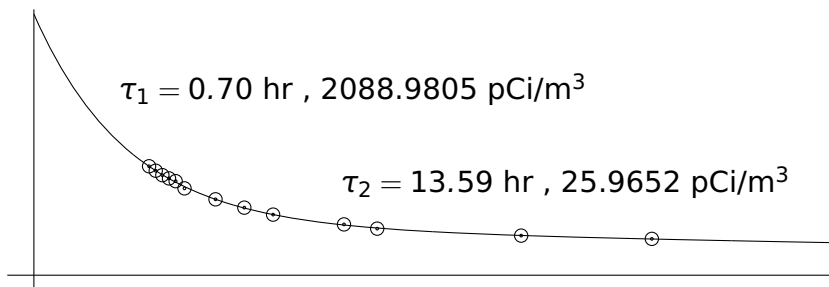


Figure 7 :  $\beta$  Activity versus Time



## 20121029 → 20121102 Exposure

$\alpha_1$  , 325.9798 pCi/m<sup>3</sup>

$\alpha_2$  , 4.3926 pCi/m<sup>3</sup>

$\beta_1$  , 2088.9805 pCi/m<sup>3</sup>

$\beta_2$  , 25.9652 pCi/m<sup>3</sup>

2445.3181 pCi/m<sup>3</sup>

61% of the EPA's benchmark for Radon in your home:

4000 pCi/m<sup>3</sup>.

Interesting aside:

Six months earlier we had purchased our retirement home in the Bear Creek Valley.

# Design Phase : SOP Document

15 Mar 2014 – 27 Feb 2015 detected  $\alpha$  plus  $\beta$  radiation

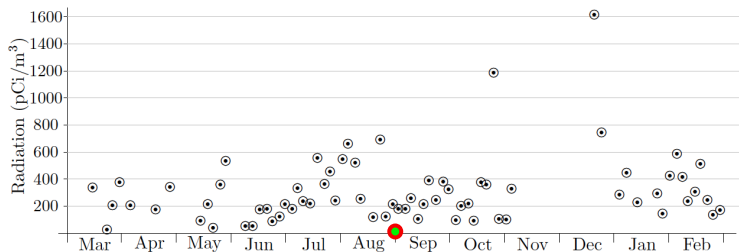


Figure 8 : Radioactivity carried by the Dust in the Air

# Design Phase : SOP Document

28 May 2014 – 01 Jun 2015 detected  $\alpha$  plus  $\beta$  radiation

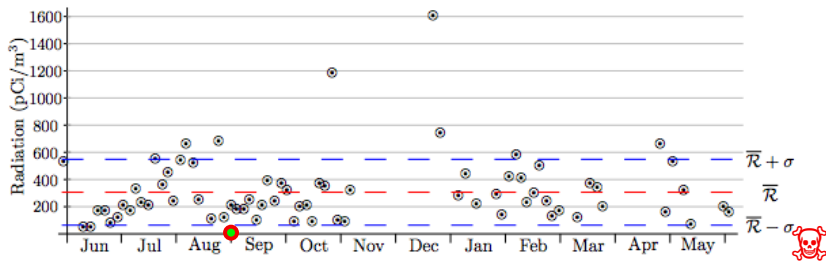


Figure 9 : Radioactivity carried by the Dust in the Air

## Postmortem

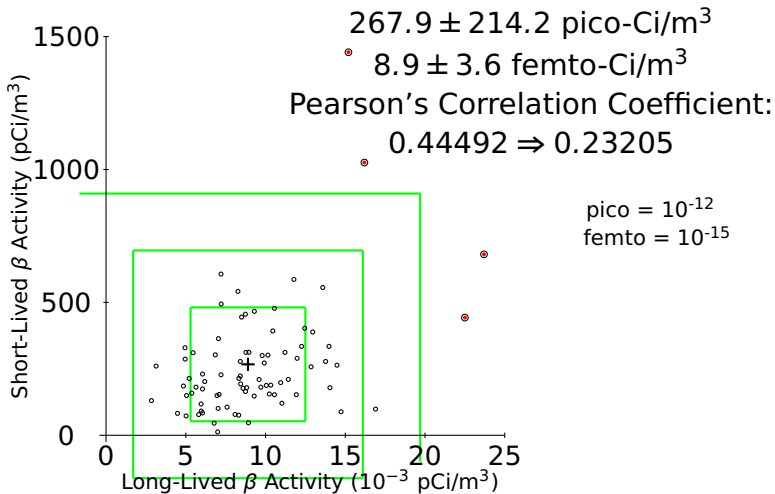


Figure 10 : Local  $\beta$  Activity versus EPA's Gross  $\beta$  Activity

## Why Should We be Concerned?

Radon is the second-leading cause of lung cancer<sup>2</sup> ... should we panic †

Buying a Geiger counter and posting information online. (+) , (-)

Radon Detection Kit verses

Dr. Robert Katz ([DigitalCommons@UNL.edu](mailto:DigitalCommons@UNL.edu)) (1917-2011)

Accurate information is an antidote to hysteria and hype. (+) , (-)

[www.epa.gov/radon/citizens-guide-radon-guide-protecting-yourself-and-your-family-radon](http://www.epa.gov/radon/citizens-guide-radon-guide-protecting-yourself-and-your-family-radon)

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# Integrity

# Dénouement

2013 National Council on Undergraduate Research Conference  
2014 NCUR Conference

Nathan Brady

Graduate Student, Elementary Particle Physics

Jeff Brittenham

Teaching Physics, Outstate Nebraska

Kayla M<sup>c</sup>Mahon

Data Analysis

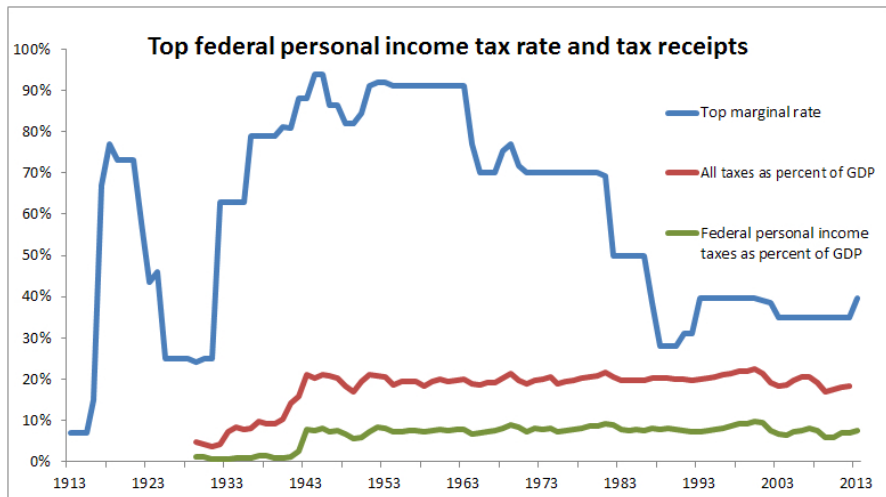
Joshua Moravec

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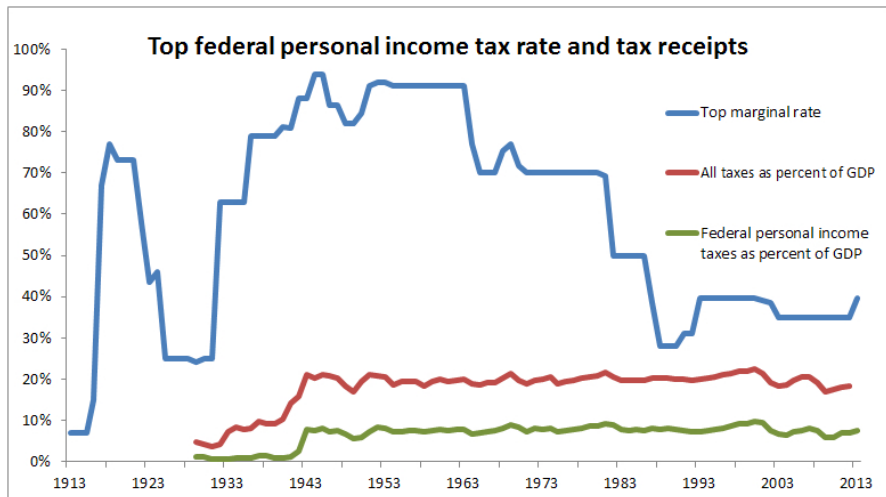
Adrián Sanabría-Díaz

Data Analysis

# The Inevitable Demise of Capitalism



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Warren Buffett – Bill Gates – The Salton Sea

The issues are not what you think.

# Seems Like 1955 again, except Worse †

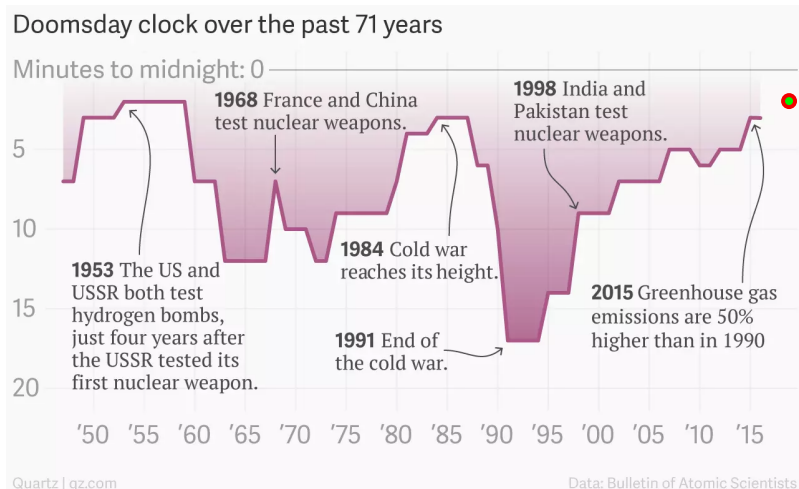


Figure 11 : Seems Like 1955 again, except Worse †