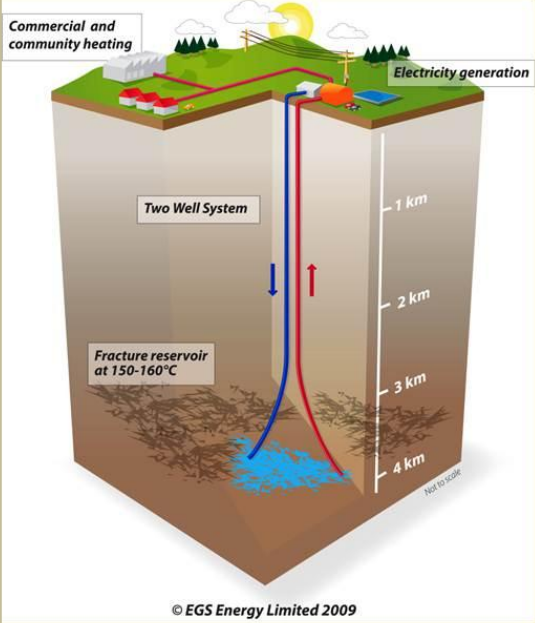


The Invisibles – Radioactivity in Granite

Summary of presentation by Hadrian Pigott – The Penzance Convention – Saturday 19th May 2012



The concept

The basic concept of deep geothermal energy comprises the injection of water down one well, circulation through an artificially stimulated reservoir within hot rock and the return of heated water to surface through the production well(s). The hot production water is used for combined heat and power.

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Whilst underground at Rosevale, our guide Tony Bennett gave a brief introduction to the radiogenic heat produced by radioactive decay within the granites that promises a new phase of extraction in the 21st century, in the form of hot rock geothermal energy.



So, the granite's radioactive. Uranium, thorium and potassium are the main contributors to terrestrial radioactivity. These elements were concentrated in the granites as the Cornubian batholith formed 290m years ago, and then reinforced by a series of later mineralisation phases as changing tectonic conditions caused the mobilisation of these elements from neighbouring deep sedimentary basins.

Pitchblende and zippeite
Wheal Edward, Cornwall



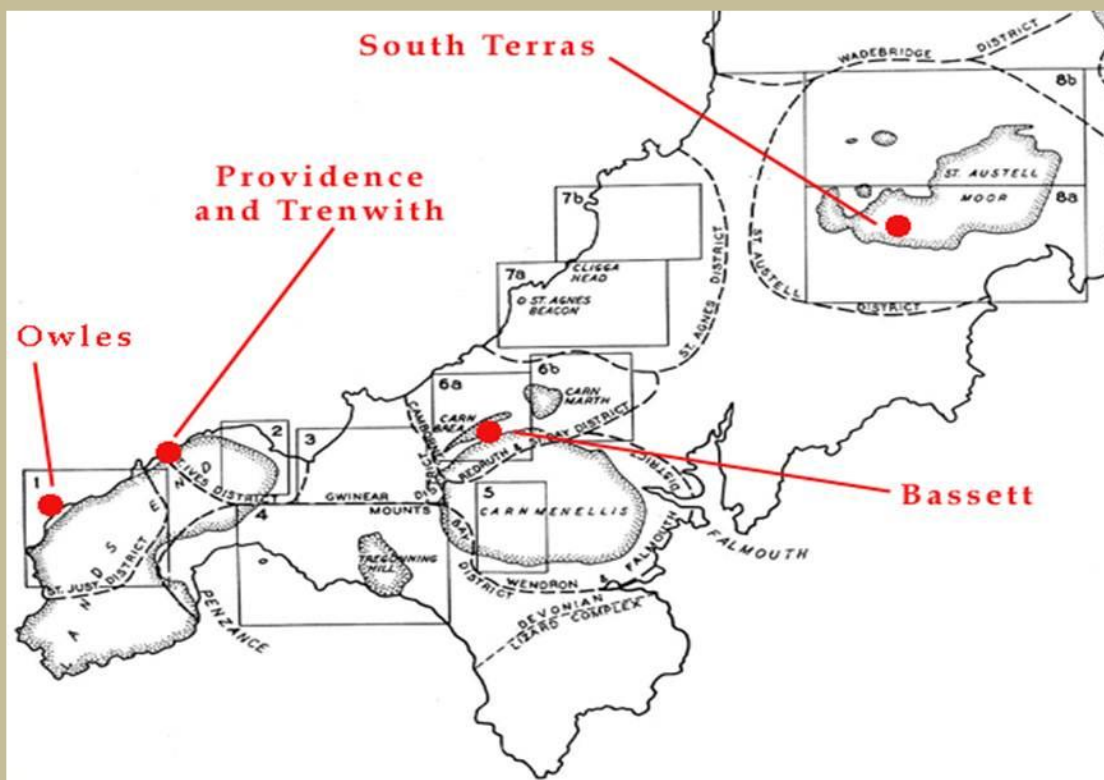
Torbernite – Wheal Basset, Cornwall



Uranium is one of the rarer metals to be extracted in Cornwall. The most common uranium mineral is the oxide uraninite (or pitchblende), and there are a number of exotic secondary uranium minerals such as zippeite, coffinite, torbernite, and zeunerite.

Marcus Perry of the St Just Mining Research Group has kindly brought a small sample of pitchblende to demonstrate the radioactivity of these minerals...thank you Marcus! [Here we demonstrated the radioactivity of a pitchblende sample with my Geiger counter...]

Uranium Mines in Cornwall



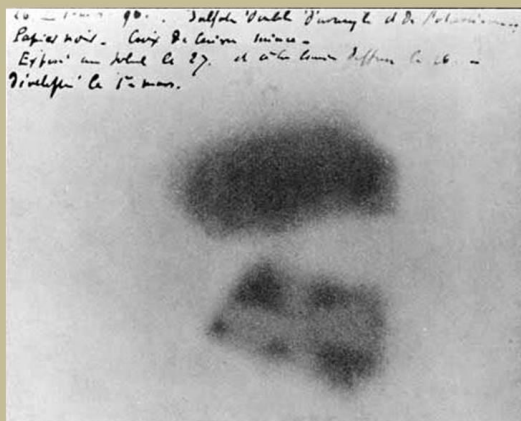
Pitchblende was found in a number of mines in Cornwall, but only two mines produced significant quantities of ore; Trenwith mine in St Ives and South Terras near St Austell. In total about 2,000 tons of Cornish pitchblende were extracted, a tiny amount compared to the estimated 2.7 million tons of tin *metal* produced.

Uranium glass



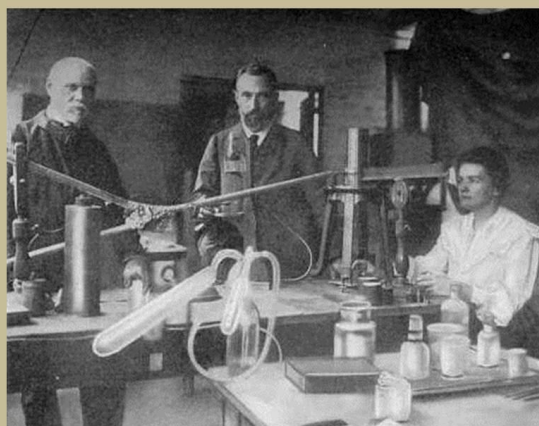
Originally pitchblende was thought to be a black copper oxide of no value and it was thrown onto the spoil tips. But by the early 19th century uranium was recognised and used for producing vivid and fluorescent colours in glass and ceramics, with a near monopoly industry at Joachimsthal in Bohemia, where uranium was first discovered in 1798. Eventually, other factories set up in France and Germany to which Cornish pitchblende was exported. But by the end of the 19th century this business was rapidly declining as other cheaper industrial colourants were found.

Henri Becquerel's radiograph of uranium radiation
1896



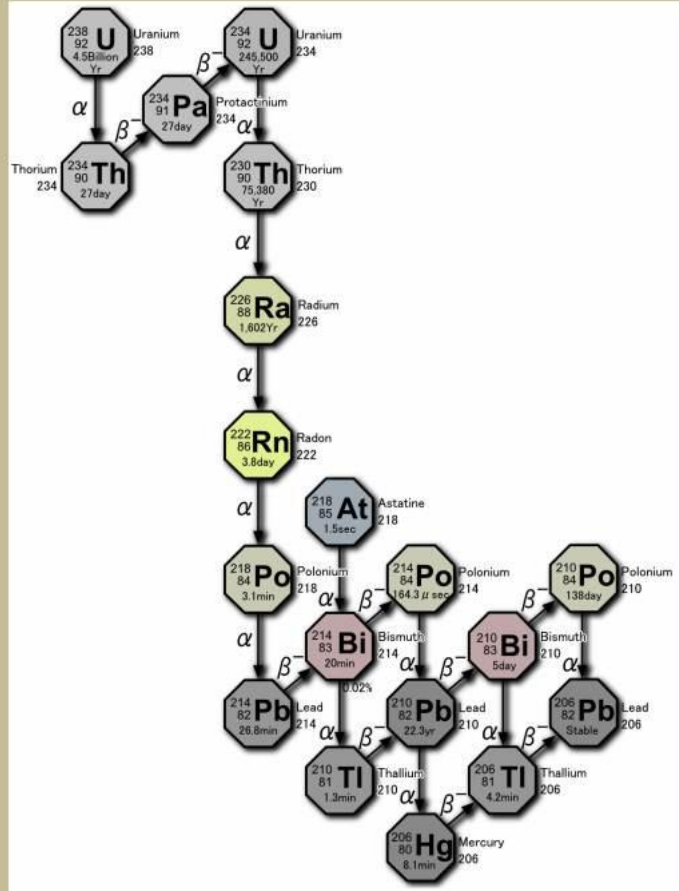
However, in 1896, Henri Becquerel discovered the radioactive properties of uranium...

Pierre and Marie Curie discover radium 1898



Following this, in 1898, Pierre and Marie Curie isolated first polonium and then radium from two tons of pitchblende.

Rutherford and Soddy discover transmutation and radioactive decay chains 1901



Then in 1901, Ernst Rutherford and Frederick Soddy discovered the natural transmutation of thorium to radium, and the significance of radioactive decay was revealed.

[Here you see the decay chain of radioactive Uranium-238 to stable lead-206, producing radium and radon on the way, and emitting alpha or beta particles and gamma rays as it does so.]

The news of these discoveries rocked the science world, and it rocked other worlds too.

Wassily Kandinsky

“In my soul the decay of the atom was the same as the decay of the whole world. Suddenly the sturdiest walls collapsed. Everything became uncertain, unsteady, and soft. It would not have amazed me if a stone had melted in to mid air before me and become invisible.”

From his autobiographic notes 1901 - 1913

Here's Kandinsky in 1902: “In my soul the decay of the atom was the same as the decay of the whole world. Suddenly the sturdiest walls collapsed. Everything became uncertain, unsteady, and soft. It would not have amazed me, if a stone had melted in to mid air before me and become invisible.”

Radium is a million times more radioactive than uranium, but is extremely rare, so that 10 tons of pitchblende might produce three tons of Uranium, but only one gram of radium.

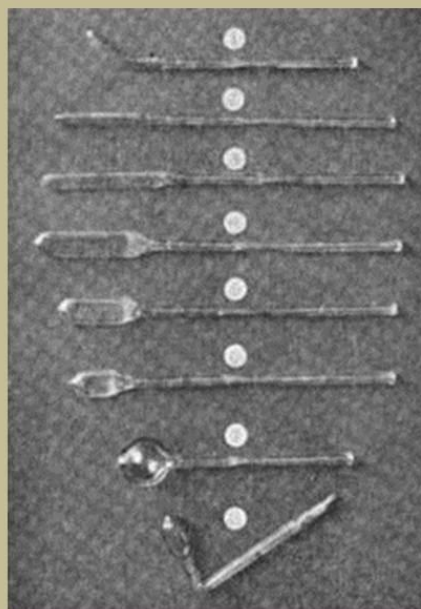
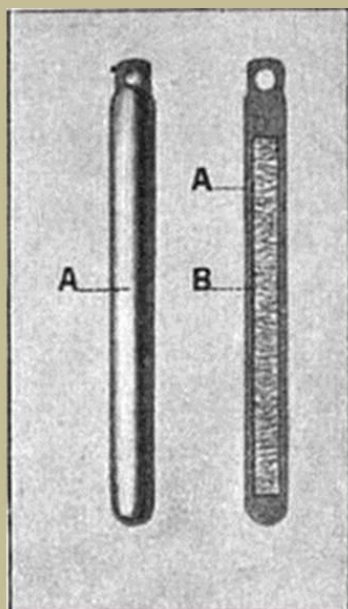
By 1903 the 'radium craze' was well underway, and in 1909 it was the most expensive substance in the world, worth over £6m per gram in today's money.

Radium / Curie Therapy – external application Radium salt tubes - 1905

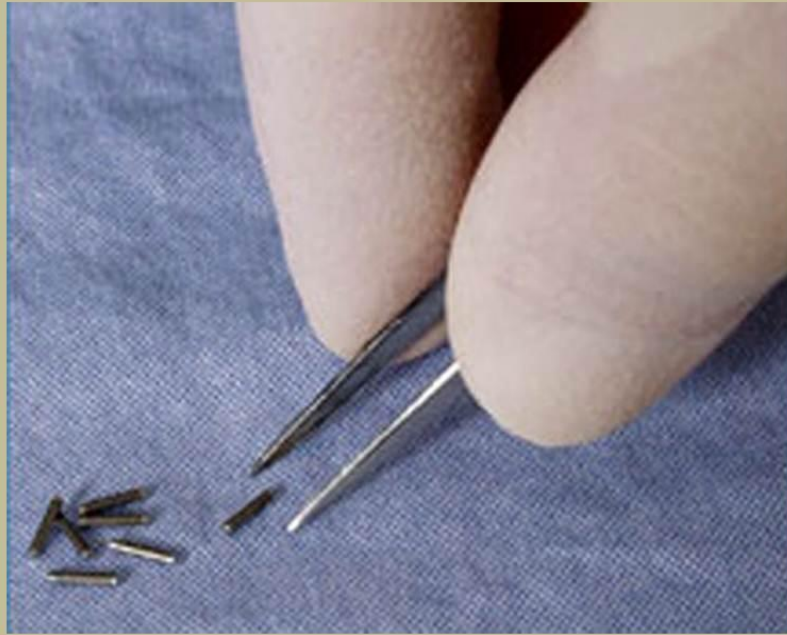


By 1910, in view of the demand from research scientists, and the potential use of radium in medicine, factories began to be built in Europe and the USA for its large-scale production.

Radium / Curie Therapy – internal application 1910 Radium salt tube Radium emanation (Radon) tube



Internal Radiotherapy – Brachytherapy 2012



The radioactive nature of radium led to some real advances in treating cancer, and the original radium or 'Curie' therapy has evolved into today's sophisticated array of radiotherapy treatments.

New York
Times 1909

HEAP OF RUBBISH IS RICH IN RADIUM

**Cornwall Mine from Which It
Came, to be Worked
Again.**

BATHS MAY BE STARTED

**Medical Value of the Mineral Found
in Pitchblende at St. Ives is
Now Recognized.**

Interestingly, one of the leading radioactivity scientists in Britain, Sir William Ramsay, acted as consulting chemist to the British Radium Corporation. Unlike Marie Curie, Ramsay had a keen eye for business and he bullishly oversaw the extraction of radium from pitchblende that came from the Trenwith mine in St Ives, setting up a factory at Limehouse in London to do this. 694 tons of pitchblende were procured from Trenwith from 1909 to 1917 to feed this production.

Ramsay also advocated the use of the radioactive waters of the mine for health treatments and therapies and the idea of St Ives becoming a spa town was floated, but never followed through.

Radium quackery?



RADIUM EMANATION WATER

Drives Out Uric Acid

Suffering from too much uric acid and diseases caused by faulty elimination—Rheumatism, Gout, Periodical Headaches, Neuralgia, Constipation, Neurasthenia, Auto-Intoxication and Lack of Bodily Vigor—quickly relieved in a natural way without drugs or chemicals by our new discovery

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SEND FOR FREE LITERATURE

Tells how you can buy or rent a Rayode to make Radium Water in your own home, with your own ordinary drinking water. Address:

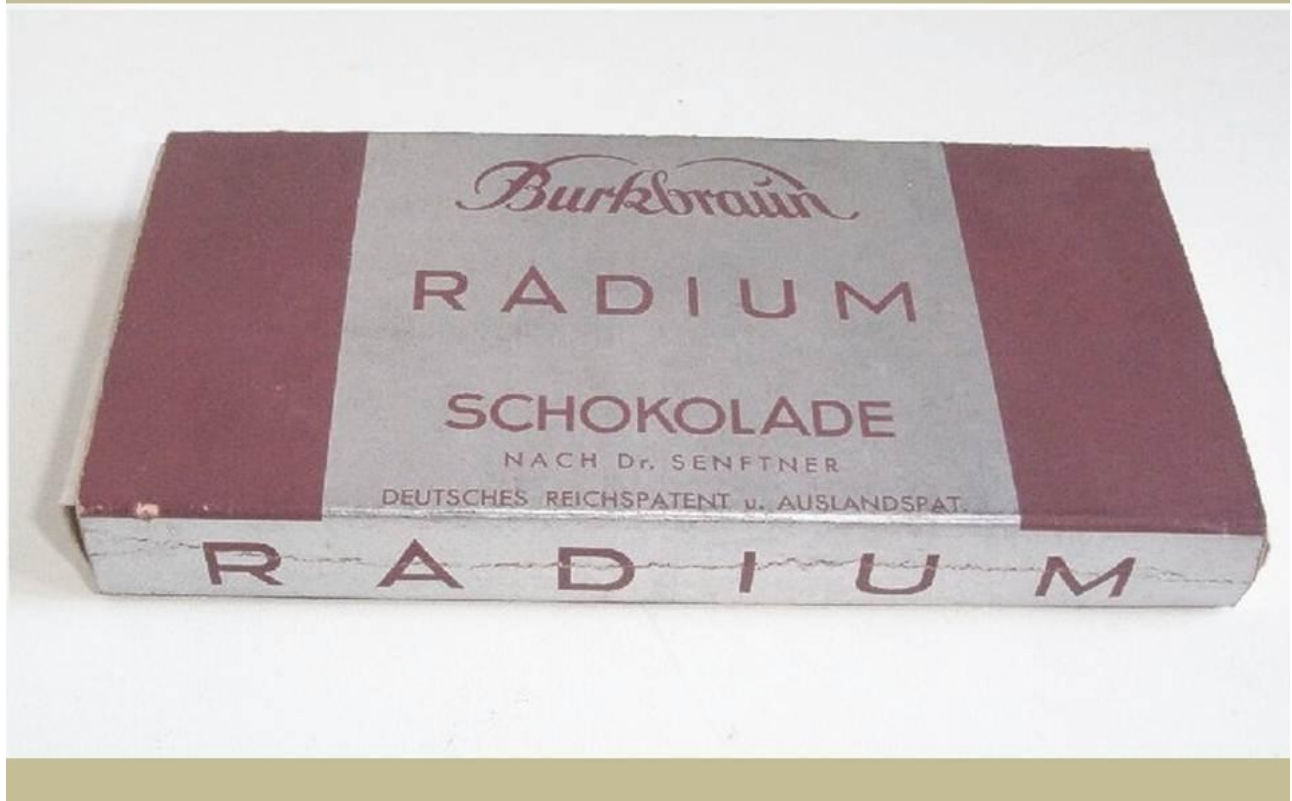
THE COLORADO RADIUM PRODUCTS COMPANY
635 First National Bank Building Denver, Colo

The apparent beneficial effect of radium spa waters, as advocated by one of Britain's top scientists of the time, demonstrates the very blurred lines between true experimental medicine and what can be seen as opportunism or quackery. But a huge range of curious and spurious products were made and sold throughout Europe and the United States, where radium was the miracle element and cure for all ailments...

Radium cosmetics



Radium chocolate



Radium crazed...



Boxes of luminous clock hands



Radium's luminous properties were also quickly exploited for a host of gimmicky domestic products, but most importantly for clock and instrument dials. By 1920 more than 4,000,000 watches and clocks had been produced using radioluminescent paint.

Radium Girls



In the States there were up to 4,000 women in factories doing this work. Similar factories existed in Britain too, on the outskirts of London.

However, during the 1920s the serious health hazards associated with radium were becoming clear.

Radium induced cancer of the jaw



The story of the illness and deaths of 'Radium Girls' who 'tipped' their brushes with their mouths whilst painting radium onto instrument dials and clocks had huge coverage and caused global outrage. The bonanza days were drawing to a close.

Today radium is practically worthless, having been superseded for use in radiotherapy by artificial radioisotopes created in nuclear reactors, especially by cobalt-60, which costs about one US dollar for the radiation equivalent of one gram of radium.

Between 1898 and 1938 it is estimated that less than 1.5kg of radium was extracted globally. Nowadays, about 10kg of radium is recovered as an unwanted and hazardous by-product from the worldwide production of 30,000 tons of uranium each year.

Thus ran the rise and fall of radium, and the extraction of pitchblende in Cornwall followed it, with the last concerted effort to mine uranium at South Terras coming to an end in 1930.



That's not quite the end though. There is even now a miniscule form of extraction going on, frowned upon by the National Trust who oversee these old mine sites.

Uranium-containing rock, uranium ore, Geiger counter check... <http://www.ebay.co.uk/itm/Uranium-containing-rock-uranium...>

ebay.co.uk Hello, Hadrian (hopigob). Sign out

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Uranium-containing rock, uranium ore, Geiger counter check source

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Starting bid: **£15.00** [0 bids]
Enter £15.00 or more **Place bid**
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1 of 1 **Description** **Postage and payments** 1 of 1

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Seller assumes all responsibility for this listing. Item number: 190667358864

Item specifics
Condition: **New**. A brand-new, unused, unopened and undamaged item.

I found this on ebay – someone selling low-level radioactive rock samples from the Wheal Owles spoil tip, feeding a sort of Geiger counter culture that exists out there, so that instrument collectors can test their equipment. This 60g sample sold for £23, which works out at £383,000 per metric ton! Not a bad price for low grade ore. I see a new radium rush coming on....

END