

Newsletter 114 - January 2023 (1)



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Future Talks

Meetings are held in Hillingdon Baptist Church on the 1st and 3rd Wednesday of the month at 10:00. The link for hybrid meetings will be sent out to everybody before the meeting.

Date	Title	Speaker
4/1/2023	Journey to the Centre of the Earth on Zoom	Sheppy Shepherd
18/1/2023	Cutty Sark. Not on Zoom	Carol Mitchell
1/2/2023	Film 'Gravity & Me' by Jim Al Khalili Not on Zoom	Len Fenton
15/2/2023	Medical Physics. Not on Zoom	Judith Sinclair

If anybody wants to join the Geology meetings they are on the 4th Tuesday of the month at 10:00. These are Hybrid meetings. If you are not on the mailing list let Judy Peddie know so that she can send a link

Next one is on the Tuesday 24th January.

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Rare Earth, lots of Euros and a trip to the Dentist...

When I started the question whether a discovery of an otherwise unknown Nickel Iron crystal in a meteorite, could be the route to 'Super Magnets' without Rare Earth strategically vulnerable elements; its was from a fascination with 'Rare Earth' history and their properties in general.

If you recall, I started with Neodymium (60) and Samarium (62); two of the 15 chemically similar Lanthanum series (57-71) of elements of the 'Period Table of Elements'. Their crucial uses being for Neodymium / Iron / Boron, or Samarium / Cobalt super strong magnets. The latter being usable at much higher operating temperatures, needed for military / industrial uses.

Before his untimely death in 1906, under the wheels of a dray in Paris; Pierre Curie was researching the deformation of crystals by electric and magnetic fields. He showed that strongly magnetic (ferro-magnetic) materials lose this ability at a specific temperature, becoming weak para-magnetics; (Curie Point C_i). (*The same is true of the Piezo-electric effect of crystals to change length in an electric field which also disappears at a high temperature*). It turns out that all 'Rare Earths' are ferromagnetic but only at very low temperatures, of no interest to engineers until alloyed; with one exception Holmium (67). Holmium is weird, it is not apparently magnetic until in a strong field when it has the highest magnetic flux saturation value, twice that of pure Iron; which makes it very useful for 'pole pieces', to shape very strong fields within machines.

Enter Praseodymium (59), which when added to the previous 'Super-Magnets' raises their operating temperature limit (C_i) and their energy retention ability. Praseodymium (*which comes from the Greek for 'leek green'*) has oxides used to enamel pottery yellow & green but its chief use is increasing the strength of light-weight Magnesium Alloys for aero-engines. It also makes glass for lasers which produce a strong green light.

Easier to say is Dysprosium (66), whose claims to fame are an exceptional ability to absorb neutrons, hence use for control rods in small nuclear reactors and also the largest known piezo-magnetic effect. Piezo-magnetic effect meaning alloys of Dysprosium change length significantly when magnetised which is a very useful property when making high energy sound beams, for Sonar and ultrasonic welding / machining. The best known alloy is Terfinol-D which was developed by the US bureau of Ordnance. The 'Ter' in the name is for Terbium (Tb 65) which is also a piezo-magnetic 'Earth' Element which further enhances the Dysprosium properties, the '-D' in the name. (*The nearest but much inferior piezo-magnetic common material is Nickel*).

What of Lanthanum (57) itself, the first of the series; whose first use was as a source of white light in early Walsbach Gas mantles and lighter 'flint' for the spark to ignite the gas. However, it has reached its greatest use in the anode electrode alloy of Nickel-metal Hydride (NiMH) batteries; particularly in Toyota Prius cars. Next in series is Cerium (58), the least rare of the Lanthanides and apart for a time as 'flints', is now the major hardening alloying addition to high performance Aluminium alloys, for aircraft airframes. Do you get the feeling that 'Rare Earths' now feature strongly in national defence /aero-space!

How about a wallet full of Thulium (69) or a jaw-full for that matter? Thulium is one of the rarest 'Rare Earths', which has sulphide compounds which fluoresce a bright blue under ultra violet light. Hence its use as a security impregnation in all Euro Bank Notes. Despite the high cost and lack of radio-activity, Thulium irradiated with neutrons in nuclear pile specifically designed for medical purposes; becomes a strong emitter of X-rays. A small rod-like sample within a hand-size shuttered block of Lead (Pb), becomes a compact dental X-ray source; at your jaw!

There is also Europium (63) which is again extremely rare, with compounds which fluoresce like Thulium but this time a strong pure red; used for colour system cathode ray tubes and now LEDs.

Gadolinium (64) though having a high melting point over 1300°C, is the only 'Earth' to be ferro-magnetic at 'normal' temperatures but still low with a Curie point 20°C; (very odd). It has medical uses after neutron irradiation as a 'trace element' in various medical 'scanners' but the main use is as neutron absorbing 'poison' for the emergency shut-down of nuclear reactors.

As Tom Lehrer might say "isn't that interesting?"

U3A S&T John Howard

Websites for You to Check

Hunga-Tonga Hunga-Ha'apai eruption <https://www.bbc.co.uk/news/science-environment-63953531>

<https://www.msn.com/en-gb/news/uknews/wind-turbines-have-an-image-problem-but-silent-bladeless-designs-could-change-all-that/vi-AA14Pftr?ocid=msedgdhp&pc=U531&cvid=ff2fc7051d0d4900b98ad7343de1fc7d&category=foryou>

[Amazing moment neutron stars collide seen in world first video \(msn.com\)](#)

[Oxford nuclear fusion spin-out raising £400m after energy breakthrough \(msn.com\)](#)

[This bubble barrier stops Amsterdam's canal plastic from reaching the North Sea | World Economic Forum \(weforum.org\)](#) Also used in Holland's rivers.

[Jupiter, too! New James Webb photos show giant planet's rings, moons and more \(msn.com\)](#)

['Sand batteries' could be key breakthrough in storing solar and wind energy year-round \(msn.com\)](#)

Voyager Spacecraft <https://www.msn.com/en-gb/news/world/nasa-prepares-to-power-down-voyager-spacecraft-after-more-than-44-years/ar-AA14PzTQx?ocid=msedgdhp&pc=U531&cvid=bda87676a166405985392d83d2d0291d>

[Physicists just rewrote a foundational rule for nuclear fusion reactors that could unleash twice the power \(msn.com\)](#)

Computer powered by algae: [Scientists power computer with algae for six months \(msn.com\)](#)

The Sun <https://www.msn.com/en-gb/news/world/sun-seen-in-unprecedented-detail-thanks-to-brit-built-spacecraft/ar-AA14Pvtw?ocid=msedgdhp&pc=U531>

[Scientists astounded as 'new hidden world' discovered inside Earth's core \(msn.com\)](#)

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Lectures

Harrow and Hillingdon Geological Society

Meetings are currently on Zoom. If you would like to join, and are not an HHGS member, please let Hilary Place know so that you can be sent the link. Non members can have three free meetings. After that we would want you to become a member.

Second Wednesday of the month. Login at 19:45

Date	Title	Speaker
11/01/2023	"Jurassic Dolerites in the Theron Mountains, Antarctica	Dr David Brook
8/02/2023	Lecture to be held at Brunel ETC and on Zoom	Dr Tom Hoyle

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