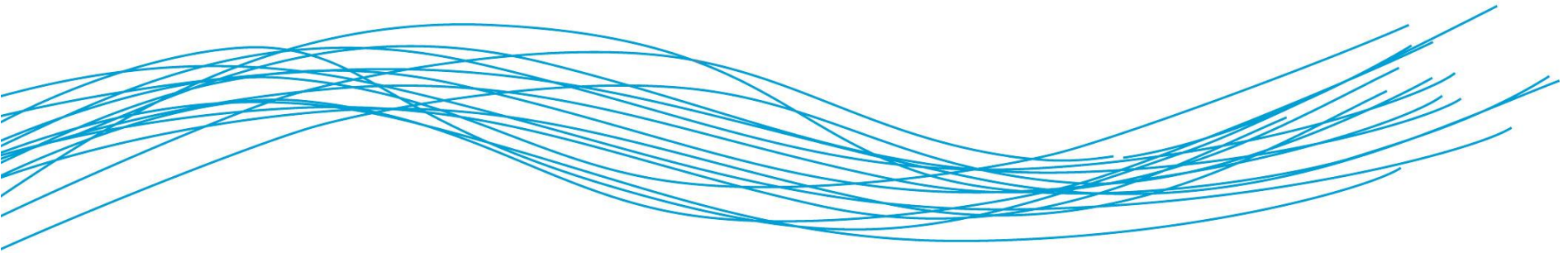




Where do new ideas come from?

Who knows?



John Wood
(Chair of ATTRACT PAC)

(Atomic Anarchist at Large)





Where did it all start?

Bachelor of Metallurgy- 1971 Sheffield University

Ph.D. 1974 Cambridge University

Doctor of Metallurgy 1994, Sheffield University

Subsequently

Fellow of Royal Academy of Engineering
1999

CBE for services to science 2008

Plus Hon Docs (Romania, Ghana, India)





European
Research Area
Board (ERAB)

Faculty of Metallurgy

4 departments



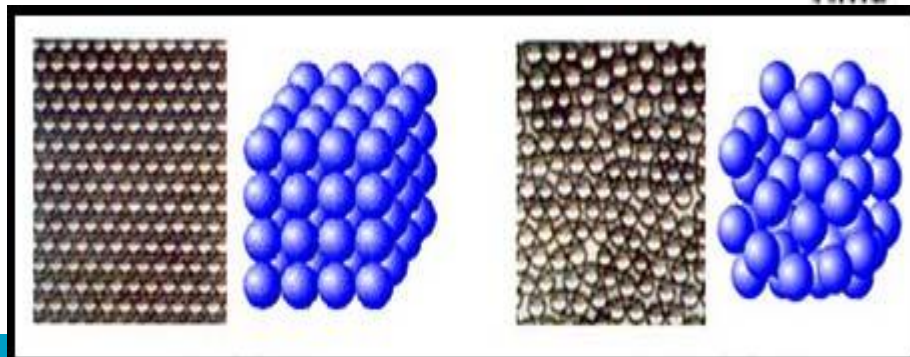
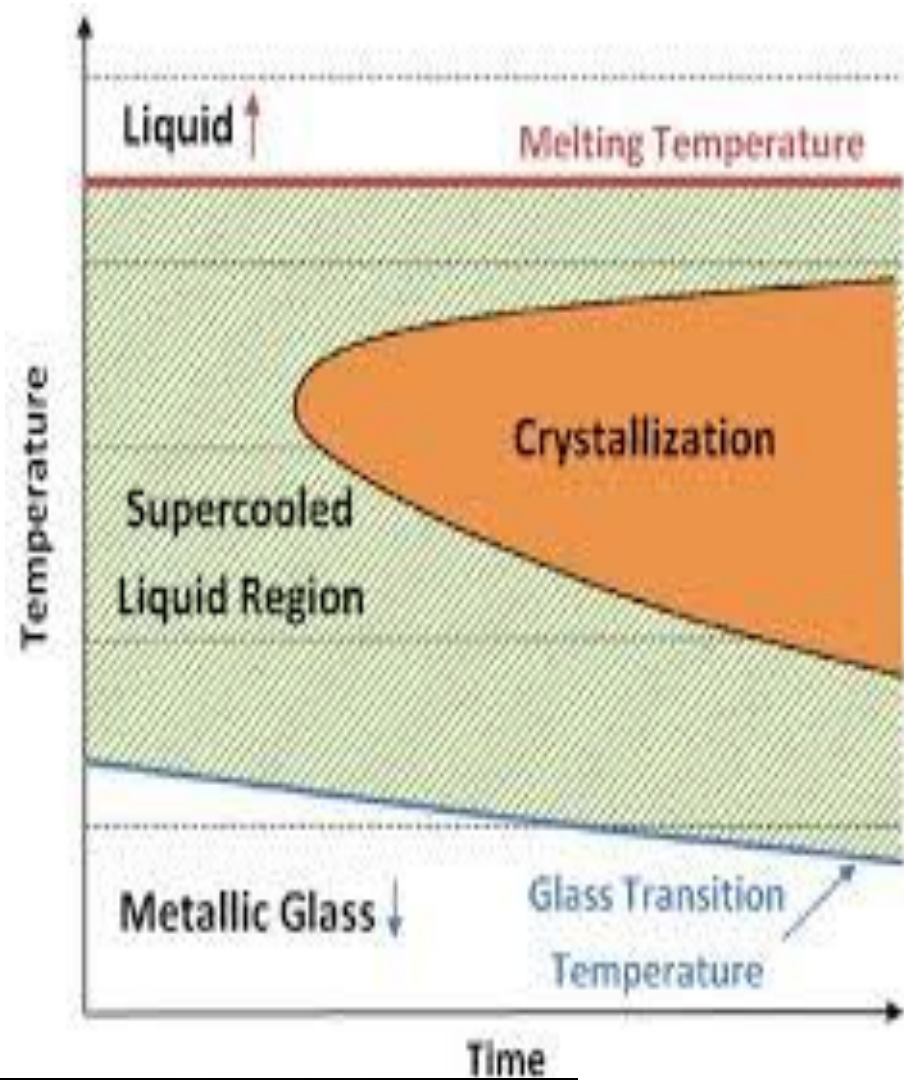


European
Research Area
Board (ERAB)

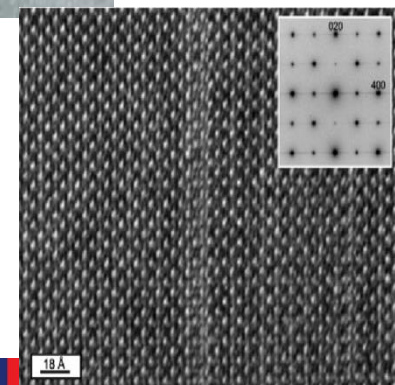
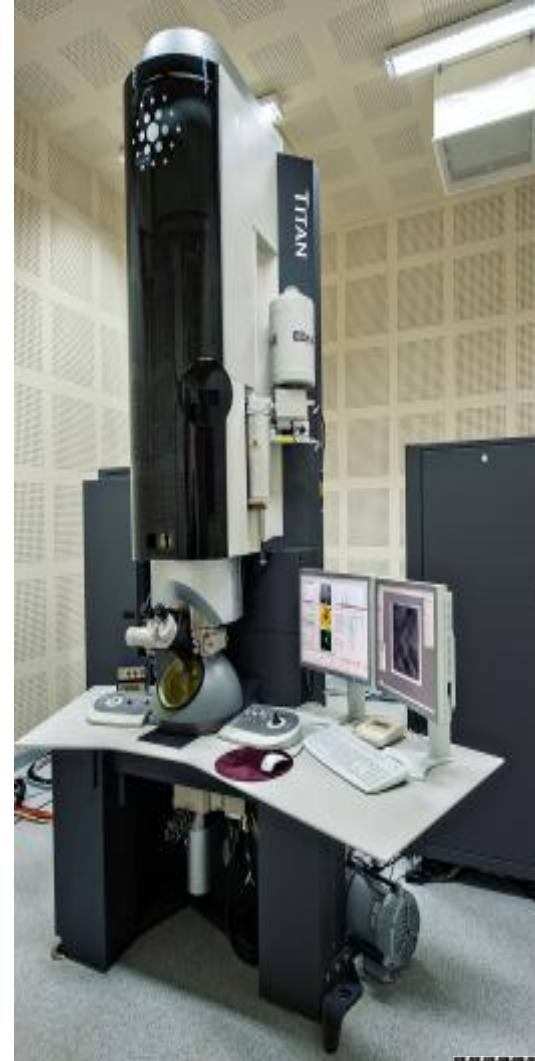
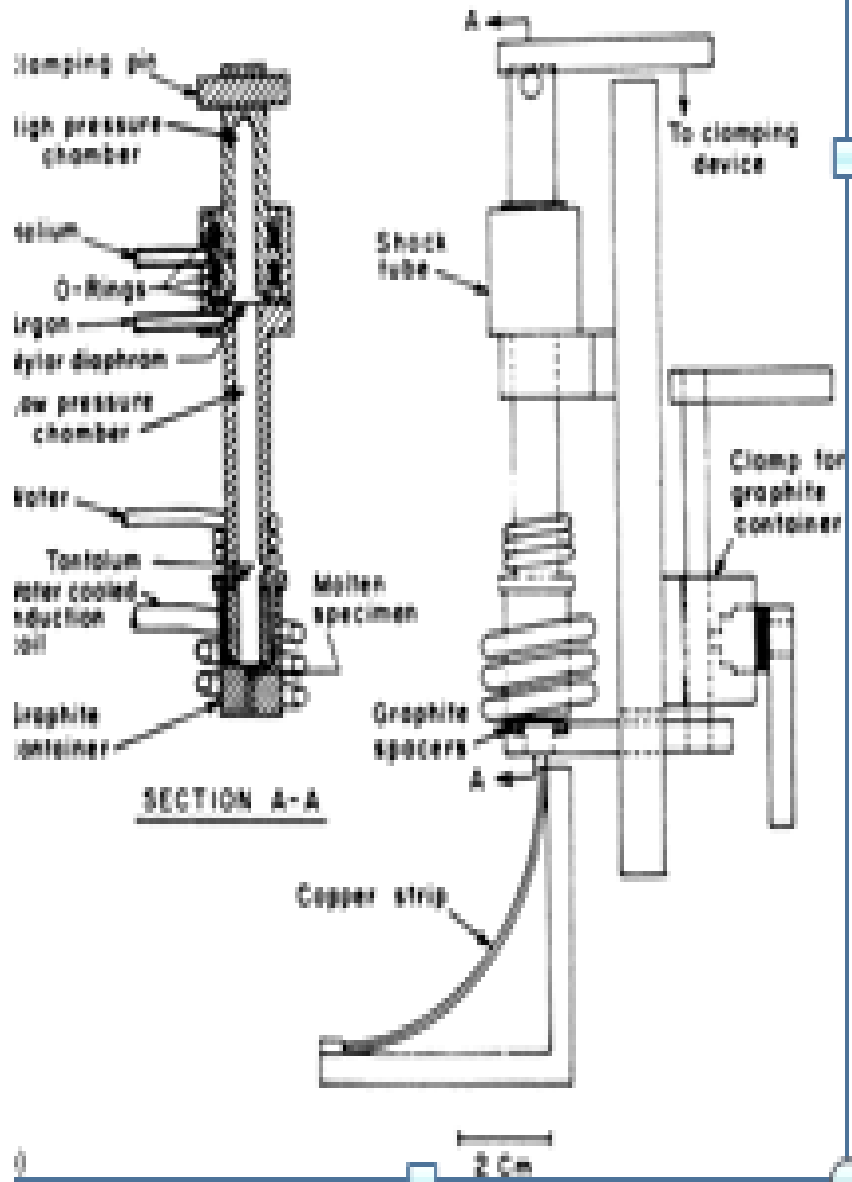
Department of Metallurgy and Materials Science, Cambridge



European Research Area



European Research Area



The structure of splat-cooled Fe-20% Cr-25% Ni austenitic steel

J. V. WOOD, R. W. K. HONEYCOMBE

Department of Metallurgy and Materials Science, University of Cambridge, Cambridge, UK

A controlled atmosphere splat quenching gun has been used to produce splats of Fe-20% Cr-25% Ni. Three types of structure were observed by thin foil electron microscopy, namely high-angle cellular, low-angle cellular, and linear arrays of dislocation loops, which were determined primarily by the heat transfer conditions. In the thin, most rapidly cooled areas (lift-off regions) high-angle cellular structures were observed which were largely free of defects. As the cooling rate decreases there was a greater tendency for low-angle cellular structures to form, but at intermediate cooling rates bands of dislocation loops were observed. These are explained in terms of solute segregation and vacancy coalescence along $\langle 100 \rangle_{\gamma}$ directions in the austenite.

1. Introduction

Despite the voluminous literature on splat cooling (see, for example, the recent bibliography of Jones and Suryanarayana [1]), there have been relatively few specific investigations into the solidification structure of rapidly cooled alloys. The present work describes the as-cast structure in a splat-quenched austenitic chromium nickel steel. This steel (Fe-20% Cr-25% Ni) was chosen because it does not undergo a solid state phase transformation during quenching, but provides a single phase fcc solid solution, which has received detailed structural studies after more conventional heat-treatments. Less highly alloyed austenitic steels (e.g. Fe-18% Cr-10% Ni) form, on splat quenching, metastable phases which complicate the study of the as-quenched state, so these compositions are best left for future studies.

2. Experimental techniques

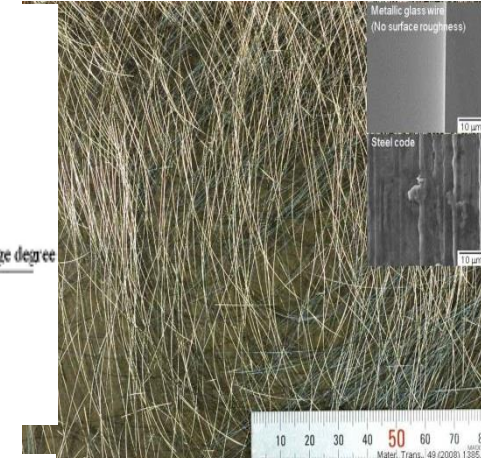
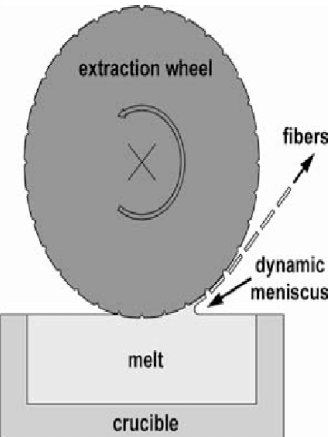
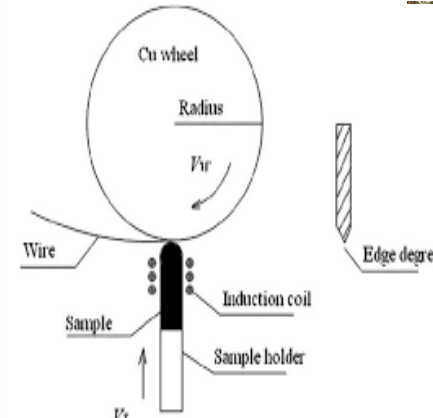
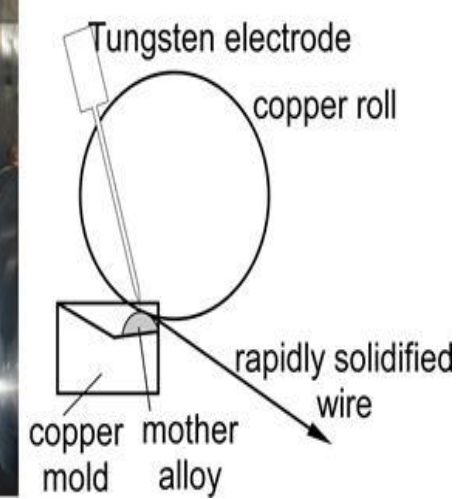
The "gun technique" of Duwez and Willens [2] affords the highest cooling rate in quenching from the liquid state. Iron-base alloys are difficult to splat for three reasons: (i) high melting points; (ii) oxidation of metal spray; (iii) possible metal-crucible reactions. These points were realized by Ruhl and Cohen [3] who consequently used a controlled atmosphere gun.

In the present work, a modified controlled atmosphere gun was developed [4] which allows

alloys with melting points up to 1700°C to be splat cooled. Heat energy was supplied by means of an r.f. source, melting a sample of about 0.2 g. This was held in an alumina crucible with an orifice diameter of 0.4 mm. The plastic (melinex) diaphragm ruptured between 3.0 to 4.0 MN m⁻² depending on the film thickness. Variation of the rupture pressure did not affect the resulting microstructures. The molten droplet was ejected onto a curved copper substrate roughened by 400 grade emery paper in two directions. The substrate was placed 10 cm from the orifice and was water cooled throughout each experiment.

Two argon arc melts of 20% Cr-25% Ni steel were made, differing only in the amount of dissolved oxygen in the iron, to check the effect of dissolved gases on the structure of the splat. The first alloy contained 400 ppm dissolved oxygen, the second < 20 ppm dissolved oxygen. After melting, the alloys were homogenized, hot-rolled and swaged to 2.5 mm diameter rod. Residual oxide was removed from the surface by electro-polishing. Samples were cut from this rod for insertion in the quenching apparatus.

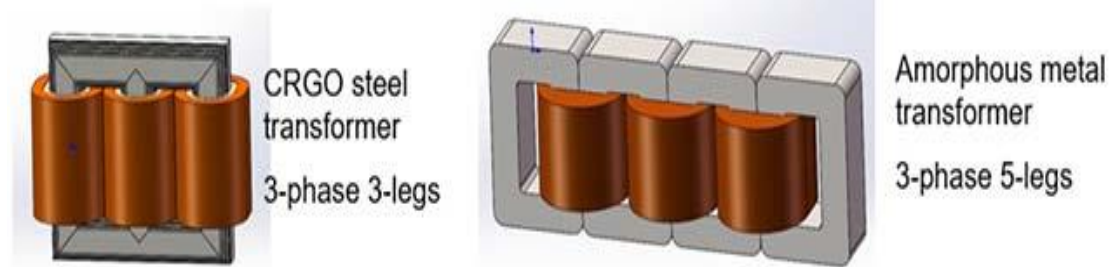
After the chamber enclosing the gun had been pumped down to a vacuum of 10⁻⁵ Torr, partial pressure of 550 Torr high purity argon was introduced. The alumina crucible was enveloped by a block of high purity graphite which acted as a getterer to remove any residual traces of oxygen in the closed system. The sma





非晶合金变压器科技

Amorphous Metal Transformer Technology



Comparing with traditional silicon steel based transformer, AMT reduces core loss by about 70%.



Labour Unions in the US said the larger size needed two operatives and therefore economically not feasible despite huge energy savings, **China and India now exploiting this Technology** 30 years after initial development when patents have ceased.





Harry Brearly

Did not believe in schools or colleges

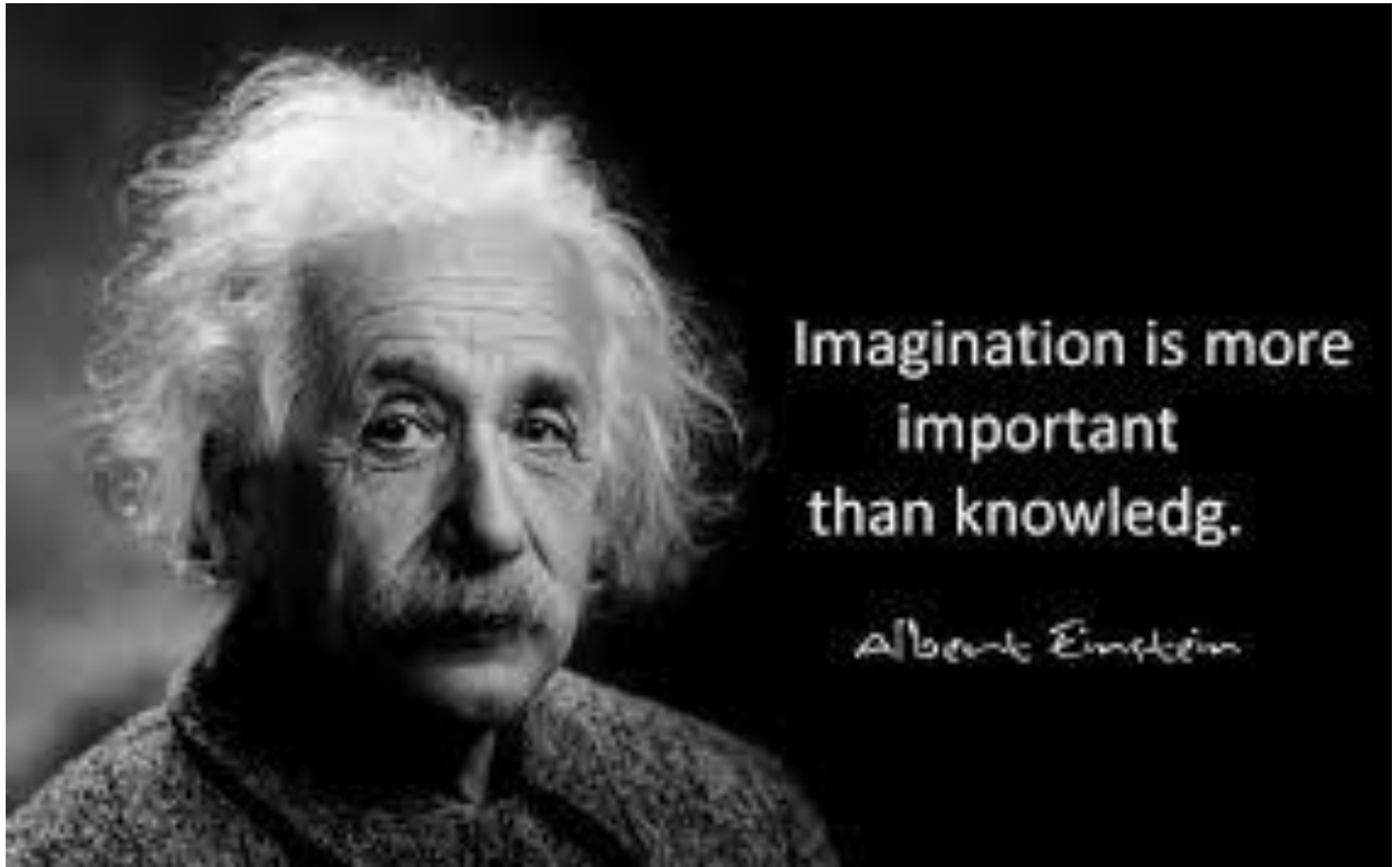


Discovered stainless steel in 1913

“You learn more by travel than sitting in a class room

- Ruostumaton teräs
- Acero inoxidable
- Acciaio inossidabile







Some quotes to help focus



“STRANGE TIMES ARE THESE IN WHICH WE LIVE WHEN OLD AND YOUNG ARE TAUGHT FALSEHOODS IN SCHOOL. AND THE PERSON THAT DARES TO TELL THE TRUTH IS CALLED AT ONCE A LUNATIC AND FOOL.”

~ PLATO (427 BC)

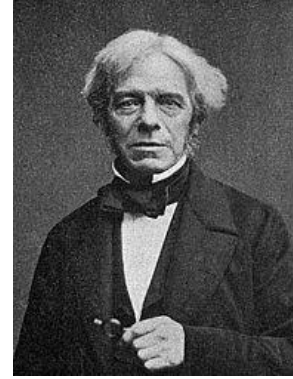


“All things change. Yet nothing is extinguished . . . there is nothing in the whole world that is permanent. Everything flows onwards and all things are brought into being with a changing nature. The ages themselves glide by in constant movement, for still waters will never reach the sea.”

Ovid



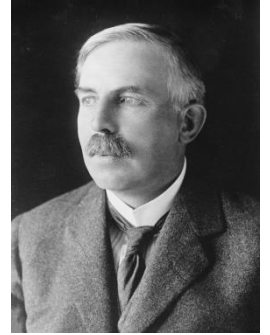
Michael Faraday



- Nothing is too wonderful to be true if it be consistent with the laws of nature
- It is the great beauty of our science, chemistry, that advancement in it, whether in a degree great or small, instead of exhausting the subjects of research, opens the doors to further and more abundant knowledge, overflowing with beauty and utility.
- I have far more confidence in the one man who works mentally and bodily at a matter than in the six who merely talk about it
- I am no poet, but if you think for yourselves, as I proceed, the facts will form a poem in your minds
- Why, sir, there is every probability that you will soon be able to tax it!"



Ernst Rutherford



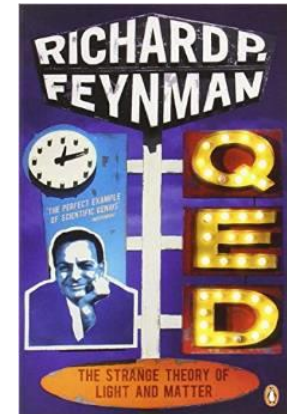
- We've got no **money** so we've got to think.
- All science is either physics or stamp collecting.
- An alleged scientific discovery has no merit unless it can be explained to a barmaid.
- Don't let me catch anyone talking about the Universe in my department.



Richard Feynman Quotes

- “I think it's much more interesting to live not knowing than to have answers which might be wrong.”
- **“If you thought that science was certain - well, that is just an error on your part.”**

From the **“Strange theory of light and matter lectures:”**



“...if you think I am going to explain it to you so you can understand it. **No**, you’re not going to be able to understand it. Why, then, am I going to bother you with all this? Why are you going to sit here all this time, when you won’t be able to understand what I am going to say? It is my task to convince you not to turn away because you don’t understand it. You see my physics students don’t understand it either. That is because I don’t understand it. Nobody does.





Fertile Ground

- Wisdom and Silence
- Tension
- Remembrance
- Poverty and Passion
- Observe
- Abandonment and dissension
- Time
- Risk
- Creative Space
- Beauty
- Analysis
- Planning





Tension and dissonance

- "It seems likely that there is another way of dealing with incompatibles and opposites within the mind, provided one is sufficiently robust to stand the tension.; and this is the way adopted by creative people. One characteristic of creative people is **just this ability to tolerate dissonance**. They see problems that others do not see;; and do not attempt to deny their existence. Ultimately the problem may be solved, and a new whole made out of what was previously incompatible, **but it is the creative person's tolerance of discomfort of dissonance that makes new solutions possible.**" (From "White Mars" by Brian Aldiss and Roger Penrose).



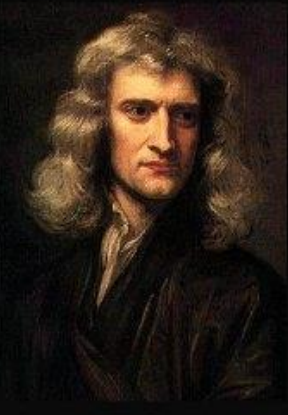
Wisdom - silence

- "Go and tell this people: "Be ever hearing, but never understanding; be ever seeing, but never perceiving.' (Isaiah)
- “Where shall the word be found, where will the word Resound? Not here, there is not enough silence
Not on the sea or on the islands, not
On the mainland, in the desert or the rain land,
For those who walk in darkness
Both in the day time and in the night time
The right time and the right place are not here
No place of grace for those who avoid the face
No time to rejoice for those who walk among noise and deny the voice” (T.S.Eliot, Ash Wednesday)




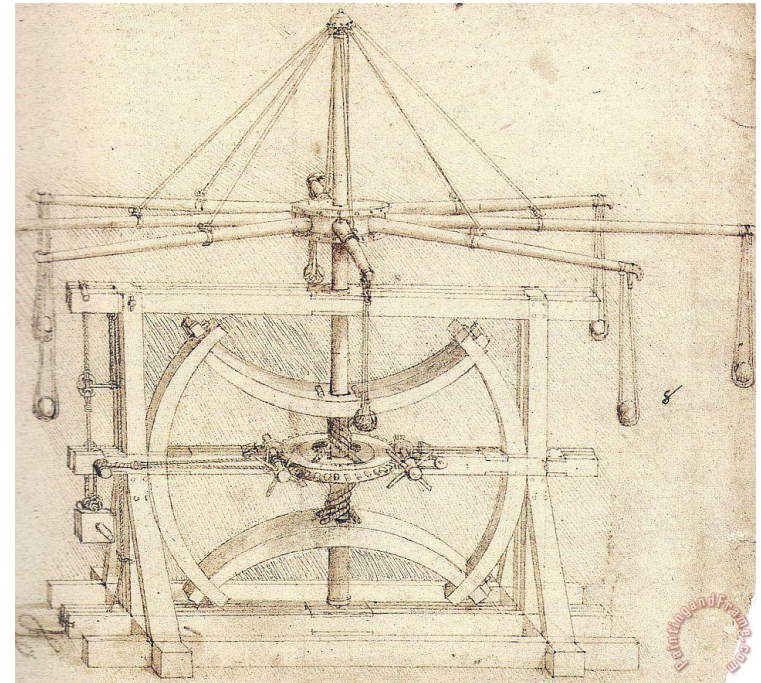


Remembrance and the role of history



If I have seen further than others, it is by standing upon the shoulders of giants.

(Isaac Newton)



Those that fail to learn from history are doomed to repeat it.

- Winston Churchill

Old Weather

Help scientists recover Arctic and worldwide weather observations recorded in ship's logs since the mid-19th century.

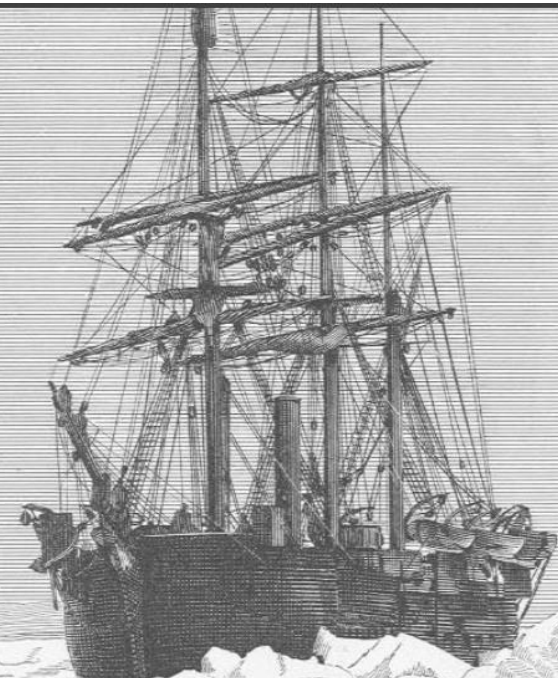
Choose a project and get started:

Old Weather: Whaling

Explore the Arctic of the past from the deck of a whaling ship

Old Weather: Arctic

Rediscover the historic Arctic voyages of the U.S. Navy and Coast Guard



Why Scientists Need You

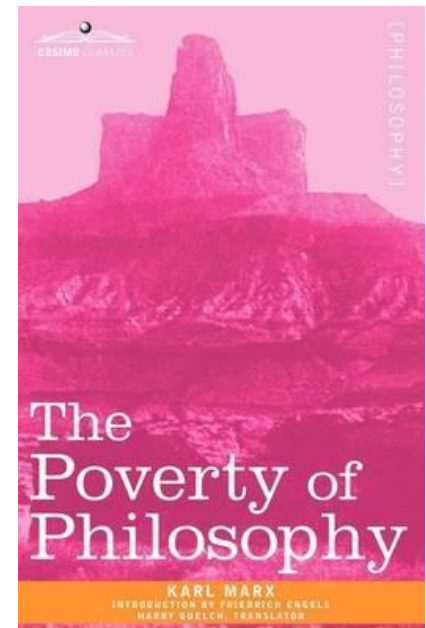
In this video scientists explain why your contributions are vital, and what they're doing with your results behind the scenes.



European Research Area

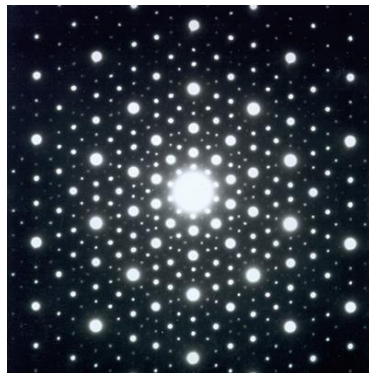
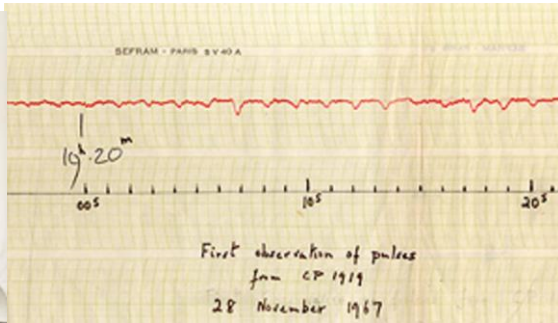
Poverty and Passion

- We've got no **money** so we've got to think
- “Do you believe in what you are doing?”



Observe

- What do you see?
- Radio has the best pictures and blind people are good seers!
- The use of senses and sensors





Abandonment and Dissension



- Holding to views with a tenacity of belief
- Room for honest dissension among colleagues – can be violent
- Intellectual hate
- Avoid herd instinct despite funding priorities
- When to admit defeat (oxide on ss)



Time

- Westerners have watches, Africans have time
- “There is a time for everything and a season fo every activity under the sun.”
(Eccleisates)
- I know what it is if no one asks; but if anyone does, then I cannot explain it.”
(St. Augustine)
- “Time’s handiworks by time are haunted.”
(Edwin Muir)





- Chronos: Relentless monotony of the ticking clock
- ” Kaironic time introduces novelty into the banality of linear, chronic time. It is time as “creative advance,” (Whitehead)
- Aionic:unbounded, sacred or eternal time.





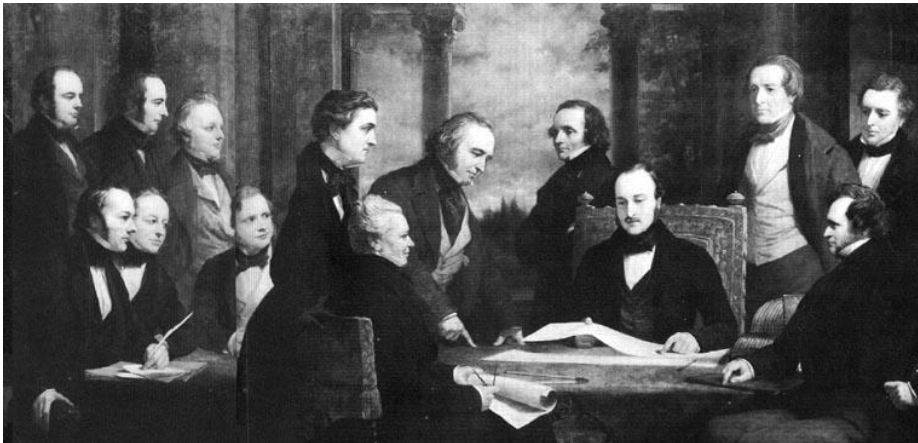
The need for disruptive time

“ A beat poised, a cross grained rhythm,
Interplays, imbrications of voice over voice,
mutinies of living are rocking the steady
state of a theme; these riffs and overlappings
a love of deviance, our genesis in noise.”
(O’Siadhail).



Risk

- Most public and private funders and universities are risk adverse
- Foundations can take risks – The Royal Commission for the Exhibition of 1851
 - “The fellowship has allowed me to engage in risky research that I probably would not have dared go into if I hadn’t had the position that this grant enabled me to get.”
- **ATTRACT!**



Fiction

- “It is precisely the daring work of fiction to probe beyond settled truth and to walk on the edge of alternatives not yet available to us. It is this probe behind our settlements that makes newness possible.” (Brueggemann)





Creative Space

- Look around you!
- Common rooms
- Coffee bars
- Hackathons
- Sandpits
- No straight corridors
- Challenges beyond the individual



Beauty

We especially need imagination
in science. It is not all
mathematics, nor all logic, but it
is somewhat beauty and poetry.

Maria Montessori

 quote fancy



Analysis and Planning

- This is what governments, research funders and industry do
- Supply chain analysis looking for “white spaces”
- Challenge and market need (clean up micro-plastics etc, clean energy for all, water).
- Impact of new standards and regulations (exhaust emissions)
- Financial and tax impacts



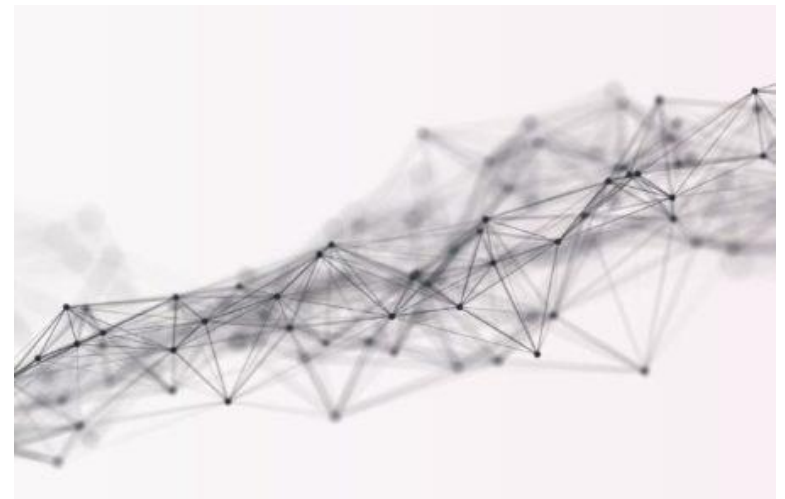


Foresighting and Scenario Planning

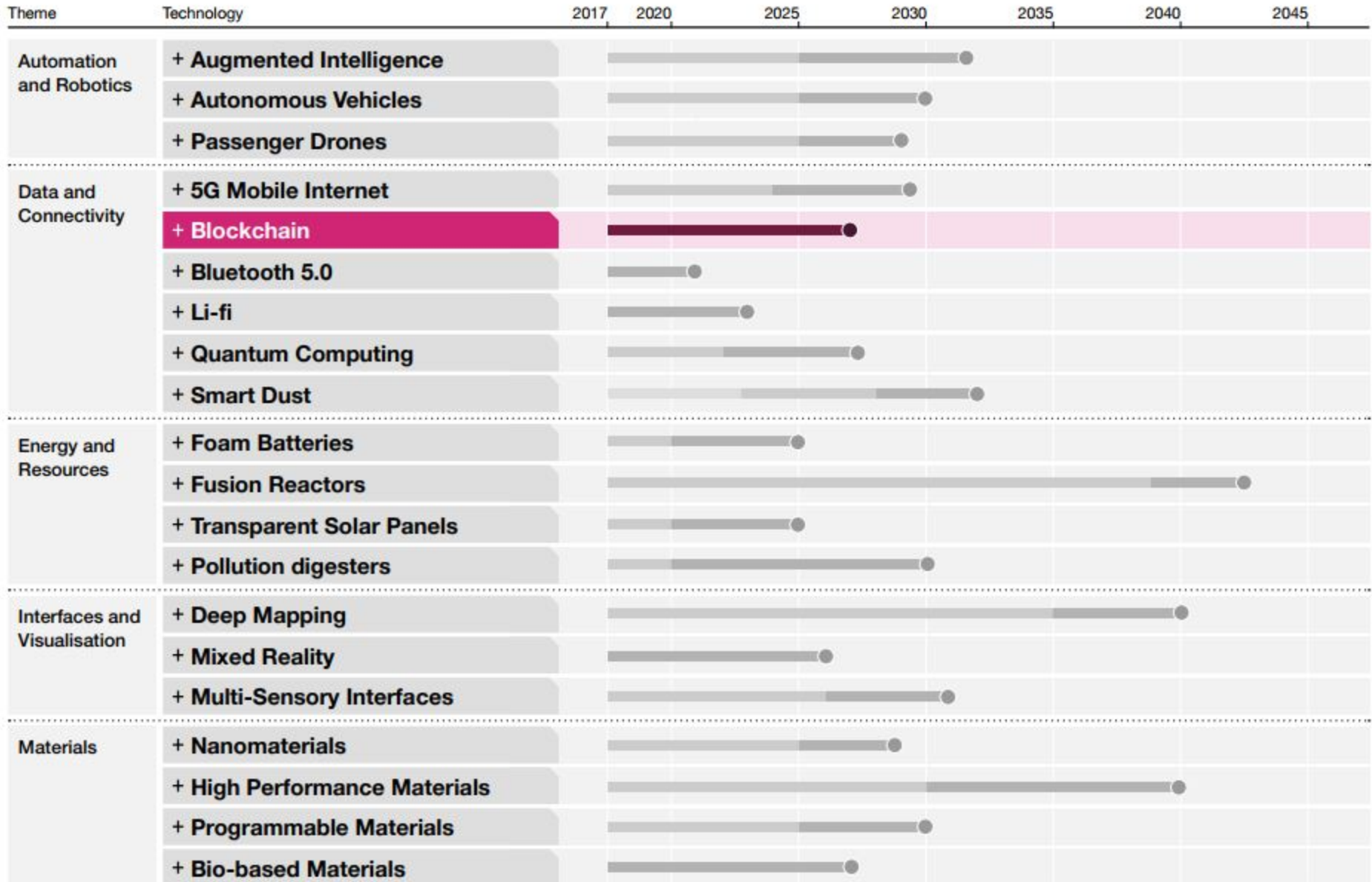
- Impact of AI, remote surgery, data mining, gene engineering, climate change etc.

Arup Technology Timeline 2017

- Interactive pdf which showcases 20 emerging and future technologies with a high disruption potential for the AEC industry.



Technology Readiness Level



Some personal observations from technology to innovation

- Expect the unexpected
- Look to the past
- The science is the easy part
- Look to function rather than hold onto a process
- Remember social issues
- Regulations, standards, finance and laws are drivers
- Look at the whole picture (holistic view)
- Check the downsides
- Believe in what you are doing
- Take risks and stay young in your thinking





Final thought – is anything really new?

Time present and time past

Are both perhaps present in time future,

And time future contained in time past.

If all time is eternally present

All time is unredeemable.

What might have been is an abstraction

Remaining a perpetual possibility

Only in a world of speculation.

What might have been and what has been

Point to one end, which is always present.

(Burnt Norton – T.S.Eliot)

