Some interesting pieces I read in March 2014

Here are some interesting pieces I've read recently (up to 1-31 March 2014). I've categorised them roughly according to the framework in my essay: '*Some thoughts on education and political priorities*' (version 2.0 here, October 2013)

My two favourites were these two essays.

1. A great essay by Michael Nielsen, author of the standard textbook on quantum computers, on applying new techniques to teach advanced concepts to non-specialists. This is the sort of thing that could make a huge impact on school-level education.

'In fact, what I'd really like to do is work together with a great designer and a great programmer, to explain a subject such as quantum mechanics or quantum computing or quantum field theory. I think you could do something truly special. And what I'd really, *really* like to do is to work on explaining all of physics or all of science in this way. Ideally, you'd have the best designers in the world, and the best explainers in the world, together in a room as equal creative partners, figuring out what is possible.'
http://michaelnielsen.org/reinventing_explanation/index.html

2. A great essay by Nobel-winning physicist Frank Wilcsek on the future of technology.

'[T]uning up production of bigger and better brains may be simple… More generally, better understanding of the molecular mechanisms behind development and learning gives new hope for improving mental vitality, just as understanding molecular genetics and physiology does for physical vitality… The fundamental design of human brains, based on ionic conduction and chemical signaling, is hopelessly slower and less compact than modern semiconductor microelectronics. Its competitive advantages, based on three-dimensionality, self-assembly, and fault tolerance, will fade as we learn how to incorporate those ideas into engineering practice. Within a century, the most capable information processors will not be human brains, but something quite different…

'Simple considerations strongly suggest that technological civilizations whose works are readily visible through-out our Galaxy (that is, given current or imminent observation technology) ought to be common. If they were, I'd base my speculations about future directions of evolution on case studies! But they aren't. Like Sherlock Holmes's dog that did not bark in the nighttime, the absence of such advanced technological civilizations speaks through silence… Whether we're barely visible to sophisticated though distant observers today, or not quite, after another hundred years of technological expansion we'll be easily visible…

'Indeed, many such planets, orbiting older stars, came out of the starting gate billions of years before we did. Among the millions of experiments in evolution in our Galaxy, we should expect that many achieved breakout much earlier, and thus became visible long ago. So, where are they?…'
http://frankwilczek.com/Wilczek_Easy_Pieces/405_Archaeopteryx_Looks_Up.pdf

1. Maths and complexity.

The success of crowdsourcing projects in maths. E.g. PolyMath8 has reduced the upper bound of the twin prime conjecture from 70 million to hundreds.
http://www.nature.com/news/crowd-sourcing-strength-in-numbers-1.14757

Progress on one problem prompts some thought on P=NP?
http://rjlipton.wordpress.com/2014/02/28/practically-pnp/

Riemann Hypothesis explained in short video.
https://www.youtube.com/watch?v=d6c6ulyieoo

A pioneer of chaos theory bags the Abel Prize.
http://www.nature.com/news/chaos-theory-pioneer-nabs-abel-prize-1.14935?WT.mc_id=TWT_NatureNews

Why didn't Newton use calculus (which he'd discovered) in *Principia*?
https://www.youtube.com/watch?v=XVRlQNVCF5s

Newton's notebook from 1664-5.
http://cudl.lib.cam.ac.uk/view/MS-ADD-04000/27

2. Energy and space.

USAF's secret space plane project (DARPA's old space plane project).
http://www.space.com/25275-x37b-space-plane.html

XS-1 (DARPA's new space plane project).
http://www.space.com/25204-military-space-plane-xs1-budget.html

3. Physics and computation

Discovery of gravitational waves, predicted by Einstein, in the Cosmic Microwave Background (CMB) radiation. 'If confirmed, it would be one of the absolute greatest discoveries in cosmology' (Wilcsek).
http://www.scientificamerican.com/article/gravity-waves-cmb-b-mode-polarization/
https://www.simonsfoundation.org/quanta/20140317-possible-echo-of-big-bang-detected/
A short video of Andrei Linde being told about the discovery.
http://www.theatlantic.com/technology/archive/2014/03/what-its-like-to-be-right-about-the-big-bang-genesis-of-a-viral-video/284474/

New ideas about quantum gravity
https://www.simonsfoundation.org/quanta/20140314-betting-on-the-future-of-quantum-gravity/

Very interesting review of the new movie *Particle Fever* about the search for the Higgs boson.
http://www.scottaaronson.com/blog/?p=1767

In 2012, a large solar storm just missed taking out trillions of dollars of infrastructure - 9 days made the difference between nobody noticing and everybody noticing.
http://www.theregister.co.uk/2014/03/19/nasa_scopes_show_how_earth_missed_devastating_solar_storm_by_nine_days_in_2012/

Quantum encryption.
http://www.wired.com/wiredenterprise/2014/03/quantum-crypto-google/

Eric Weinstein's Edge answer - we should retire String Theory
http://edge.org/response-detail/25547

3D printers used in hospitals to save money and speed up repairs.
http://www.makerbot.com/blog/2014/03/19/makerbot-stories-hospital-cable-guy-saves-money-lives/

Gershenfeld on 'internet of things'.
'Buildings account for three-quarters of all electricity use in the United States, and of that, about one-third is wasted… This enormous amount of waste persists because the behavior of thermostats and light bulbs are set when buildings are constructed; the wiring is fixed and the controllers are inaccessible. Only when the infrastructure itself becomes intelligent, with networked sensors and actuators, can the efficiency of a building be improved over the course of its lifetime…

'Health care is another area of huge promise. The mismanagement of medication, for example, costs the health-care system billions of dollars per year. Shelves and pill bottles connected to the Internet can alert a forgetful patient when to take a pill, a pharmacist to make a refill, and a doctor when a dose is missed. Floors can call for help if a senior citizen has fallen, helping the elderly live independently. Wearable sensors could monitor one's activity throughout the day and serve as personal coaches, improving health and saving costs…

'A refrigerator could communicate with a grocery store to reorder food, with a bathroom scale to monitor a diet, with a power utility to lower electricity consumption during peak demand, and with its manufacturer when maintenance is needed. Switches and lights in a house could adapt to how spaces are used and to the time of day. Thermostats with access to calendars, beds, and cars could plan heating and cooling based on the location of the house's occupants. Utilities today provide power and plumbing; these new services would provide safety, comfort, and convenience.

'In cities, the Internet of Things will collect a wealth of new data. Understanding the flow of vehicles, utilities, and people is essential to maximizing the productivity of each…

'Weather, agricultural inputs, and pollution levels all change with more local variation than can be captured by point measurements and remote sensing. But when the cost of an Internet connection falls far enough, these phenomena can all be measured precisely. Networking nature can help conserve animate, as well as inanimate, resources; an emerging "interspecies Internet" is linking elephants, dolphins, great apes, and other animals for the purposes of enrichment, research, and preservation.

'The ultimate realization of the Internet of Things will be to transmit actual things through the Internet. Users can already send descriptions of objects that can be made with personal digital fabrication tools, such as 3-D printers and laser cutters. As data turn into things and things into data, long manufacturing supply chains can be replaced by a process of shipping data over the Internet to local production facilities that would make objects on demand, where and when they were needed…

'The unsung hero that has made this possible is the microcontroller, which consists of a simple processor packaged with a small amount of memory and peripheral parts. Microcontrollers measure just millimeters across, cost just pennies to manufacture, and use just milliwatts of electricity, so that they can run for years on a battery or a small solar cell. Unlike a personal computer, which now boasts billions of bytes of memory, a microcontroller may contain only thousands of bytes. That's not enough to run today's desktop programs, but it matches the capabilities of the computers used to develop the Internet…

'Putting the power grid online raises obvious cybersecurity concerns, but centralized control would only magnify these problems. The history of the Internet has shown that security through obscurity doesn't work. Systems that have kept their inner workings a secret in the name of security have consistently proved more vulnerable than those that have allowed themselves to be

examined -- and challenged -- by outsiders. The open protocols and programs used to protect Internet communications are the result of ongoing development and testing by a large expert community. Another historical lesson is that people, not technology, are the most common weakness when it comes to security. No matter how secure a system is, someone who has access to it can always be corrupted, wittingly or otherwise. Centralized control introduces a point of vulnerability that is not present in a distributed system…

[The internet was established as a decentralised network. It used packet-switching. Internet Protocol (IP) allowed standardisation. The internet's functions reside at the edge of the network: the 'end-to-end principle' allows new applications to be invented and added without having to upgrade the whole network.]
http://www.foreignaffairs.com/articles/140745/neil-gershenfeld-and-jp-vasseur/as-objects-go-online

Interview with Nobel physicist Steve Weinberg.
http://infoproc.blogspot.co.uk/2014/03/weinberg-on-weinberg.html?utm_source=twitterfeed&utm_medium=twitter

3D printers used in hospitals to speed up and save money.
http://www.makerbot.com/blog/2014/03/19/makerbot-stories-hospital-cable-guy-saves-money-lives/

4. Biological engineering.

Cost of sequencing a human genome hits $1,000 - a million-fold reduction in a decade. The Pentagon is planning for the price to drop to $100.
http://www.synthesis.cc/cgi-bin/mt/mt-search.cgi?blog_id=1&tag=Carlson+Curves&limit=20

CIRSPR - the new tool for genome engineering which suddenly took off in 2013. It has already been used to create monkeys with new genes and to fix genes that cause diseases. It raises the prospect of engineering babies *in utero.* It was realised that bacteria have genes that give them an immune system against viruses. Bacteria copy DNA sequences from viruses into their own genomes - then if the bacteria encounter the sequence again, the CRISPR immune system slices it up. New viruses are partly copied and added to the whole. Scientists have discovered how to use this naturally occurring system to edit the human genome.
http://www.nytimes.com/2014/03/04/health/a-powerful-new-way-to-edit-dna.html?hpw&rref=health&_r=0&referrer=

Why the new technique 'Genome-wide Complex Trait Analysis (GCTA)' works.
http://infoproc.blogspot.co.uk/2014/03/why-does-gcta-work.html?utm_source=twitterfeed&utm_medium=twitter

Venter starts a new company to examine the genome to find ways to extend life.
http://mobile.nytimes.com/2014/03/05/business/in-pursuit-of-longevity-a-plan-to-harness-dna-sequencing.html?referrer=

An Open Source genetic engineering hacking project to create a new drug.
https://sciencehack.synbiota.com

Very interesting paper on epidemiology and randomness. Those who dislike twin studies applied to IQ should note their standard use in epidemiology.
http://ije.oxfordjournals.org/content/40/3/537.full.pdf+html

Pinker on the unlikelihood of genetic engineering any time soon.

'Most genes have multiple effects, and evolution selects those genes that achieve the best compromise between positive and negative impacts. Take the most famous case of genetic enhancement on record: the mice that were given extra copies of the NMDA receptor, which is critical to learning and memory. These poster mice did learn mazes more quickly-but they also turned out to be hypersensitive to pain. Closer to home, there is a gene in humans that may be correlated with a 10-point boost in IQ. But it is also associated with a 10-percent chance of developing torsion dystonia, which can confine the sufferer to a wheelchair with uncontrollable muscle spasms.'
http://pinker.wjh.harvard.edu/articles/media/2003_06_06_globe.htm

Why are athletes bigger, stronger, faster? TED talk by author of great book *The Sports Gene*.
http://blog.ted.com/2014/03/20/whats-making-athletes-faster-better-stronger-david-epstein-at-ted2014/

5. Mind and machine.

DARPA's latest robot Grand Challenge.
http://www.popularmechanics.com/technology/engineering/robots/behind-the-scenes-at-the-robot-olympics-16632390

Facebook buys Occulus (virtual reality platform) for $2 billion.
http://venturebeat.com/2014/03/25/facebook-is-buying-oculus-for-2b-to-get-ready-for-the-platform-of-tomorrow/

What happens when the 1% have drone swarms and don't fear the 99%?
http://qz.com/185945/drones-are-about-to-upheave-society-in-a-way-we-havent-seen-in-700-years/

Generally, attempts at training programmes to improve general fluid intelligence have failed: people improve on the narrow task taught but it does not raise general intelligence. IARPA (DARPA's intelligence world twin) has a programme to try new methods to change this.
http://www.digitaljournal.com/pr/1806709

First study 'to show the importance of auditory pathway genes in musical aptitude'.
http://www.nature.com/mp/journal/vaop/ncurrent/full/mp20148a.html

Companies look at SATs or IQ scores for a good reason - it works better than anything else.
'… decades of quantitative research in the field of personnel psychology have shown that across fields of employment, measurements of "general cognitive ability" — which is another way of referring to the old-fashioned concept of intelligence or IQ — are consistently the best tools employers have to predict which new employees will wind up with the highest performance evaluations or the best career paths.'
http://www.latimes.com/opinion/commentary/la-oe-chabris-google-intelligence-20140309,0,7897686.story?utm_content=bufferd8c64&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer#axzz2vV2AHMtf

New study on maths anxiety.
'Genetic factors accounted for roughly 40% of the variation in mathematical anxiety, with the remaining being accounted for by child-specific environmental factors… The development of mathematical anxiety may involve not only exposure to negative experiences with mathematics, but also likely involves genetic risks related to both anxiety and math cognition. These results suggest

that integrating cognitive and affective domains may be particularly important for mathematics and may extend to other areas of academic achievement.'
http://onlinelibrary.wiley.com/doi/10.1111/jcpp.12224/abstract;jsessionid=7760D2E24D522D1660C976890650AD46.f02t04

On the row over genes and IQ - for once a scientifically accurate piece.
http://www.crassh.cam.ac.uk/blog/post/educational-genetics-cultivating-the-playing-field

Computer 'Go' makes progress using Monte Carlo simulations.
http://www.newyorker.com/online/blogs/elements/2014/03/the-electronic-holy-war.html

6. The scientific method, education, training and decisions.

Stanford embraces an Odyssean education.
http://news.stanford.edu/news/2014/march/facsen-joint-majors-030614.html

Leading mathematician Ed Frankel writes on why we should introduce more advanced concepts, such as complex numbers, into the school curriculum. There is sadly very strong resistance to such ideas in England's education world.
http://www.latimes.com/opinion/commentary/la-oe-adv-frenkel-why-study-math-20140302,0,5177338.story#axzz2uq4Dq067

Leading physicist's new book to teach quantum mechanics.
http://www.amazon.com/Quantum-Mechanics-The-Theoretical-Minimum/dp/0465036678

Synbiobeta: online course in synthetic biology, suitable for school children (according to Chris Anderson)
http://synbiobeta.com/course/introduction-synthetic-biology-22-march-2014/

Rob Coe blog on classroom observation and evidence.
http://www.cem.org/blog/414/

Open source maths resources.
http://gowers.wordpress.com/2014/03/12/a-few-analysis-resources/

Freeman Dyson: The case for blunders.
http://www.nybooks.com/articles/archives/2014/mar/06/darwin-einstein-case-for-blunders/?pagination=false

When does the 'wisdom of crowds' work?
It falls apart when the individual estimates are *not independent*. 1. When people hear others' estimates there is 'social influence' and the diversity of estimates falls a lot. 2. If there is social influence, then the *range* of estimates narrows and it narrows on the wrong answer: i.e. the crowd not only gives a wrong answer but appears confident by showing a narrow range. 3. Social influence increases the confidence of those estimating without justification.
https://medium.com/p/266cbbf2e3aa

Big data: problems with Google Flu Trends.
http://www.smithsonianmag.com/science-nature/why-google-flu-trends-cant-track-flu-yet-180950076/?no-ist

Role of scientific advice in policy-making and government.

http://www.nature.com/news/policy-the-art-of-science-advice-to-government-1.14838?WT.ec_id=NATURE-20140313

7. Political economy.

Successes from 'econophysics'.
https://medium.com/the-physics-of-finance/dae83e0d7d8a

New implications of Dyson's discovery of 'zero determinant' strategies for iterated Prisoners' Dilemma: generosity is not doomed after all.
'Soon after the Press-Dyson report appeared, Christoph Adami and Arend Hintze of Michigan State University tested various zero-determinant strategies in an evolutionary simulation. The coercive strategies did well against certain opponents, but eventually they were displaced by other players, most notably Pavlov. The reason is that a "nasty" player can become a victim of its own success. The reward for winning in an evolutionary game is to become more common in the population, with the result that you encounter more members of your own species. Dictators and extortionists do not thrive in that environment. Thus Adami and Hintze concluded that zero-determinant strategies are unlikely to evolve in the wild…

'But this is not the end of the story. It turns out that not all zero-determinant strategies are weapons wielded by brutes and bullies. Alexander J. Stewart and Joshua B. Plotkin of the University of Pennsylvania have identified a set of "generous" zero-determinant players that form a mirror image to the extortionate ones. An extorter tries to claim more than his or her fair share, but when this gambit fails must accept the low payoff for mutual defection. A generous player offers to accept less than a fair share of the average payoff as an inducement to mutual cooperation. In other words, the generous player is willing to be a patsy if that's what it takes to secure cooperation.

'Generous behavior might seem like a maladaptive invitation to abuse, but Stewart and Plotkin found otherwise. In a series of evolutionary experiments, the generous subset of zero-determinant strategies were the dominant species in all contests except those with a very small population (fewer than about 10 individuals). Stewart and Plotkin went on to prove that generosity is a "robust" strategy, able to establish itself and proliferate in a diverse population and then repel invasion attempts by others. Apparently it pays to put up with a little unfairness if that leads to greater opportunities for beneficial cooperation.

'Is that the moral of the story? The players of these games are very simple and mechanistic; they are algorithms, not personalities. Nevertheless, it's hard to resist giving them value-laden labels such as "extortionate" or "generous." Axelrod's analysis of tit-for-tat clearly echoes the fundamental principle of *lex talionis*: take an eye for an eye (but no more than that). The evolutionary results of Stewart and Plotkin hint at a new dispensation: Mercy is greater than justice.'
http://www.americanscientist.org/issues/id.16112,y.0,no.,content.true,page.1,css.print/issue.aspx
A new Plotkin paper (2/14)
http://arxiv.org/pdf/1402.6628.pdf

Humans form the same scale of hierarchies in online games as in real world.
http://www.technologyreview.com/view/525696/how-virtual-gaming-worlds-are-revealing-the-nature-of-human-hierarchies/?utm_campaign=socialsync&utm_medium=social-post&utm_source=twitter&utm_content=arxiv

Proposal to reduce systemic risk in the financial system by radical transparency of the network structure.
http://physicsoffinance.blogspot.co.uk/2014/03/stop-banking-abuse-with-radical.html

Rules of social contagion.
http://www.nature.com/srep/2014/140311/srep04343/pdf/srep04343.pdf