

Diabologic: Smorgasbörd

by Frank Dolinar

There is so much to choose from this month that I've had a difficult time identifying a specific topic to write about. Therefore, I've decided not to decide and have gathered items from a number of topics that I found interesting.

Energy

2008 may be the year that the incandescent light bulb finally sees its approaching demise as the US Department of Energy invests over \$20 million for a baker's dozen research projects in solid-state lighting (SSL). These devices efficiently convert electric power directly into light, with little or no residual heat. High on the list are light-emitting diodes (LEDs) and organic light-emitting diodes (OLEDs). [Another application of OLEDs is in flat video screens, such as those introduced at the end of last year by Sony.]

A new company called SolarReserve is being created by Hamilton Sundstrand (a division of United Technologies) to commercialize a new molten salt solar power plant. Using techniques like those already in use at Nevada's Solar One power plant, the salt is heated to more than 1000 degrees Fahrenheit. The resultant heating / cooling reaction cycle is apparently very efficient. Venture capitalist Vinod Khosla has said: "Three percent of the land area of Morocco could support all of the electricity for Western Europe."

Researchers at Penn State have built a solar cell that can harvest hydrogen directly from water, mimicking photosynthesis and providing a clean way to gather power for the fuel cell car in your future.

And in a bit of technological "heresy" that combines both energy and environmental considerations, *Wired* magazine reports a new method to produce fuel with lots of concentrated sunlight and carbon dioxide (<http://www.wired.com/science/discoveries/news/2008/01/S2P>) in a process that reverses combustion and may make liquid hydrocarbons a renewable fuel.

Nanotech

2008 Feb 25 – Self-cleaning clothes have come one step closer according to an article in MIT's Technology Review magazine (Article: <http://www.technologyreview.com/Nanotech/20306/>). According to the article, "Researchers at Monash University, in Victoria, Australia, have found a way to coat fibers with titanium dioxide nanocrystals, which break down food and dirt in sunlight." The crystals do not harm the fabric or human skin. An additional benefit of the cleaning process is that the coating can also destroy pathogens, making such self-cleaning fabrics of interest to hospitals and other medical environments.

2008 Feb 14 – The BBC reports another nanotech treatment of fabric may provide clothing that can generate electricity using a piezoelectric effect from brush-like fibers. (<http://news.bbc.co.uk/2/hi/technology/7241040.stm>) The article humorously suggests that this gives the idea of "Power Dressing" a literal meaning. The real reason for creating and using such fabric is to generate power for nanotech processes and for portable electronic gadgets. This was also reported in the March 17, 2008, issue of *Time* magazine.

Computers

The computer industry's mantra seems to be "more, more; faster, faster". According to Intel's website (http://www.intel.com/performance/server/entry_level/linpack.htm), its dual-core Xeon processor is rated at about 1.5 billion (1.5×10^9) floating point operations per second (aka 1.5 'gigaflop'). The quad-core Xeon rates at about 2.5 gigaflop. The typical computer user keeps about 10% (or less) of the processor busy. Some researchers, trying to solve extraordinarily complex problems, need all the processing power they can get. Here are a few examples.

2008 Jan 02 – In the UK, the largest and fastest supercomputer, called HECToR, is housed at the University of Edinburgh and owned by the Research Councils of the UK. It will be used to simulate climate change and atomic structures among other projects (<http://www.guardian.co.uk/technology/2008/jan/02/computing.climatechange>). Hector is based on an array of Cray XT4 processors with a processing capability of 60 teraflop (6.0×10^{13}) – approximately twenty-four thousand times an Intel quad-core Xeon system.

2008 Feb 23 – Texas has a new Ranger, but in this case it's a supercomputer housed at the University of Texas (<http://www.hpcwire.com/hpc/2111550.html>). Ranger was funded by a \$59 million grant from the National Science Foundation. The computer was by Sun Microsystems from 3,936 Constellation blade servers, each with four quad-core AMD "Barcelona" Opteron processor chips running at a clock speed of 2.0 GHz. The system's 15,744 processors have an aggregate peak processing power at 504 teraflops (5.04×10^{14}), about 8.3 times faster than HECToR. According to the article, Ranger's processing power will deal with societal grand challenges such as "global climate change, water resource management, new energy sources, natural disasters, new materials and manufacturing processes, tissue and organ engineering, patient-specific medical therapies, and drug design."

2008 Feb 22 – Not to be outdone, however, researchers from Sandia and Oak Ridge National Laboratories want to create an even faster computer (<http://www.sandia.gov/news/resources/releases/2008/exaflop.html>). Working together, they have created the Institute for Advanced Architectures to create an even faster computer. The goal of the institute, according to the article, is "to close critical gaps between theoretical peak performance and actual performance on current supercomputers". The Institute is currently funded in FY2008 by a \$7.4 million congressional mandate. The goal is to create an exaflop (a million, trillion – or 10^{18} – floating point operations per second) supercomputer, 2000 times faster than Ranger.

The exaflop supercomputer, when built, will be about **400 million** times faster than my humble desktop computer.

Astronomy & Cosmology

Humans have been looking at the sky, particularly the night sky, since the dawn of history and wondering about our place in the universe. As answers to this, and a myriad of related questions, are proposed, considered, and – in many cases – accepted, we use that understanding as a springboard for further questions.

2008 Feb 21 – Here's an example of reality catching up with science fiction. NASA has awarded a \$500K grant to MIT's Kavli Institute for Astrophysics and Space Science to develop plans for an array of radio telescopes on the far side of the moon. (<http://web.mit.edu/newsoffice/2008/moonscope-0215.html>) Placing the array on the far side of the moon will shield it from Earth's electromagnetic interference and will make it possible for the array to make observations not possible from Earth. According to the article, "The new MIT telescopes would explore one of the greatest unknown realms of astronomy, the so-called "Dark Ages" near the beginning of the universe when stars, star clusters and galaxies first came into existence."

2008 Jan 06 – Our sun has reached the end of its low point of activity and the start of the return to Solar Maximum (<http://wattsupwiththat.wordpress.com/2008/01/04/solar-cycle-24-has-officially-started/>). Solar physicists are watching this particular solar cycle because it may be a test for the some CO2-based global warming theories.

2008 Feb 24 – The National Science Foundation is in the process of upgrading its Very Large Array (VLA) radio telescope, located in Socorro, NM. (<http://www.sciam.com/article.cfm?id=very-large-array-radio-telescope&sc=rss>) When these improvements are completed in 2012, the array will be sensitive enough to receive a cell phone signal from Jupiter (an interesting concept considering how volatile Jupiter's atmosphere and planetary magnetic field are). More to the point, the telescope will be able to see much farther into the universe and provide higher resolution images than are currently possible.

2008 Jan 02 – Brian Whitworth, a physicist at Massey University in New Zealand, has written a paper suggesting that the universe may actually be a virtual reality simulation, one of the strangest cosmological suggestions I've ever heard. (Abstract: <http://arxiv.org/abs/0801.0337>) The paper claims it should be possible to perform experiments to prove the hypothesis. If we do live inside a simulation, how could we ever discover or prove it?

Physics

2008 Feb 17 – Physorg has reported that the University of Michigan has produced the world's strongest laser. (<http://www.physorg.com/news122298608.html>) The laser's beam is a mere 1.3 microns wide, but generates 300 terawatts of power – about a hundred times more powerful than any other laser in the world [this week].

Based on my limited understanding of the energy needed, this may be another step on the road to developing a controlled nuclear fusion reaction, which always seems to be ten or twenty years in the future regardless of new breakthroughs in physics.

Emerging Tech for 2008

2008 Feb 19 – MIT's Technology Review magazine has identified 10 emerging technologies that will be important over the next few years (<http://www.technologyreview.com/specialreports/specialreport.aspx?id=25>). Here's a quote from the magazine's online abstract: *"This is work ready to emerge from the lab, in a broad range of areas: energy, computer hardware and software, biological imaging, social interactions. Two of the technologies — cellulolytic enzymes and atomic magnetometers — are efforts by leading scientists to solve critical problems, while five — surprise modeling, connectomics, probabilistic CMOS, reality mining, and offline Web applications — represent whole new ways of looking at problems. And three — graphene transistors, nanoradio, and wireless power — are amazing feats of engineering that have created something entirely new."* Don't worry if you haven't heard of half of these, neither had I. Each description is accompanied by a link to a PDF describing the technology in more detail.

Engineering Challenges for the 21st Century

2008 Feb 20 – The National Science Foundation announced 14 grand engineering challenges for the 21st century. These challenges are grouped in four major areas – sustainability, health, reducing vulnerability, and joy of living. The NSF considers these challenges essential for humanity to flourish. The article, including further links, is available at <http://www.networkworld.com/community/node/25219>.

General Science / Critical Thinking

2008 Feb 25 – Finally, here's something that, while not strictly a "technical" topic, certainly relates to our understanding of technology in our lives – a concept of some importance.

Ars Technica published an article on credible science. There are so many people with impressive credentials who often argue for completely incompatible and contradictory positions that the public (in which group I include myself) is often confused about who to believe and why. The article, by John Timmer, is clearly stated and provides a number of links to additional sites and information sources. It's worth reading.

(<http://arstechnica.com/news.ars/post/20080224-getting-the-public-to-pay-attention-to-good-science.html>)

At the beginning of the 21st century, at a time in human history when we find ourselves surrounded – perhaps even inundated – by all manner of technology, we need to be reliably and accurately informed on the issues that clamor for our attention every day and on an ongoing basis. Too many people have no scientific or technological savvy in an era and a culture that requires it for good decision making and perhaps even survival.

The reference to Mr. Timmer's article showed up on Slashdot, where I found it. (http://science.slashdot.org/article.pl?no_d2=1&sid=08/02/26/0031231) The reviewer had some very good comments, which I quote here:

"We all know that false or misleading science headlines are all too common these days and that misleading media combined with an apathetic and undereducated public lead to widespread ignorance. But the real question is, how can this trend be reversed? At a session at the recent AAAS meeting, a study was discussed indicating that [what matters most is how the information is portrayed](#). While people are willing to defer to experts on matters of low concern, for things that affect them directly, such as breast cancer or childhood diseases, expertise only counts for as much as giving off a 'sense of honesty and openness,' and that it matters far less than creating a sense of empathy in deciding who people will listen to. In other words, it's not enough to merely report on it as an expert. You need to make sure your report exudes a sense of honesty, openness, empathy, and maybe even a hint of humor."

The process of creating a sense of empathy also applies to our politics and the shaping of our policies, processes that require an educated populace – much as our Founding Fathers envisioned. Moreover, we need a populace educated in science and critical thinking. Toward that end, we owe it to ourselves, our children, and our future to integrate the teaching of fundamental science and critical thinking skills into our educational system at all levels.