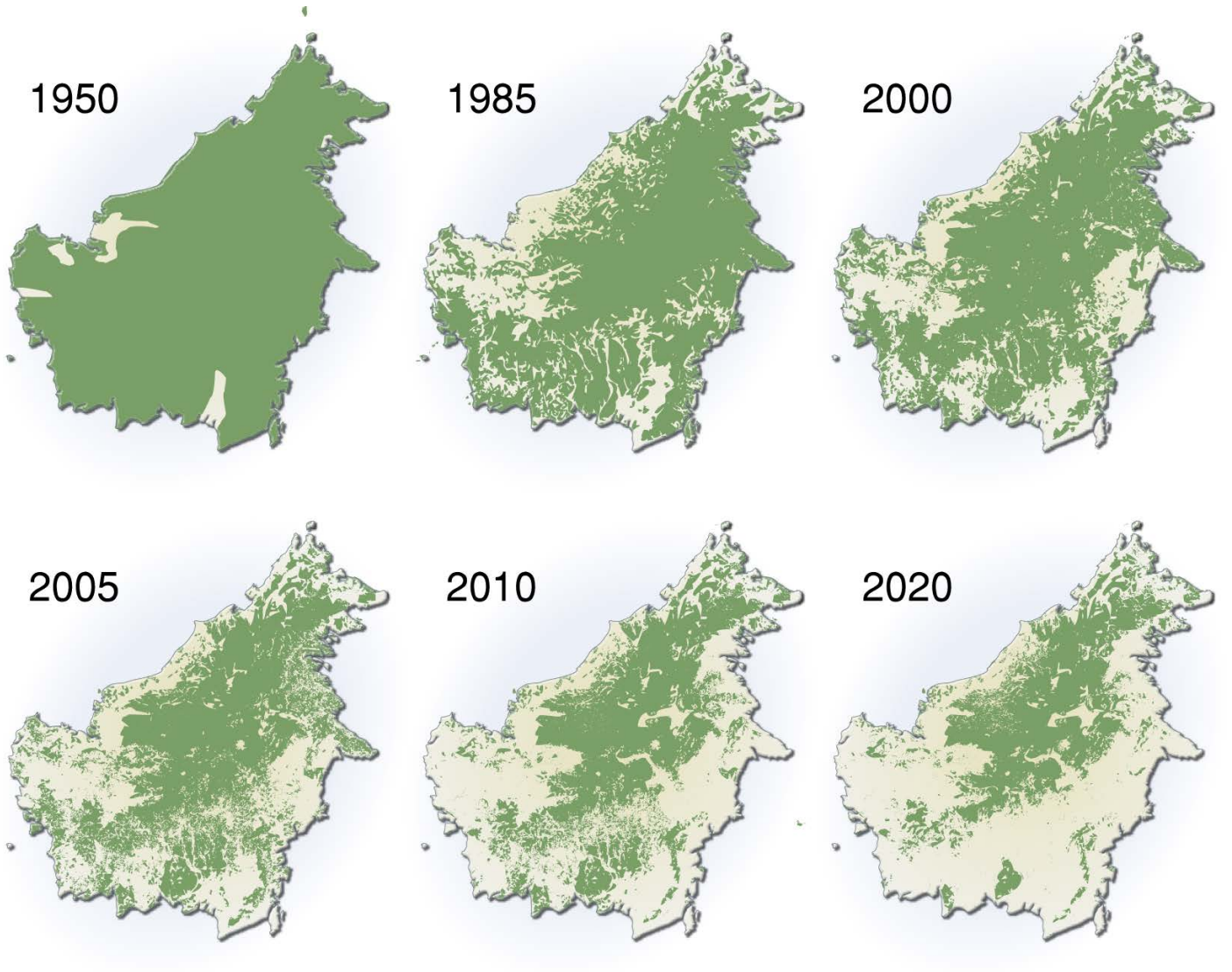
[For my December 2009 diary, go here.]

Diary - January 2010

John Baez

January 1, 2010



Extent of deforestation in Borneo 1950-2005, and projection towards 2020.

As the Earth burns, people are starting to consider "geoengineering":

- Kevin Bullis, The geoengineering gambit, *Technology Review*, January/Feburary 2010.

  Rivers fed by melting snow and glaciers supply water to over one-sixth of the world's population — well over a billion people. But these sources of water are quickly disappearing: the Himalayan glaciers that feed rivers in India, China, and other Asian countries could be gone in 25 years. Such effects of climate change no longer surprise scientists. But the speed at which they're happening does. "The earth appears to be changing faster than the climate models predicted," says Daniel Schrag, a professor of earth and planetary sciences at Harvard University, who advises President Obama on climate issues.

> Atmospheric levels of carbon dioxide have already climbed to 385 parts per million, well over the 350 parts per million that many scientists say is the upper limit for a relatively stable climate. And despite government-led efforts to limit carbon emissions in many countries, annual emissions from fossil-fuel combustion are going up, not down: over the last two decades, they have increased 41 percent. In the last 10 years, the concentration of carbon dioxide in the atmosphere has increased by nearly two parts per million every year. At this rate, they'll be twice preindustrial levels by the end of the century. Meanwhile, researchers are growing convinced that the climate might be more sensitive to greenhouse gases at this level than once thought. "The likelihood that we're going to avoid serious damage seems quite low," says Schrag. "The best we're going to do is probably not going to be good enough."
>
> This shocking realization has caused many influential scientists, including Obama advisors like Schrag, to fundamentally change their thinking about how to respond to climate change. They have begun calling for the government to start funding research into geoengineering — large-scale schemes for rapidly cooling the earth.

One of the most popular schemes — if "popular" is the right word — is to inject large amounts of sulfates into the upper atmosphere. When Mount Pinatubo blew its top in 1991, it shot 15 million tons of sulfur dioxide into the stratosphere, and temperatures dipped an average of 0.5 °C worldwide for the next 15 months. But rainfall dropped too! According to Kevin Trenberth of the National Center for Atmospheric Research, it was 50 percent lower than the previous low of any year recorded so far! Not good.

There are other dangers: if we let the Earth become dependent on an artificial cooling system, a war or economic crisis that puts a temporary halt to the scheme could cause *sudden* warming of an extreme sort. In other words: once we get on the merry-go-round, it's hard to jump off. And what helps one region might hurt another, so unilaterally starting such a scheme could even start a war. But some country might still try it:

> David Victor, the director of the Laboratory on International Law and Regulation at the University of California, San Diego, sees two scenarios in which it might happen. First, "the desperate Hail Mary pass": "A country quite vulnerable to changing climate is desperate to alter outcomes and sees that efforts to cut emissions are not bearing fruit. Crude geoengineering schemes could be very inexpensive, and thus this option might even be available to a Trinidad or Bangladesh — the former rich in gas exports and quite vulnerable, and the latter poor but large enough that it might do something seen as essential for survival." And second, "the Soviet-style arrogant engineering scenario": "A country run by engineers and not overly exposed to public opinion or to dissenting voices undertakes geoengineering as a national mission — much like massive building of poorly designed nuclear reactors, river diversion projects, resettlement of populations, and other national missions that are hard to pursue when the public is informed, responsive, and in power." In either case, a single country acting alone could influence the climate of the entire world.

Geoengineering clearly calls for caution. But it may be the road we head down — since if human-induced climate change is a real problem, by the time its effects are clearly visible to everyone, it'll be hard to stop.

"It's not a techno-fix. It's not a Band-Aid," says Daniel Schrag. "It's a tourniquet. There are potential side effects, yes. But it may be better than the alternative, which is bleeding to death."

January 9, 2010

My friend Bruce Smith pointed out this op-ed column:

- Thomas L. Friedman, Who's sleeping now?, *New York Times*, January 9, 2010.

Friedman's book *Hot, Flat, and Crowded* proposes that Americans revitalize the USA by taking the lead in the "energy technology revolution" that the world so desperately needs. In his column here, written in Hong Kong, he reports on what China is doing. He argues that now not China but the USA is the "sleeping giant":

> In the last year alone, so many new solar panel makers emerged in China that the price of solar power has fallen from roughly 59 cents a kilowatt hour to 16 cents, according to *The Times*' bureau chief here, Keith Bradsher. Meanwhile, China last week tested the fastest bullet train in the world — 217 miles per hour — from Wuhan to Guangzhou. As Bradsher noted, China "has nearly finished the construction of a high-speed rail route from Beijing to Shanghai at a cost of $23.5 billion. Trains will cover the 700-mile route in just five hours, compared with 12 hours today. By comparison, Amtrak trains require at least 18 hours to travel a similar distance from New York to Chicago".
>
> China is also engaged in the world's most rapid expansion of nuclear power. It is expected to build some 50 new nuclear reactors by 2020; the rest of the world combined might build 15.
>
> "By the end of this decade, China will be dominating global production of the whole range of power equipment," said Andrew Brandler, the C.E.O. of the CLP Group, Hong Kong's largest power utility.

Doubtless he's trying to scare Americans into action. But from a worldwide perspective it's a great thing that China is taking the energy problem seriously... since this country will dominate the 21st century.

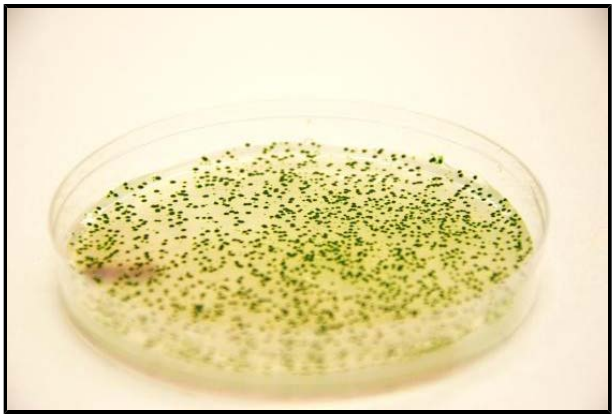
I want to get more seriously involved in environmental issues. The mathematics of n-categories is great fun, but it's getting harder and harder for me to convince myself that I should be working on it. Some very talented people have taken up the subject; it doesn't need me anymore. The Earth, on the other hand, is in desperate need of *all* our help. I don't want to look back and feel I was fiddling while Rome burned.

I'm not quite sure what to do yet — that's the main thing that's been holding me back. But I think being in Singapore will give me a new perspective, and a kind of nudge. And I'm hoping that this conference will give me some ideas:

- 2010 Harvey Mudd College Mathematics Conference on the Mathematics of Environmental Sustainability and Green Technology, Harvey Mudd, Claremont, California, Friday-Saturday, January 29-30, 2010. Organized by Rachel Levy.

Here's something cool: a genetically modified cyanobacterium that can convert carbon dioxide and sunlight into isobutanol — an alcohol that can be used as fuel!

- Matthew Chin, UCLA researchers engineer bacteria to turn carbon dioxide into liquid fuel, *UCLA Newsroom*, December 10, 2009.



January 10, 2010

People are working on interspecies cloning as a possible way to resurrect extinct species like woolly mammoths... or Arabian sand cats.

Arabian sand cats? Yes, they're not extinct yet — but they're endangered, so this is the best time to practice cloning them. Betsy Dresser is at work on this — she's the director of the Audubon Center for Research of Endangered Species.

Dr. Dresser is responsible for creating a "frozen zoo" holding the frozen embryos of 75 animal species. And, she's already succeeded in implanting ordinary cats with the genome of African wild cats! The kittens grew up just fine:

- Lesley Stahl, Could Extinct Species Make a Comeback?, *60 Minutes*, CBS, January 10, 2010.
- Endangered African wildcat clones produce kittens, About.com: Cats, August 19, 2005.

Betsy Dresser with African wildcat kittens

January 14, 2010

UC Riverside approved my leave! I can go to Singapore!

This was not unexpected: Lisa had already gotten her leave approved, and the administration said mine would be too. But it's nice to be certain. Starting in July, she'll be teaching at the Department of Philosophy at NUS — the National University of Singapore. I'll be doing research at the CQT — the Centre for Quantum Technologies.

Upon getting the good news, the first thing I did is announce my new plans on the *n*-Category Café. Namely: I want to shift the focus of my research away from fancy abstract n-categorical math to slightly more practical things. My job at the CQT will give me a chance to explore computer science, microtraps, and quantum optics. I'll also get to interact with the Nanoscience and Nanotechnology Initiative.

But what I *really* want to do is help save our beleagured planet. There are so many things we need to do, that I'm sure I can find ways to help out. I'm good at math, physics, learning things, explaining them, and getting crowds of people interested in them. Surely there are ways to harness these talents in support of the Earth.

My remarks on the *n*-Category Café started an interesting conversation. Lots of leads to follow up!

I'm excited about this new phase of my career. Over the last decade, my work on *n*-categories had become a kind of race as more and more smart people got involved. What started out as free-form exploration had become more of a

competitive game, at least in my own mind. And the work was becoming more and more technical. All this made me feel old and tired.

But there's a lot of mathematics and physics that I want to explore that's less esoteric and more vitally connected to engineering, biology and the environmental problems we face. The more I think about it, the more ideas I get... and the younger I feel!

January 18, 2010

Some big rainstorms are headed our way...

And while Southern California desperately needs rain, the charred mountain slopes will turn into mud when the big storms hit. So, we'll see mudslides. All part of the process of deforestation and soil loss caused by global warming in this part of the world.

January 19, 2010

Lots of rain!

January 20, 2010

Much more rain — we've had about 2.3 inches in the last 48 hours! Jim Dolan and I talked about math at a restaurant today. Walking there it seemed very windy and rainy, but after we got there it *really* started pouring — with lightning and sleet! Sleet is pretty rare here.

Later, I found out there was a tornado in Los Angeles today, four waterspouts, and some mudslides too. More big storms are expected tomorrow and the next day as well.

Waterspout off Newport Beach, photographed by Sergio Calvillo

I told you about my brand-new compost pile on October 22nd. It's great! I turned it over last week, and now I've got a Biostack Bin half full of brand new dark rich soil! We'll use it to improve the dirt on the east side of the house, where we grow tomatos.

You wouldn't believe how much happier you'll feel when you can take all your yard waste, grapefruit peels, banana peels, coffee grounds, tea leaves and other vegetable matter and do something useful with it. For me, throwing out trash was always an occasion for mild guilt: I couldn't help but imagine plastic bags of my junk, mummified in the local dump for centuries to come. Now I feel downright productive — at least when I'm taking stuff out to the compost pile. And because Lisa and I don't buy tons of crud in plastic packaging, and we eat pretty well — more fruits and vegetables than meat and junk food — the amount of trash we send to the dump has been drastically reduced, so even putting trash out for the garbage trucks elicits feelings of smug self-satisfaction, rather than shame.

You met Martin Gisser in my September 1st diary entry. He read my entry about compost piles, and today he sent me an email about terra preta and biochar.

To set the stage: in the Amazon Basin, there's a lot of nice rich soil. This is man-made! The soil there is naturally infertile, but between 450 BC and 950 AD, the natives enriched it using bone, manure and *charcoal*... producing a layer of soil full of organic material as much as 2 meters thick. This is called "terra preta", which means "black earth" in Portuguese.

Left: nutrient-poor soil in the Amazon basin.
Right: terra preta

Besides improving the soil, there's another wonderful thing about turning plant matter into charcoal and burying it this way. It keeps the carbon underground for hundreds of thousands of years. Thus, it significantly slows the rate at which carbon returns to the atmosphere in the form of carbon dioxide!

In fact, the people believe the only real chance to fight global warming on the massive scale needed is via massive "biochar" projects. It's low tech: anyone can do it.

For example, in the *Guardian*, James Lovelock wrote:

> I said in my recent book that perhaps the only tool we had to bring carbon dioxide back to pre-industrial levels was to let the biosphere pump it from the air for us. It currently removes 550bn tons a year, about 18 times more than we emit, but 99.9% of the carbon captured this way goes back to the air as CO_2 when things are eaten.
>
> What we have to do is turn a portion of all the waste of agriculture into charcoal and bury it. Consider grain like wheat or rice; most of the plant mass is in the stems, stalks and roots and we only eat the seeds. So instead of just ploughing in the stalks or turning them into cardboard, make it into charcoal and bury it or sink it in the ocean. We don't need plantations or crops planted for biochar, what we need is a charcoal maker on every farm so the farmer can turn his waste into carbon. Charcoal making might even work instead of landfill for waste paper and plastic.
>
> Incidentally, in making charcoal this way, there is a by-product of biofuel that the farmer can sell. If we are to make this idea work it is vital that it pays for itself and requires no subsidy. Subsidies almost always breed scams and this is true of most forms of renewable energy now proposed and used. No one would invest in plantations to make charcoal without a subsidy, but if we can show the farmers they can turn their waste to profit they will do it freely and help us and Gaia too.
>
> There is no chance that carbon capture and storage from industry or power stations will make a dent in CO2 accumulation, even if we had the will and money to do it. But we have to grow food, so why not help Gaia do the job of CO_2 removal for us?

I need to learn more about this. But anyway, here's Martin Gisser's email:

> Here's a tip for the c21st compost fetishist: Try producing Terra Preta! It is the only tool we have at hand to repair the climate system. Paradoxically, it's simple Stone Age technology.
>
> In the humid and hot tropics it is trivial to produce: Add charcoal dust to soil and get amazing soil productivity boosts:
>
> - Dr. Sai Bhaskar Reddy Nakka, Terra Preta Info.

- Biochar Central.

In other climate zones two things need to be taken care of:

1. Pure charcoal eats up surrounding soil.
2. Charcoal is water repellant at first. You need to cook it, e.g. by flushing the fireplace with water.

Here's how I do it:

I'm heating my snowy Bavarian Forest home with briquettes of compressed shredded wood. When they are red glowing, I sometimes put some into a bucket with water. (Of course using an iron shovel and bucket not coated with plastic. Beware the dioxins!) Then I pee into the bucket (I no longer waste my precious pee to the toilet) to improve the carbon/nitrogen balance and then mix it into the young compost heap (I got 3 heaps of different age). The stuff tends to emit smelly ammonia (NH_3) first, which luckily is water soluble and important food for soil organisms. So I cover the peed char with other wet stuff. I can't say if it makes a difference, because there's no difference to make: There was no garden soil before I came and saw...

Sadly, he refused to make a video demonstrating his technique.

January 23, 2010

It stopped raining! Blue skies and snow-capped mountains!

In the afternoon, Lisa and I drove over to Irvine. Lisa went on a walk with Greg Benford while I attended a meeting of the Southern California Reading Group in the Philosophy of Physics. This is a group that meets about three times per quarter at UC Irvine to discussion the foundations of physics. We had a nice long rambling question-and-answer session where I explained the good and bad sides of string theory and loop quantum gravity, why I quit working on quantum gravity and started working on n-categories, and why I recently stopped working on n-categories and started trying to find a way to help save the planet. I finally met Craig Callender, who helped edit the book *Physics Meets Philosophy at the Planck Length*. I have a paper in there, but I'd never met him before! Now he's at U.C. San Diego. So is Christian Wüthrich, who invited me to this meeting. I also met David Malament and Jeffrey Barrett from the Department of Logic and Philosophy of Science at U.C. Irvine, and some other interesting people.

After the talk we had dinner at the Steelhead Brewing Company, and I spent a lot of time talking to James Owen Weatherall, who already has a PhD in physics but is now a grad student with Malament. He told me that Geroch and Jang had proved a theorem that in general relativity, a test particle must move along a geodesic — a fact sometimes treated as an axiom. A later paper by Geroch and Jürgen Ehlers, generalized this to to the case where the particle's energy-momentum is included in Einstein's equation. Weatherall has been working on similar results in the coordinate-free formulation of Newtonian gravity, sometimes called Newton-Cartan gravity. I've been sort of interested in Newton-Cartan gravity, so I was happy to hear that it's explained in some lectures notes by Malament.

Later I spoke to Craig Callender, and it turned out he had gotten serious about environmentalism too. His approach was to start teaching courses on the subject. He sounded a bit apologetic for only doing that, but as he correctly pointed out, there's a big multiplier effect when you teach 100 people something. So maybe when I return to U. C. Riverside after my Singapore jaunt I should try to do something like that... as well as the other things I'm vaguely planning. I need to see if there's some sort of interdisciplinary program I could hook onto.

We also talked about decision theory and the whole problem of how to make decisions about huge problems in the face of great uncertainty and insufficient evidence. Jeffrey Barrett mentioned the problem of "what if it's already too late to stop a disaster?", and pointed me to the following paper. But we agreed that even if it's too late to stop a disaster, it can be worthwhile trying to keep the disaster from becoming even worse! And I think this is very much true here, both when it comes to human suffering and the extinction of species.

- Susan Solomona, Gian-Kasper Plattner, Reto Knuttic and Pierre Friedlingstein, Irreversible climate change due to

carbon dioxide emissions, PNAS **106** (2009), 1704-1709.

Abstract: The severity of damaging human-induced climate change depends not only on the magnitude of the change but also on the potential for irreversibility. This paper shows that the climate change that takes place due to increases in carbon dioxide concentration is largely irreversible for 1,000 years after emissions stop. Following cessation of emissions, removal of atmospheric carbon dioxide decreases radiative forcing, but is largely compensated by slower loss of heat to the ocean, so that atmospheric temperatures do not drop significantly for at least 1,000 years. Among illustrative irreversible impacts that should be expected if atmospheric carbon dioxide concentrations increase from current levels near 385 parts per million by volume (ppmv) to a peak of 450-600 ppmv over the coming century are irreversible dry-season rainfall reductions in several regions comparable to those of the "dust bowl" era and inexorable sea level rise. Thermal expansion of the warming ocean provides a conservative lower limit to irreversible global average sea level rise of at least 0.4-1.0 meters if 21st century CO_2 concentrations exceed 600 ppmv and 0.6-1.9 meters for peak CO_2 concentrations exceeding 1,000 ppmv. Additional contributions from glaciers and ice sheet contributions to future sea level rise are uncertain but may equal or exceed several meters over the next millennium or longer.

Here it's worth comparing this article which focuses on the really long term. It's not consoling, and perhaps not very important for us short-termers, but still interesting:

- Franklin Hadley Cocks, Global warming vs. the next Ice Age, *Technology Review*, January/February 2010.

  In about 300 years, all available fossil fuels may well have been consumed. Over the following centuries, excess carbon dioxide will naturally dissolve into the oceans or get trapped by the formation of carbonate minerals. Such processes won't be offset by the industrial emissions we see today, and atmospheric carbon dioxide will slowly decline toward preindustrial levels. In about 2,000 years, when the types of planetary motions that can induce polar cooling start to coincide again, the current warming trend will be a distant memory.

  This means that humanity will be hit by a one-two punch the likes of which we have never seen. Nature is as unforgiving to men as it was to dinosaurs; advanced civilization will not survive unless we develop energy sources that curb the carbon emissions heating the planet today and help us fend off the cold when the ice age comes. Solar, nuclear, and other non-fossil–fuel energy sources need to be developed now, before carbon emissions get out of hand.

I don't know if anyone is thinking about these longer-term climate issues very seriously. Maybe Cocks' book *Energy Demand and Climate Change* is a place to look.

Here's something:

- Mason Inman, Carbon is forever, *Nature Reports Climate Change*, November 20, 2009.

The issue is contentious, but one model predicts something like this:

After dinnner I rejoined Lisa and Greg, who'd had dinner at a nearby Indian restaurant, and we went over to his house. Some interesting tidbits: Russia is again starting to send a lot of spies to the US. Buzz Aldrin told Benford that some of us may live to see the day when nobody still alive ever set foot on the Moon. Winston Churchill wrote an alternative-history piece called "What if the North had won the war?" - set in a universe where the *South* won the Civil War.

January 24, 2010

I've been corresponding with the mathematician André Joyal about climate change. I wrote:

> I'd like to figure out some way to use my skills to help the environment, and lure other mathematicians into doing the same. I think a lot of people want to do something, but aren't quite sure what. Maybe I can find out some things for mathematicians to do.

He replied:

> I see it as a kind of moral obligation to stop climate warming and save the biosphere. The problem is to know how. I spent almost a year reading everything I could on the subject of climate warming and I became acutely aware of the danger. Many people agree with me, but nothing seems to be happening at the moment! The scale of the problem is so enormous that we all feel powerless.
>
> I liked the book of Harald Welzer because it contains a clear analysis of the social-psychological-historical-cultural aspects of problem. He thinks that we cannot convince people to make important changes in their life if they cannot see the benefit of these changes in their life. He thinks that climate warming is a special case of a larger problem which people may truly want to solve because they will be able to see the benefits of solving it in their life. I interpret this as a wake-up call, a call for a cultural revolution, of metamorphosis of the culture. This seems utopian, but we don't have the choice. We will have to take our dreams seriously. Of course, we should remain very realistic, rational and scientific. Put differently, we should begin to forge strong dreams and makes serious efforts to realise them.
>
> There is a kind of philosophical problem here, because our perception of reality is very much influenced by our culture. Culture is fundamentally a good thing, but it is inherited from the past, adapted to solving the problems of the past. It may inhibit our vision of the future. I have great admiration for the founding fathers of America because they were able to free themselves from the past, to perceive the future. Of course, the historical context made it possible. This is why we should not miss every opportunity of making changes in the right direction. An accumulation of small changes can lead to a fundamental transformation. Even a small change not directly related to the problem of climate warming is good. Maybe we could make some changes in our way of doing mathematics and publishing.
>
> Best, André

January 25, 2010

My friend Bruce Smith's son Peter suddenly noticed that logically, October should be the eighth month, November the ninth and December the tenth. Why are they off by two? Bruce and his family guessed that once upon a time, the months started with March.

They're right! I checked, and the story is roughly this. The Roman calendar started out like this:

Martius (31 days)
Aprilis (30 days)
Maius (31 days)
Iunius (30 days)
Quintilis (31 days)
Sextilis (30 days)
September (30 days)
October (31 days)
November (30 days)
December (30 days)

61 days in winter were not assigned to any month!

In 713 BC, the king of Rome added January and February. Opinions differ on the details, but Plutarch says it went like this:

Ianuarius (29)
Februarius (28)
Martius (31)
Aprilis (29)
Maius (31)
Iunius (29)
Quintilis (31)
Sextilis (29)
September (29)
October (31)
November (29)
December (29)

Then, later, Julius Caesar got a month named after him. And then came one for Augustus Caesar. So, by 45 BC the calendar looked like this:

Ianuarius (31)
Februarius (28, or in leap years: 29)
Martius (31)
Aprilis (30)
Maius (31)
Iunius (30)
Iulius (31)
Augustus (31)
September (30)
October (31)
November (30)
December (31)

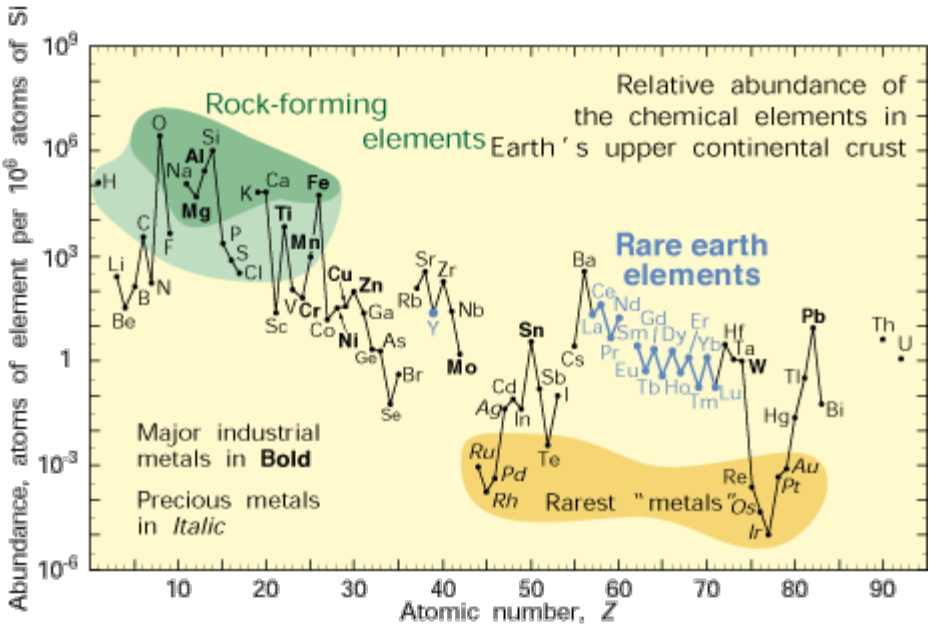
January 30, 2010

Today I went to this conference:

- Conference on the Mathematics of Environmental Sustainability and Green Technology, Harvey Mudd, Claremont, California, Friday-Saturday, January 29-30, 2010. Organized by Rachel Levy.

A quick brain dump of what I learned:

- Harry Atwater of Caltech gave a talk on photovoltaic solar power. Silicon crystal efficiency peaked out at 24% in 2000 Fancy "multijunctions" get up to 40% and are still improving. But they use fancy materials like gallium arsenide, gallium indium phosphate, and so on. 1 terawatt of photovoltaics would use up too much rare earth metals, unless we use silicon as a semiconductor. There just aren't enough of these metals! See P. H. Stauffer's paper on rare earth abundances.



So, what do we do? In 1961, Shockley and Quiesser wrote a paper on the limiting efficiency of a solar cell. It's limited by thermodynamical reasons: since anything that can absorb energy can also emit it, any solar cell also acts as a light-emitting diode.

What are the tricks used to approach this theoretical efficiency? Multijunctions use layers of different materials to catch photons of different frequencies. These are expensive, so people use a lens to focus more sunlight on the photovoltaic cell. See the Umuwa Solar Power Station in Australia. But then the cells get hot and need to be cooled.

Roughening the surface of a solar cell promotes light trapping, by large factors! Light bounces around ergodically and has more chances to get absorbed and turned into useful power. There are theoretical limits on how well this trick works. But those limits were derived using ray optics, where we assume light moves in straight lines. But we can beat those limits by leaving the regime where the ray-optics approximation holds good. In other words, make the surface complicated at length scales comparable to the wavelength at light.

For example: we can grow silicon wires from vapor! See Brendan M. Kayes *et al* in App. Phys. Lett. They can form densely packed structures that absorb more light:

Also, with such structures the charge carriers don't need to travel so far to get from the n-type material to the p-type material, which boosts efficiency.

There are other tricks, still just under development. Using surface plasmons we can adjust the dispersion relations to create materials with really low group velocity. We can create meta-materials and meta-atoms. Using these, we can make materials with negative refractive index, like n = -5!

These exhibit a reversed version of the ordinary Goos-Hänchen effect. In the ordinary version, light "slips" a little before reflecting during total internal reflection inside a material of higher refractive index (like glass) surrounded by one of lower refractive index (like air). The "slip" is actually a slight displacement of its wave crests from their expected location — a "phase slip". But for a material of negative refractive index, the light slips *backwards*. This allows for resonant states where light gets trapped in thin films. Maybe this can be used to make better solar cells.

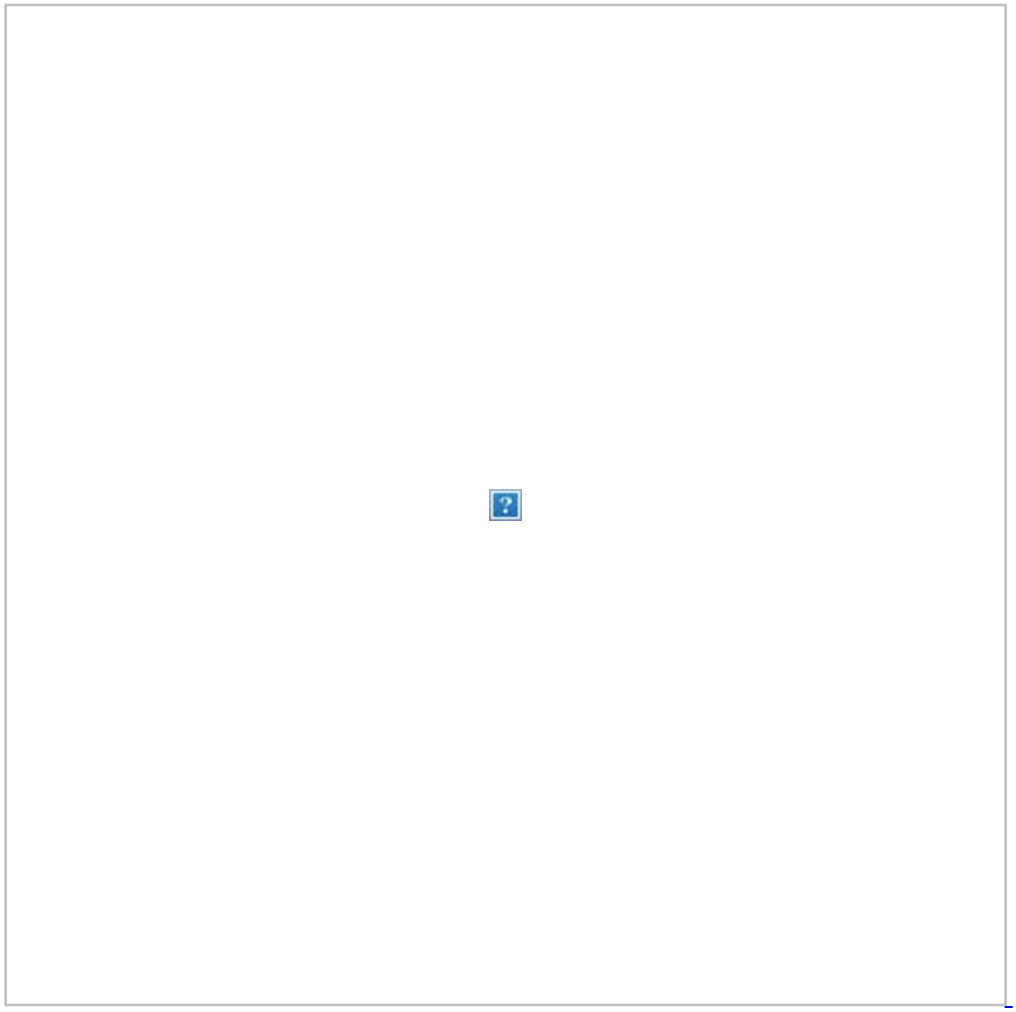
- Kenneth Golden gave a talk on sea ice, which covers 7-10% of the ocean's surface and is a great detector of global

warming.

Salt gets incorporated into sea ice via millimeter-scale brine inclusions between ice platelets, forming a "dendritic platelet structure". Melting sea ice forms fresh water in melt ponds atop the ice, while brine sinks down to form "bottom water", driving the global thermohaline conveyor belt.

When it gets hotter, the Earth's poles get less white, so they absorb more light, making it hotter: this is "ice albedo feedback". Ice albedo feedback is *largely controlled by melt ponds*. So questions like this are very important: when do they get larger, and when do they drain out?

Sea ice is diminishing rapidly in the Arctic — much faster than the climate models predicted. There's a lot less sea ice in the Antarctic, mainly in the Wedell Sea, and there it seems to be growing. In the Arctic, winter sea ice has diminished in area by about 10% from 1978 to 2008. But summer sea ice has diminished by about 40%! It took a huge plunge in 2007, leading to a *500% increase in solar heat input in this area* due to the ice albedo effect. See Perovich et al in *Geophysical Research Letters*.

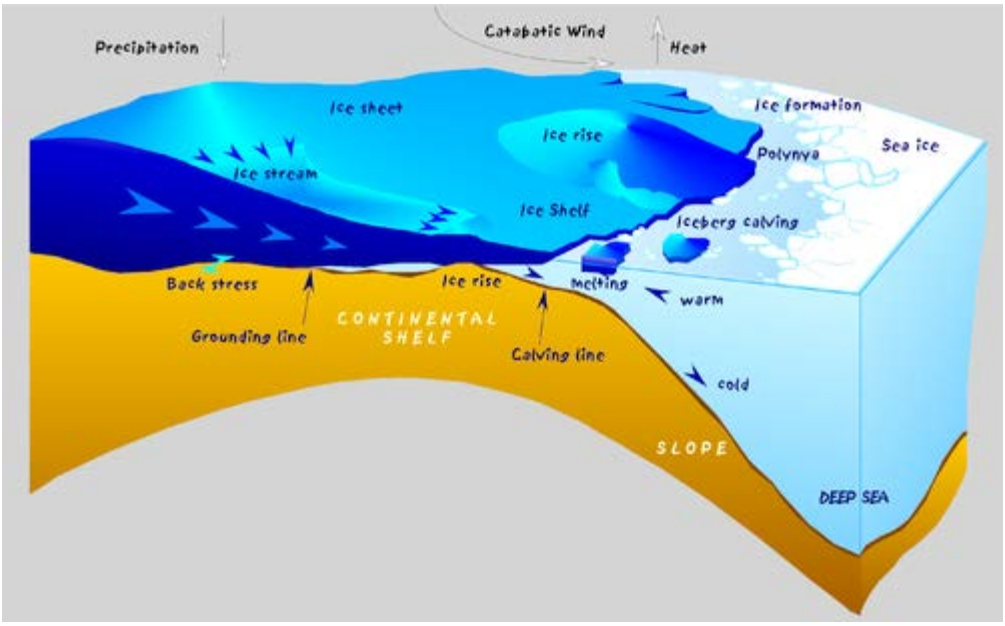


Time series of the percent difference in ice extent in March (the month of ice extent maximum) and September (the month of ice extent minimum) relative to the mean values for the period 1979-2000. Based on a least squares linear regression for the period 1979-2009, the rate of decrease for the March and September ice extents is -2.5% and -8.9% per decade, respectively. Figure from Perovich *et al*.

The icea thickness distribution equation was worked out by Thorndike et al in 1975. The heat equation for ice and snow was worked out by Maykut and Understeiner in 1971. Sea ice dynamics was studied by Kibler.

Ice floes have two fractal regimes, one from 1 to 20 meters, another from 100 to 1500 meters. Brine channels also have a fractal character, well modeled by diffusion limited aggregation. Brine starts flowing when there's about 5% of brine in the ice - a kind of percolation problem familiar in statistical mechanics. Here's what it looks like when there's 5.7% brine:

Polynyas occupy .001% of the overall area in Antarctic sea ice, but create 1% of the icea. Icy cold catabatic winds blow off the mainland, pushing away ice and creating patches of open water — poylnyas — which then refreeze.



Nobody knows why polycrystalline metals have a log-normal distribution of crystal sizes. Similar behavior, also unexplained, is seen in sea ice.

There was anomalous export of sea ice through Fran Strait in the 1990s, which may have been one of the preconditions for high ice albedo feedback.

20-40% of sea ice is formed by surface flooding followed by refreezing. This was *not included in the sea ice models* that gave such inaccurate predictions.

The food chain is founded on diatoms. These form extracellular polymeric substances (EPS), goopy mucus-like stuff made of polysaccharides that protects them and serves as antifreeze. There's a lot of this stuff; the ice gets visibly stained by it.

For more, see:

- Kenneth M. Golden, Climate change and the mathematics of transport in sea ice, *AMS Notices*, May 2009.
- Mathematics Awareness Month, April 2009: Mathematics and Climate.

- Julie Lundquist of the University of Colorado at Boulder spoke about wind power. With increased reliance on wind, the power grid will need to be redesigned to handle fluctuating power sources. In the US, currently, companies aren't paid for power they generate in excess of the amount they promised to make! So, accurate prediction is a hugely important game: being off by 1% can cost millions of dollars. Europe has more sensible laws, which encourage firms to maximize the amount of wind power they generate.

  Complete simulation of the Navier-Stokes equation is too computationally intensive, so people use "mesoscale" simulation for weather simulation, but we need more fine-grained simulations to see how much wind a turbine will get. A famous Brookhaven study suggested that the power spectrum of wind has peaks at 4 days, 1/2 day, and 1 minute. This perhaps justifies an approach where different length scales are treated separately and the results then combined somehow. Night air is stable, day air is often not, since the ground is hot and hot air rises. Eddy diffusivity is modeled by Monin-Obuklov Similarity Theory.

  The wind turbines at Altamont Pass kill more raptors than *all other wind farms in the world combined*. Old-fashioned wind turbines look like nice places to perch, spelling death to birds. Cracks in concrete attract rodents, which attract raptors, who get killed. The new ones are far better.

  For more:

  - National Renewable Energy Laboratory, Research needs for winds resource characterization.

For my Februrary 2010 diary, go here.

The most important thing is to keep the most important thing the most important thing. - Donald P. Coduto

baez@math.removethis.ucr.andthis.edu

home

For my January 2010 diary, go here.

Diary - February 2010

John Baez

February 1, 2010

He Who Conquers

There is he whose spirit casts shadows
upon valleys
he who drowns thunder with words
who steps heavy and broad
pressing green into soft wet earth

and there is he who does naught
save to unweave the spider's web
and bind it back again –

Anon

February 2, 2010

Check out this moonlit fog bow in Hawaii, with Mars gleaming bright.

February 3, 2010

In email, Robert Smart wrote:

> There are lots of "might save the world" stuff that need mathematical help, but I'd like to suggest something different.
>
> Resource depletion and environmental destruction, and the measures to counter these things, will play out through the economic system. Understanding of the economic system is shockingly weak. Much of the understanding only works in a growing economy, but oil depletion alone will see economic contraction for a decade or so.
>
> All current mathematical understanding of economics seems to be in terms of money. But money is one of the oddest things in economics. It doesn't have the properties of stability it is assumed to have, when governments can "print" more at the stroke of a pen (quantitative easing).
>
> So how about running some sort of cooperative Internet thing to try to build a better understanding of economics. Certainly money and some other things look like fluids, so there is scope for n-ports. And maybe the work on large sparse random matrices has something to do with very large networks with semi-regular features. Obviously I'm guessing.
>
> When you need to make significant changes to a large complex thing like the economy, it is wise to understand it better. However I think there are many other reasons to do this. For one thing: the Nobel Prize

for Economics seems to be a lot easier to get than any of the others :-).

Robert Smart

P.S. I have been writing stuff in an attempt to understand economics better in a qualitative way. However we don't understand stuff till we understand it mathematically.

- Savings match lending
- Devaluing the US Dollar
- Unreal Economics
- Economic Production = Energy + Workers
- Economic Fundamentals continued
- Economic Notes
- External National Assets
- Energy Crisis Economics

P.P.S. With the latest feature of Google Reader I can get changes to your Diary as if it had an RSS feed. We'll see if it works.

February 4, 2010

Pretty soon I'm going to start a new blog focused on environmental and related issues. My plan is to learn stuff by explaining it. In the meantime, I've been getting some emails on this topic. For example, in response to Robert Smart's comment above, Dave Tweed wrote:

Dear John,

Since I saw Robert Smart's comment on your diary, I guess an email is appropriate. I wouldn't presume to give you advice, but I'll just suggest that money is not a well-defined fundamental concept in economic theory, and probably can't be uncontroversially defined. Arguably a more important understanding in economics is understanding how feedback/system effects can manifest themselves. From there you can start to figure out what characteristics money needs to play, and hence how it should be "defined". One example of the kind of thing is presented here, where it's suggested that the historic choice of definitions and tools leads to what you consider the problems to be (namely only those that fit nicely within your toolset framework):

- Steve Keen, Circuit theory and state of post Keynesian economics, talk at the 4th Dijon money conference.

I'll leave it there, but if youre interested in money as hydraulics consider MONIAC.

Anyway, best wishes,
Dave Tweed

February 6, 2010

A lot of rain! We need this rain badly... but it's causing mudslides near the coast.

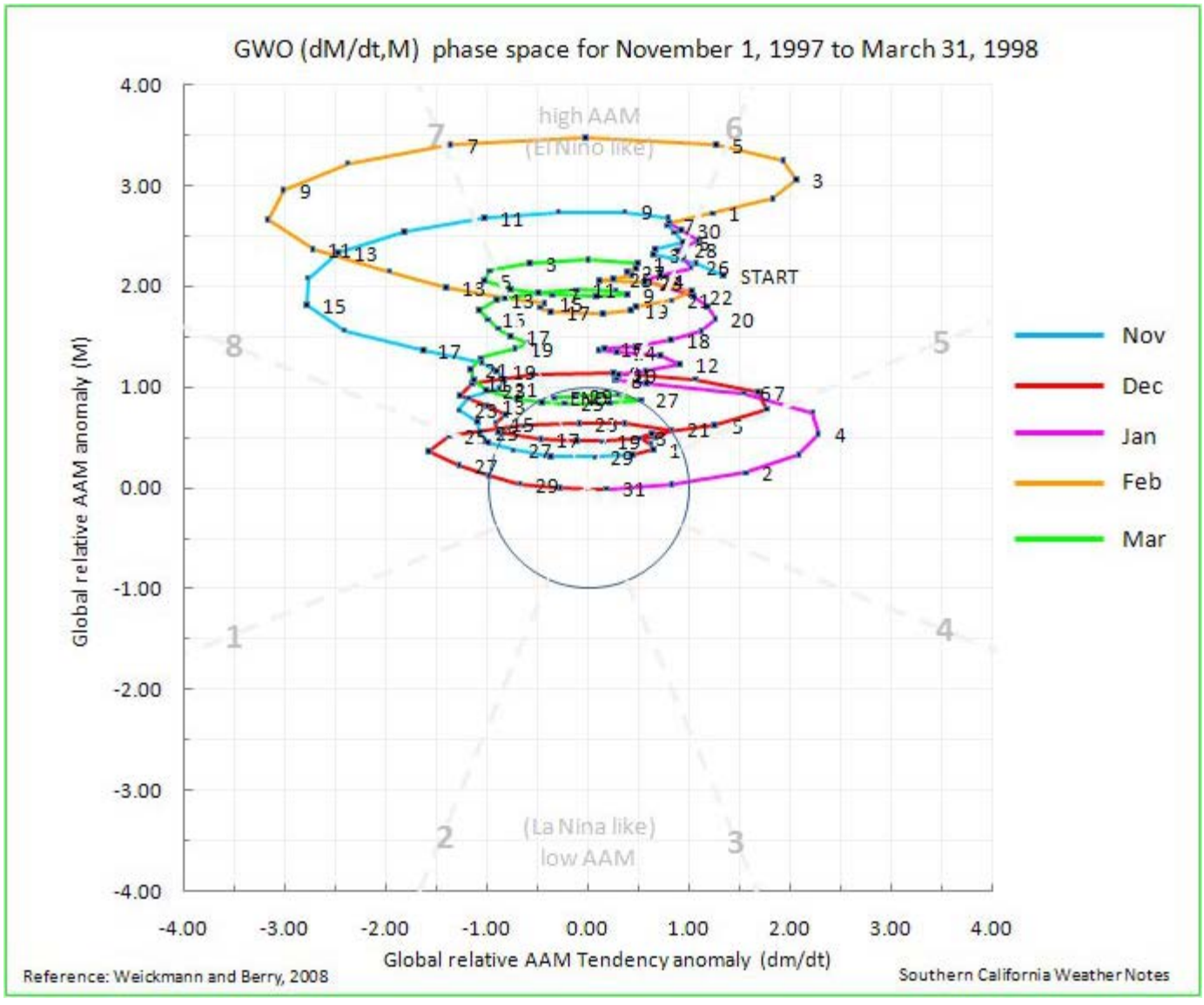
According to Southern California Weather Notes:

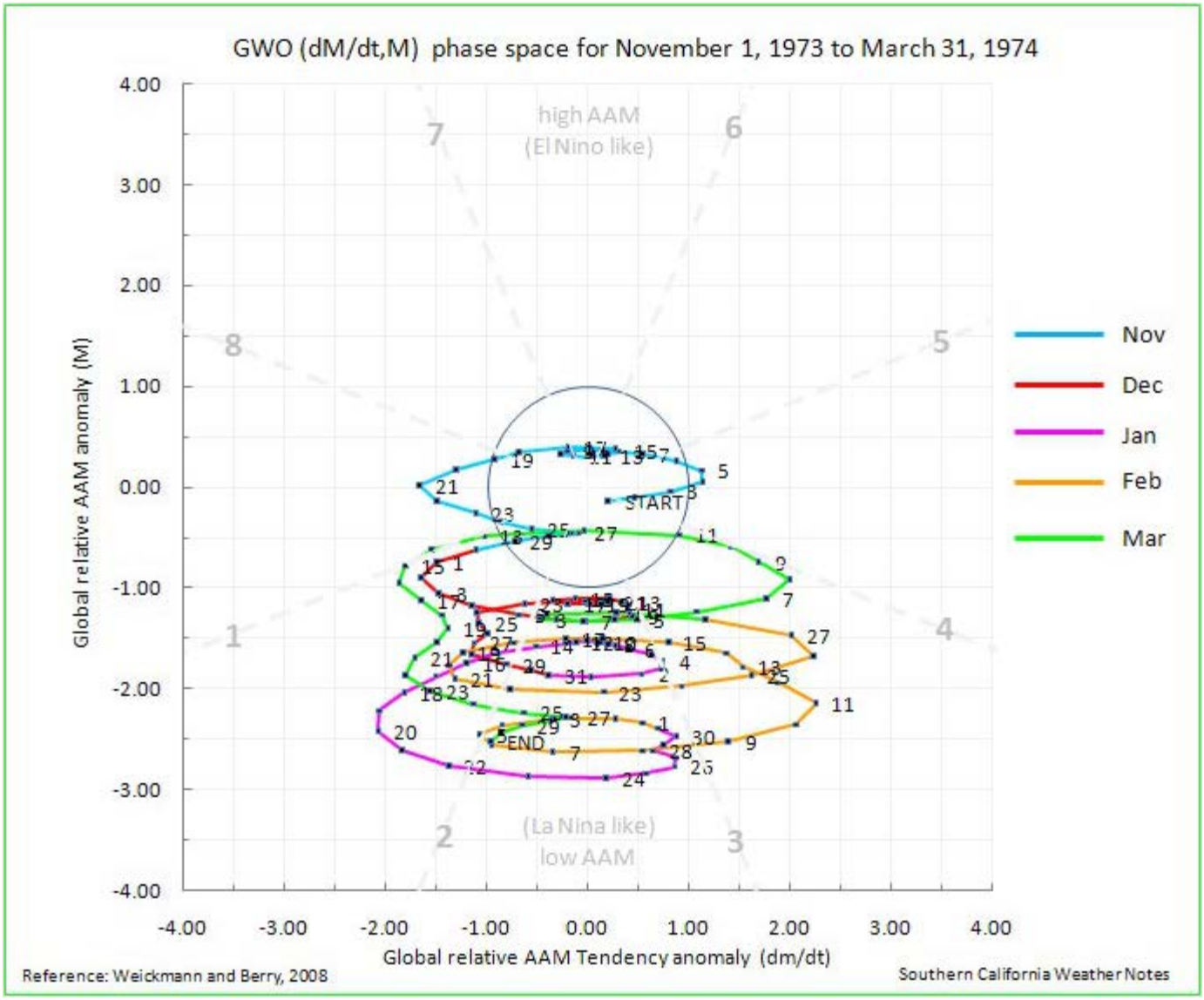
The recent enhancement of El Nino convection in the equatorial Pacific by the Madden-Julian Oscillation (MJO) has triggered a strong atmospheric response. A Global Wind Oscillation (GWO) phase space plot shows large increases in relative atmospheric angular momentum (AAM) and AAM tendency. As a result of this increase, the average relative AAM anomaly for the rain season to date is now positive. As

mentioned in this post from December 2009, relative AAM is correlated with rain season precipitation in Southern California. This suggests an increased likelihood of wet weather in Southern California in the medium range outlook period.

That December post says:

> Will the current El Niño produce the expected seasonal impacts in Southern California? A new tool that can help gain some insight into the linkage of climate and weather is the Global Wind Oscillation (GWO) phase space plot. Ed Berry repeatedly demonstrated the usefulness of this tool in his blog Atmospheric Insights. Although the blog has been discontinued, its content remains a valuable resource.
>
> The GWO is a recurring subseasonal phenomenon that involves the transport and interchange of momentum in the earth-atmosphere system. It encompasses the MJO and occurs on a similar timescale. Analogous to the MJO phase space plot, but based on a framework of atmospheric angular momentum (AAM), the GWO phase space plot is a measure global relative atmospheric angular momentum and its tendency. For details, see Weickmann & Berry, 2008.
>
> Relative AAM is generally positive during an El Niño and negative during a La Nina. Relative AAM is correlated with rain season precipitation in Southern California, and can be helpful in assessing potential El Niño impacts. The following November to March GWO phase plots show the distinctly different behavior of the GWO during the strong El Niño of 1997-98, and the strong La Nina of 1973-74:





In a decade characterized by quirky El Niños, the El Niño of 2009-10 has been acting like another odd one. From a Southern California perspective, the concern has been that it might be like the El Niño of 2006-07 when Downtown Los Angeles recorded only 3.21" of rain over the water year. In the early stages of the El Niño of 2006 strong convection developed in the Indian Ocean during November, but an MJO did not develop until a second round of Indian Ocean convection occurred in mid December. Relative AAM remained negative, and in terms of the atmosphere, the 2006 El Niño didn't make it to 2007.

This year, Indian Ocean convection did spawn an MJO which eventually enhanced El Niño convection near the dateline. Significant momentum was added to the mid-latitudes of the Northern Hemisphere, energizing the westerlies and contributing to the pattern change that resulted in our recent wet weather. However, the increase in mid-latitude AAM has been mostly offset by negative anomalies at higher latitudes. Following are the GWO phase space plots for the current rain season to date, and the quirky El Niño of 2006-07.

Luckily the El Niño seems to have gotten its act together by now and produced some hefty rains!

I'm struggling to understand the graphs shown above. I believe that the quantity called M is defined on page 7 of this paper:

- Klaus Weickmann and Edward Berry, The tropical Madden-Julian oscillation and the global wind oscillation, NOAA, October 3, 2008.

It seems to be an estimate of the total angular momentum of the Earth's atmosphere: AAM means "atmospheric angular

momentum". Angular momentum is a vector, but they're only considering the component aligned with the Earth's rotation, since winds tend to blow east-west. A typical value of the angular momentum of the Earth's atmosphere is 1.25×10^{25} kilogram meter^2 / second. This corresponds to a uniform wind blowing due east at a speed of 0.5 meters/second over the whole planet's surface.

The graphs above also show the time derivative dM/dt. A typical value of this is 1.8×10^{19} kilogram meter^2 / second^2.

I don't know what units the graph is using, but you can get the idea: an El Niño tends to boost the overall westerly flow of the planet's winds, while La Niña boosts the easterly flow. According to Rich Monastersky, writing for Science News:

> During non-El Niño years, winds in the tropics tropics, also called tropical zone or torrid zone, all the land and water of the earth situated between the Tropic of Cancer at lat. 23 1-2°N and the Tropic of Capricorn at lat. 23 1-2°S. blow from east to west, whereas winds over the rest of the globe travel from west to east. Combined, they give the atmosphere a net eastward momentum.
>
> The atmosphere routinely trades some of this momentum back and forth with the solid Earth as winds drag across the surface of the planet and push against mountain ranges. In the Northern Hemisphere's winter, the atmosphere speeds up and Earth slows. In summer, the reverse happens. El Niño boosts the atmosphere's angular momentum by slowing down the tropical easterlies and speeding the westerlies outside the tropics, says Salstein.
>
> As the atmosphere speeds up during El Niño, Earth itself slows down to conserve the combined angular momentum. John M. Gipson of NASA's Goddard Space Flight Center in Greenbelt, Md., has tracked the planet's spin by monitoring changes in the length of the day. Over a typical year, the day shortens and lengthens by roughly 1 millisecond, mostly because of shifts in atmospheric angular momentum. During the current El Niño, the day has grown longer by four-tenths of a millisecond, he says.

For more, try:

- British Atmospheric Data Centre (BADC), Background information on AAM.

February 7, 2010

In week293 of This Week's Finds, I announced that I'm going to quit writing This Week's Finds in Mathematical Physics after week300, and start a slightly column, This Week's Finds, which will address a new range of issues. I'm going to start by examining the case for human-caused global warming.

My friend Nathan Urban writes:

> Strange to hear that TWFMF is ending ... but good to hear there will still be a TWF! And I think it will be a lot of fun for you to explore these new areas. It was for me.
>
> A few things which come to mind as I read Week 293:
>
> Photovoltaics are definitely the most interesting from a quantum physics and optics perspective ... but there's also boring old concentrated solar thermal (i.e. mirrors and steam turbines) which is already a pretty developed technology and doesn't suffer from limited supplies of rare earth elements. (Instead it needs water, which can be problematic in deserts! But some have proposed using molten salt to use for heat storage during night time, although you still need water for the turbines.)
>
> - Climate Progress, Concentrated solar thermal power - a core climate solution.
> - Climate Progress, An introduction to the core climate solutions.
> - Climate Progress, The technologies needed to beat 450 ppm, Part 1

Some papers on the decline and future of Arctic sea ice:

- Donald K. Perovich and Jacqueline A. Richter-Menge, Loss of Sea Ice in the Arctic.
- Dirk Notz, The future of ice sheets and sea ice: Between reversible retreat and unstoppable loss.
- I. Eisenman and J. S. Wettlaufer, Nonlinear threshold behavior during the loss of Arctic sea ice.
- Julien Boi, Alex Hall and Xin Qu, September sea-ice cover in the Arctic Ocean projected to vanish by 2100.
- Ian Simmonds and Kevin Keay Extraordinary September Arctic sea ice reductions and their relationships with storm behavior over 1979-2008.
- R. Kwok *et al*, Thinning and volume loss of the Arctic Ocean sea ice cover: 2003-2008.
- R. W. Lindsay, J. Zhang, A. Schweiger, M. Steele, and H. Stern, Arctic Sea Ice Retreat in 2007 Follows Thinning Trend.
- James Maslanik *et al*, On the Arctic climate paradox and the continuing role of atmospheric circulation in affecting sea ice conditions.

Papers on wind (and solar) spectra:

- John Laumer, Solar Versus Wind Power: Which Has The Most Stable Power Output?
-
- Jay Apt, The spectrum of power from wind turbines.
- Aimee E. Curtright and Jay Apt, The character of power output from utility-scale photovoltaic systems.
- Jay Apt and Aimee E. Curtright, The Spectrum of Power from Utility-Scale Wind Farms and Solar Photovoltaic Arrays.
- Warren Katzenstein, Emily Fertig, Jay Apt, The variability of interconnected wind plants.

Jay Apt at CMU has been working on the inefficiencies induced by having to match the wind power spectrum to the electricity grid spectrum.

You talk about mesoscale and large-eddy simulation. This ties into "multiscale simulation", which is about how to represent sub-grid scale physics in a large-scale numerical simulation. Common approaches are to treat the sub-grid scale physics stochastically in some way as "unknown physics with given statistical behavior", either analytically or by embedding small-scale simulations inside larger ones to numerically compute said statistics. There are a number of mathematicians working on this, e.g. at these UCLA workshops this spring:

- Institute for Pure and Applied Mathematics, UCLA, Model and Data Hierarchies for Simulating and Understanding Climate.

See e.g. work by Andrew Majda, Ilya Timofeyev, Weinan E, and others.

- Andrew J. Majda.
- Ilya Timofeyev.
- Weinan E.

There is some debate as to how to do this properly, between "heterogeneous multiscale" vs. "equation free" approaches. (I gather the former is more systematically mathematical, and the latter is more purely numerical.)

- Weinan E, Bjorn Engquist, Xiantao Li, Weiqing Ren and Eric Vanden-Eijnden, Heterogeneous Multiscale Methods: A Review.
- Weinan E, Weiqing Ren and Eric Vanden-Eijnden, A general strategy for designing seamless multiscale methods.
- Weinan E, The heterogeneous multiscale method and the "equation-free" approach to multiscale

modeling.
- Weinan E and Eric Vanden-Eijnden, Some Critical Issues for the "Equation-Free" Approach to Multiscale Modeling.

Multiscale modeling is particularly important in modeling cloud physics since clouds are hugely important to the Eath's radiative balance but are too small to realistically model globally, hence "cloud superparameterization". See:

- David Randalla, Marat Khairoutdinova, Akio Arakawab, and Wojciech Grabowski, Breaking the Cloud Parameterization Deadlock.
- Wei-Kuo Tao *et al*, A multiscale modeling system: developments, applications and critical issues.

JB wrote:

> I have some ideas. For starters, something like science journalism / blogging, but with a focus on issues where we need a scientist to understand technical details and then explain them clearly. I think I'm good at that.

Yes, that could be a good strategy. There are a number of topics which I think could benefit from a good technical exposition. In fact, I've toyed with writing a little book about this, with simple qualitative reasoning about systems dynamics. You can probably explain these things much better than I could.

1. Why the "urgency"

People need to understand better the ideas of sources/sinks in systems analysis and the concepts of physical and socioeconomic inertia. This is, e.g., one of the themes of the Solomon "irreversible climate change" paper you've mentioned.

For example, people often think that we just have to stop increasing our CO_2 emissions and the problem will be solved. But CO_2 levels will continue to increase as long as emissions (source rate) exceed the sink strength, and natural carbon sinks are much weaker than current emissions: terrestrial sink takes about 1/4 of what we emit, the oceans take about 1/4, and 1/2 stays in the air. So we'd have to drop emissions to half what they are now before natural sinks can even keep up with them, let alone reduce CO_2 (assuming that the strength of natural sinks stays constant). A lot of people get confused between CO_2 *concentrations* and CO_2 *emissions/sinks*:

- Andrew C. Revkin, The greenhouse effect and the bathtub effect.
- John D. Sterman, Risk communication on climate: mental models and mass balance.
- Climate Interactive, The climate bathtub animation.
- Jorge L. Sarmiento and Nicolas Gruber, Sinks for anthropogenic carbon.

Related concepts are "airborne fraction" or AF (how much anthropogenic CO_2 stays in the air) and whether AF is changing (and how that relates to how CO_2 *concentrations* are changing, some people falsely think that a constant AF means CO_2 isn't increasing). Also misunderstood is the difference between carbon atmospheric residency time and the e-folding time of carbon sinks. A given CO_2 molecule only spends a few years in the atmosphere before ending up in a sink, but the *effective lifetime* of atmospheric CO_2 is much longer, decades to centuries on average. (Analogy: a molecule is emitted and quickly absorbed by some sink, leaving CO_2 concentration unchanged. But how long for CO_2 concentration to *decrease*? For that, maybe you have to grow a whole new tree to absorb the extra CO_2 molecules that aren't already being absorbed by existing trees.) This confuses many people:

- David Archer *et al*, Atmospheric Lifetime of Fossil Fuel Carbon Dioxide.

In fact, there are multiple timescales involved in carbon sinks, and some of them are very slow. This is where I think Mason Inman's analysis and David Archer's work (e.g., *The Long Thaw*) are more relevant than Franklin Cocks, as you discuss in your diary. A lot of CO_2 is going to be around for a long time, and this may affect the ice age cycle itself:

- David Archer and Andrey Ganopolski, A movable trigger: Fossil fuel CO_2 and the onset of the next glaciation.

So, it's not just a matter of keeping emissions steady, we have to cut them, and cut them a lot, before atmospheric CO_2 will actually stabilize or decrease. And ultimately, even cutting emissions to zero isn't going to necessarily avoid dangerous climate change. For example, if we cut them to zero by simply burning all fossil fuels! If we want to avert the full amount of climate change possible, we have to *leave fossil fuels in the ground and never burn them*, not just burn them more slowly (e.g., by more efficient use of energy). Otherwise, you're just delaying the problem a little. (There's so much focus on 2100 that people forget that a huge amount of global warming in, say, 2200 is also a problem!) What really matters is our *cumulative emissions*, the total amount of fossil fuels we will ever emit, and how much less that is than the total amount available. See here:

- Myles Allen *et al*, The exit strategy.

People don't understand this either. Many think that all we have to do is be more energy efficient, but this isn't going to stop us from burning fossil fuels, it will just slow it a little. To stop burning fossil fuels altogether, they have to become more expensive than alternatives (or regulated). (Also related is the Jevons paradox: if we become more efficient, that just lets us burn more fossil fuels for the same cost! To keep consumption down, economists have argued that you need a price incentive or need to regulate consumption.)

Then there is inertia. If we mitigate our emissions, we're not going to see that reflected in the climate system immediately. Most of the heat capacity in the planet is in the oceans, with a characteristic heat mixing timescale of decades. That's how long it takes to fully adjust to changes in radiative forcing (and the time also depends on feedback strengths, with stronger feedbacks implying slower responses). You can see this by analyzing the simple linear response model:

$$C\,dT/dt = F - \lambda T$$

where T is temperature, C is heat capacity, F is radiative forcing (e.g. log CO_2 concentration), and λ is a feedback factor (inversely related to climate sensitivity).

The oceans will slow the climate response to anything we do, sea level rise from thermosteric expansion will continue as long as the oceans continue to heat as they try to re-equilibriate. Ice sheets have even slower response times.

Then there is socioeconomic inertia. People often think we should be embarking on a crash program to develop breakthrough energy technologies. That just takes too long to rely on. It probably takes about 50 years from initial research, to development, to deployment, to *widespread* deployment for a new energy technology. Breakthroughs could eventually help, but things we can deploy widely *now* (like simple baseload solar) are the most important, when coupled to the long lag times in the climate system itself.

2. Climate sensitivity and feedbacks

What is CO_2 going to do to the climate? Well, we expect about 3.7 W/m^2 extra radiative forcing, top of atmosphere, from doubled CO_2. (Radiative forcing is logarithmic in CO_2 concentration, basically the Beer-

Lambert law, so we count CO_2's effect in terms of doublings.) This is expected to produce about 1 C of warming for each doubling. That by itself is not too bad. It's the feedbacks which get you: they can increase the response to 3 C or more. These are things like water vapor increases in a warmer climate (water vapor is a greenhouse gas), ice albedo feedback (melt ice, Earth's surface is darker and absorbs more heat), cloud cover changes, changes in the carbon cycle, etc. That's where most of the problem, and most of the uncertainty in how bad the problem is, comes from. I think people could use a good introduction to linear feedback theory in the climate system. Something like a layman's version of this:

- Gerard Roe, Feedbacks, Timescales, and Seeing Red.

3. Climate surprises, thresholds, nonlinearities, and abrupt climate change

These are the big risks which might be unlikely but could be so bad that we ought to take steps to reduce their risk anyway. Disintegration of major ice sheets, collapse of the Atlantic overturning circulation (although that's looking like less of a risk), runaway permafrost or methane clathrate melting, etc. Some of these can occur if you pass a "threshold" (bistable system, can exhibit hysteresis) and can be effectively irreversible. For example, if you melt Greenland and later reduce temperatures back to pre-industrial, the ice sheet won't return to its pre-industrial state. It will be gone. You need an ice age to rebuild it. I bet you could show this analytically in a simple conceptual model.

Some miscellaneous links that come to mind, perhaps not the best selection:

- Timothy M. Lenton *et al*, Tipping elements in the Earth's climate system.
- Jonathan M. Gregory, Climatology: Threatened loss of the Greenland ice-sheet.
- Young-Gyu Park, The Stability of Thermohaline Circulation in a Two-Box Model.
- R. B. Alley *et al*, Abrupt Climate Change.
- Reto Knutti and Thomas F. Stocker, Limited Predictability of the Future Thermohaline Circulation Close to an Instability Threshold.
- R. J. Stouffer, K. W. Dixon, M. J. Spelman, and W. Hurlin, Investigating the Causes of the Response of the Thermohaline Circulation to Past and Future Climate Changes.
- Jonathan Bamber, What happens when an ice sheet melts?
- this.
- this.

JB wrote:

> Then, maybe learning enough and getting to know enough people to tackle some more specific technical projects.

Not sure what I can suggest about that, as most of the mathematical research I know of in climate science is pretty far from "abstract nonsense" and bond diagrams ... more numerical analysis.

JB wrote:

> Apparently people need better modelling techniques all over, especially for designing the "smart grid". I can sense an opportunity for abstract nonsense like "bond graphs" here.

I'm no expert on "the smart grid", but you might want to look at CMU's energy research:

- this.

Some interesting people in their Engineering and Public Policy department are M. Granger-Morgan, Jay Apt, Lester Lave. For electricity research, see their Electric Industry Center:

this.

At Penn State we have Seth Blumsack (who did his PhD at CMU) who works on energy grid design (although mostly from an economic policy perspective rather than, say, network design and modeling):

- this.

February 10, 2010

Another bit of rain.

February 12, 2010

Tim van Beek writes:

> Dear John,
>
> I always wondered if climate models that try to predict sudden climate changes could profit from the knowledge that physicists have about phase changes in condensed matter physics. Item 3 in Nathan Urban's email, "Climate surprises, thresholds, nonlinearities, and abrupt climate change", reminded me of this analogy. The article
>
> - T. M. Lenton H. Held, E. Kriegler, J. Hall, W. Lucht, S. Rahmstorf, and H. J. Schellnhuber, Tipping elements in the Earth's climate system.
>
> was particularly interesting to me for this reason.
>
> The following article is a little addendum to this:
>
> - Alan Hastings and Derin Wysham, Regime shifts in ecological systems can occur with no warning.
>
> That requires a subscription, unfortunately, but the authors are — remote — colleagues of yours. By the way, the Potsdam Institute of Climate Impact Research has a nice homepage that will be a good distraction, should you suffer from insomnia. 
>
> Kind regards,
>
> Tim van Beek

February 13, 2010

In South Carolina, terrorists now need to register with the state. Here's the form:

- Secretary of State, South Carolina, Subversive Agent Form.

There's a $5 filing fee. You have to outline the fundamental beliefs of your subversive organization, attach a copy of its bylaws or the minutes from your last meeting, and list your members.

February 14, 2010

It's Valentine's Day! And last night we had our Lunar New Year party, where the guests help us make *jiaozi* — the dumplings that are traditional for this occasion in China.

Charlie Clingen writes:

> Hi, John-
>
> Recently I've been thinking a lot about your change of direction and what you will be doing next. I'm beginning to form a clearer idea of what I think you could do (and enjoy doing) in order to have a significant impact of the future direction of our country and our planet.
>
> I'll sketch the outline and see if it appeals to you at all.
>
> First, I'm assuming that we do best that which we like most to do (and vice versa). It seems to me that some of your most outstanding abilities include: the ability to summarize difficult, technical concepts and relate them to each other in new and interesting ways; the ability to explain complicated ideas clearly in novel and interesting ways; the ability to organize and display large amounts of interrelated information in efficient ways. You are also good at keeping blog responses under control before they spin off into flame wars.
>
> Given that, and your past history as visible to me, I'm guessing that the following might be of interest to you.
>
> A summary:
>
> - You can create a new blog intended for use by professional, technical people world-wide, with expertise in fields related to climate analysis, energy production, natural resource conservation and pollution control.
>
> - You would initiate discussions in several strings, including those just mentioned, by writing a brief

introductory summary paper for each topic stating your understanding of the state-of-the-art plus the severity of the threat and the purpose of the discussion in the blog.

- You would monitor discussions forcing people to give their professional opinions, not their personal opinions. You would emphasize the requirement for data as opposed to beliefs and opinions. Relentless reinforcement of that requirement would be an effective way to keep the wingnuts at bay.

- You would collect papers and publications, much as you are now doing, and consolidate them on an ongoing basis into bibliographies for future reference.

- You, with the help of some new-found colleagues, would prepare, update continuously, and display online, perhaps in style of This Week's Finds, summaries of the state-of-the-art and the state-of-the-crisis for various areas, such as those proposed above.

- Perhaps your most valuable contribution, in addition to all the hard work above, would be the imposition of your professional value judgments upon all of this information. It would be up to you to aggregate and prioritize the various professional results and then "make the call", stating authoritatively what it all means. This will make you uncomfortable, because you know you will make mistakes. But that doesn't matter. What matters is that you will be right most of the time, and the fact is that you will be in a better position to make such judgments calls, and you, personally and technically, will be better equipped to make such broad, cross-specialty value judgments than anyone else. So, you should just go for it. Be the oracle, be the wizard. When people challenge you, point them to your summary papers and ask them to provide data that disproves your conclusions. If they can do so, accept it gratefully, change your summary, and move on, just as you do today in This Week's Finds and the n-Category Café. That's what we all need in these crazy, confusing times of change and chaos.

- These summaries would be written with the objective of being referenced and quoted as the authoritative status of the state-of-the-art and the state-of-the-problem. I will take a couple of years for you to achieve that level of acceptance, but it is possible, indeed probable, if that is your objective.

- Success would be measured by how widely known and accepted your summaries become. One of the most difficult challenges would be to find a way to get them properly quoted by the popular press, rather than misquoted, as is almost always the case. This would probably require you and your colleagues to submit yourselves to media interviews from time to time in order to set things straight.

So, in a nutshell, that's a summary of my thoughts. I haven't thought through clearly yet the proper division of responsibility between blog discussions and on-line technical summary papers, but you know a lot more about that than I do.

As usual, I have violated one of my own "Charlie's Laws": "Never define a problem by stating your solution." But hey, sometimes I just can't help myself.

Hope this gives you some useful food for thought.

I believe you have the potential to make a big difference. Go for it! If later you decide it's not for you, you always have plan B — the deeper integration of advanced math and theoretical physics.

Best regards,

Charlie Clingen

This plan appeals to me, not only for noble reasons, but also for ignoble ones. I enjoy grandstanding and being at the center of attention. Unfortunately, pursuing this plan would require a vast amount of energy and dedication on my part

— especially the parts that involve dealing with other people. I have a lot of energy when I'm doing what I want to do, but my interests flit around in a somewhat unpredictable way. I want to indulge that tendency a bit more than I've been able to recently. One reason I want to quit working on *n*-categories is that it started feeling very burdensome: there were more and more half-completed papers I *needed* to finish, less and less time for free exploration. I feel much happier if I wake up and have a few hours to do whatever I want — whatever excites me at the moment! That's when I come up with good ideas. As soon as I quit working on *n*-categories, I started having lots of good ideas.

This Week's Finds suits this aspect of my personality — it lets me jump from subject to subject without feeling guilty about it. I like the idea of writing a *This Week's Finds* whose scope is broader, including environmental issues. But making myself into a dedicated compiler of information — "the oracle, the wizard" — and building up people's expectations that I'll be there whenever they need a judgement rendered — that doesn't sound so good. I'll burn out!

So, I need to tweak Charlie Clingen's plan a bit. I want a role that's a bit less grandiose, a bit less of a full-time job.

Also: when my 5 grad students finish up, I'm going to switch back to having one or two at most. It's great fun having a big team of people to work with. But doing research with grad students is like driving a train: it takes a long time to start them up on something, and you can't stop a project suddenly, or turn on a dime. When I get more seriously into work on ecology, engineering, quantum computation and the like (and maybe algebraic geometry with Jim Dolan), I want to become more maneuverable.

February 16, 2010

A Tibetan Buddhist monk on a road in the Qinghai province of China.
He is on a pilgrimage to Lhasa, 400 miles away. The journey will take about six months.
Photograph by Christopher Brown of NPR.

Here's a fun and enlightening radio show about a journey down the Mekong River:

- Michael Sullivan, The Mekong: a river and a region transformed, National Public Radio:
  - At Mekong's source in China, past and present collide.
  - Mekong flows along troubled Myanmar's east.
  - Mekong divides different worlds in 'Golden Triangle'.
  - Cambodia's fortunes ebb and flow along the Mekong.
  - As Mekong rolls to the sea, turbulence on its banks.

I'll be pretty near some of these places when I move to Singapore! I'd like to visit Cambodia and Laos. But I don't want to get anywhere near the opium fields of the Golden Triangle, or Myanmar. Those places sound like trouble.

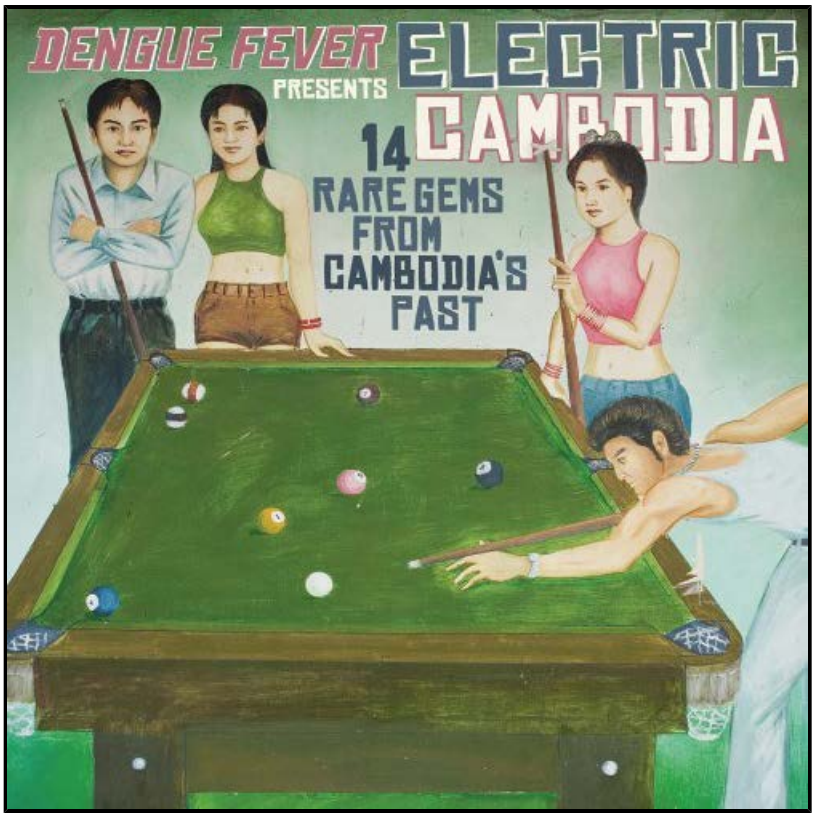
February 20, 2010

It rained last night!

As you can see, I'm trying to get myself into the swing of living in Southeast Asia a little bit before I actually go there. So I found this story interesting:

- Scott Simon, Psychedelic Cambodian rock actually pretty inspirational, *Weekend Edition*, National Public Radio, February 20, 2010.

A condescending story title, but a nice story about an album of Cambodian rock music from the late 60's and early 70's — the good old days, before the Khmer Rouge took over and devastated the country, killing almost a quarter of the population through execution, torture, forced work and starvation. The album is called Electric Cambodia, and it was compiled by a band called Dengue Fever.



This sort of music can grate on Western ears. For starters, the high-pitched, sweet but slightly whiny female vocals in Cambodian music don't sound "cool". It reminds me a bit of how Lisa used to combat neighbors who played loud rock music by playing Chinese opera at full volume! And there can also be something a bit pathetic about Asian attempts to imitate Western music fads. You think "why don't they do their own thing?" But music styles are like highly contagious viruses — they hop unstoppably from culture to culture, mutating in weird ways as they go. And I'm learning it's good to check your pre-established notions of "cool" at the door if you want to explore a wide range of music. And so, I think I could get to like this stuff.

Here's what I'm listening to these days. Click on the artist's name for more information on them, or the album title to hear a bit:

- Bill Frisell, Disfarmer. Jazz guitarist with band playing deep, haunting miniatures with interlocking themes.
- Blossom Dearie, Verve Jass Masters 51. Jazz singer and pianist with a baby-doll voice — may sound corny at first, but it grows on you. These days when Lisa and I drive to the grocery store we practice singing along to Rhode Island is Famous for You.
- Aphex Twin, Drukqs. Aphex Twin is Richard James, and Richard James is a madman. Here he plays grating, wildly energetic techno interspersed with otherworldly, sometimes gentle prepared piano tracks.
- Richie Hawtin, Musik. Techno put out by Richie Hawtin under the monicker "Plastikman", with some entrancing tracks like Plastique and Marbles. The excitement comes from gradually changing timbres made on some classic Roland synthesizers. You need good speakers to fully appreciate these sounds. On my tinny computer speakers, this music sounds like crap.
- Michèle Claude et L'Ensemble Aromates, Jardin de Myrtes: Mélodies Andalouses du Moyen-Orient. Beatiful Andalusian melodies played on traditional instruments. It's slightly marred by the Western classical style of the instrumentalists — it doesn't "swing" as much as it could. But it's still good, and the title track is unforgettable.
- Eduardo Paniagua Group, Danzas Medievales Españolas. Truly ravishing performances that explore the interplay between north African music, Andalusian music and the music from the Catholic tradition in medieval Spain.

Unlike the previously listed album, Eduardo Paniagua's musicians have a fiery sense of rhythm. It's absolutely tragic how hard his albums are to find — I just shelled out $30 for Latidos de Al-Andalus. But Danzas Medievales Españolas is easy to find.

February 21, 2010

Mike Stay has some great pictures on his blog:

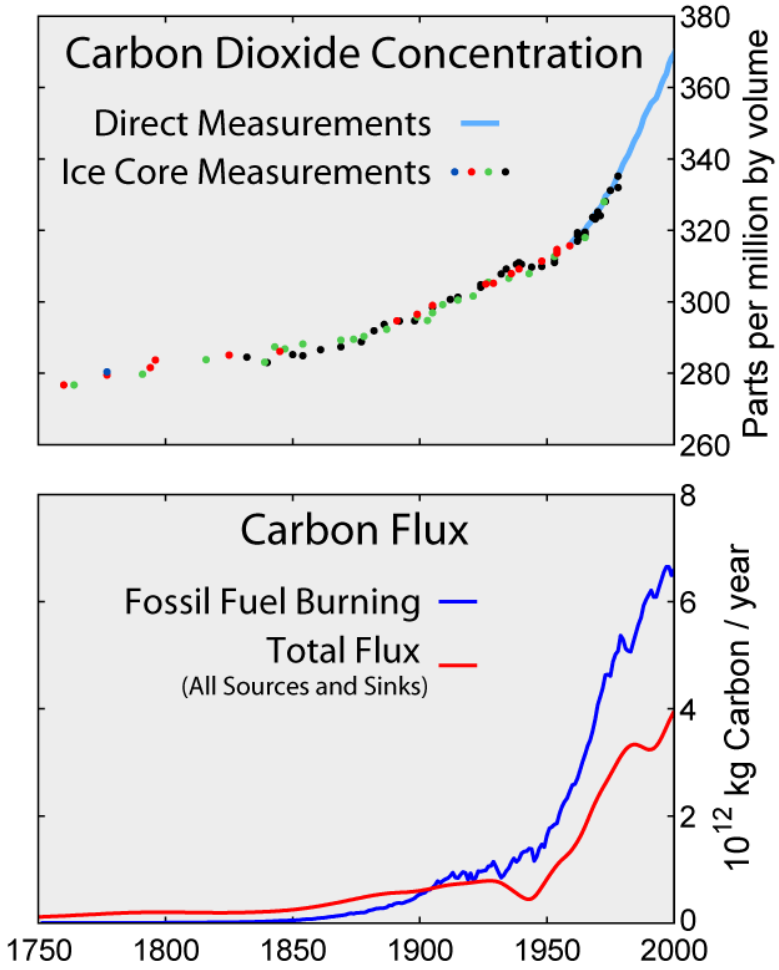
February 22, 2010

Simon Willerton arrived in town last Tuesday — he's a pal of mine, a mathematician from Sheffield who works on quantum topology. He's going to be visiting Riverside until the end of April. We had him over for dinner last night, along with a music professor at UCR named Paolo Chagas, who Lisa met recently — he turned out to live just a few

It was cloudy all day yesterday, and last night it finally broke down and rained again! The hills are nice and green.

February 24, 2010

In 1750 there were about 280 part per million of carbon dioxide in the atmosphere. Now it's about 380 ppm.



MIT scientists predict roughly 886 parts per million by 2095 in a business-as-usual scenario - that's the median of a probabilistic simulation described here.

So, by the century's end, the the amount of CO_2 in the atmosphere may almost quadruple from its level before the industrial revolution. How much will each doubling of the CO_2 raise the Earth's temperature? The long-term answer may be quite different from the short-term answer, because there are feedback effects like the ice albedo effect that take a while to kick in. A short-term estimate is roughly 3°C. Long-term estimates could be more like 6°C:

- Climate Progress, Another 'Must Read' from Hansen: 'Long term' climate sensitivity of 6° C for doubled CO2, October 1, 2007.

The MIT study predicts a median of about 5°C of warming by the century's end, with a 90% chance of warming between 3.5 to 7.4 degrees. They call for rapid and massive action to avoid this.

February 25, 2010

In response to my mention of Hansen's 2007 estimate of 6° C 'long term' temperature increase in response to doubled CO_2, a correspondent writes:

> I've always been skeptical about Hansen's claim of 6 C for long-term sensitivity. This may be appropriate over the glacial-interglacial cycles, in which there was a large ice-albedo feedback from vast continental ice sheets in the Northern Hemisphere. However, since we are in an interglacial, those ice sheets aren't there anymore. Thus, we should expect a much smaller ice-albedo feedback under further warming, even if the Greenland and West Antarctic ice sheets disintegrate.

Hansen was still making his 6 C claim in this paper:

- James Hansen, Makiko Sato, Pushker Kharecha, David Beerling, Robert Berner, Valerie Masson-Delmotte, Mark Pagani, Maureen Raymo, Dana L. Royer, James C. Zachos, Target Atmospheric CO2: Where Should Humanity Aim?, *The Open Atmospheric Science Journal*, 2, 217-231.

  Abstract: Paleoclimate data show that climate sensitivity is 3°C for doubled CO2, including only fast feedback processes. Equilibrium sensitivity, including slower surface albedo feedbacks, is 6°C for doubled CO2 for the range of climate states between glacial conditions and ice-free Antarctica. Decreasing CO2 was the main cause of a cooling trend that began 50 million years ago, the planet being nearly ice-free until CO2 fell to 450 ± 100 ppm; barring prompt policy changes, that critical level will be passed, in the opposite direction, within decades. If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO2 will need to be reduced from its current 385 ppm to at most 350 ppm, but likely less than that. The largest uncertainty in the target arises from possible changes of non-CO2 forcings. An initial 350 ppm CO2 target may be achievable by phasing out coal use except where CO2 is captured and adopting agricultural and forestry practices that sequester carbon. If the present overshoot of this target CO2 is not brief, there is a possibility of seeding irreversible catastrophic effects.

I've never quite followed the chain of logic in that paper completely. He derives a slow-feedback of 6 C from the glacial-interglacial cycle in Section 2.2. But the question is does that generalize to slow feedback starting from a low-ice state? He argues that 35 My in the Cenozoic is a good analog for that, but I don't see him actually derive a number for slow feedback in Section 3.2. In Section 3.3 he argues that "the equilibrium climate sensitivity ... is almost as large between today and an ice-free world as between today an the ice ages", which implies that you should still get a slow 6 C into a future ice-free state. I guess I could sit down and try to verify this from figures, but he doesn't show a calculation as far as I can tell.

This paper was written in 2007 and published some time in 2008. Interestingly, in December 2008 Hansen gave the Bjerknes Lecture at the AGU fall meeting, with slides here. In these slides (see pp. 8-9), Hansen says that the empirical climate sensitivity relevant to today's climate is "nailed" precisely to 3 C, *including* paleo constraints. In the footnotes he notes that slow feedbacks are sensitive to the climate state. And he doesn't mention 6 C anywhere in the lecture. Many have interpreted this as backing off from the claim that the slow sensitivity relevant to a modern interglacial climate is 6 C. But he doesn't come out and say it.

My question to you is, since you've read his new book, does he say anything about very large slow feedbacks which are relevant to modern climate (i.e., a 6 C climate sensitivity)? i.e., is he still pushing this claim publicly? I would imagine that if so, he would put it in his book somewhere, since he's been pounding the drum about extreme climate risk (e.g., his runaway greenhouse stuff ... which he mentions in his Bjerknes lecture, but using GISS modelE with a climate sensitivity of something like 2.8 C, IIRC).

My answer: no, apparently Hansen is no longer pushing the 6° C figure. On page 45 of his book:

Fortunately, Earth's history allows precise evaluation of climate sensitivity without using climate models. This approach is suggested by the fact that some feedback processes occur much faster than others.

[...]

Using Earth's history, we can evaluate Charney's fast-feedback climate sensitivity by comparing the last glacial period, 20,000 years ago, with the recent interglacial period, the late Holocene. [...] We see that the total forcing of about 6.5 watts maintained an equilibrium temperature change of about 5 degrees Celsisus, implying a climate sensitivity of about 0.75 degree Celsius for each watt of forcing. This corresponds to 3 degrees Celsius for the 4-watt forcing of doubled carbon dioxide. The sensitivity is smack in the middle of the range that Charney estimated, 1.5 to 4.5 degrees Celsius.

From page 157:

> Earth's temperature changed about 14 degrees Celsius between 50 million years ago and the recent ice ages. Between 50 and 34 million years ago, the period when there were no large ice sheets on Earth, we expect climate sensitivity to be 3 degrees Celsius for doubled carbon dioxide (the empirical climate sensitivity we inferred earlier from glacial-interglacial climate change).

I don't understand where higher sensitivity due to larger ice sheets fits into his story here, and I don't even understand where the fast/slow issue shows up. But the figure of 3 degrees, not 6, is the one that keeps showing up.

Here's an online book about tipping points for climate change:

- Daniel B. Fagre and Colleen W. Charles, *et al*, Thresholds of Climate Change in Ecosystems.

Since I live in Southern California, where a cycle of drought, bark beetle infestations, fires, and mudslides have been destroying forests for about a decade now, I was particularly interested in the section on broad-scale forest die-back as a threshold response to climate change in the southwestern United States. Here's a quote, with references deleted to make it easier to read:

> Currently, climate-induced dieback of woody plants is being recognized as an important vegetation response to climate variation and change, with examples of forest dieback emerging from around the world. (It should also be noted that other recent studies have documented increased tree growth in dry forests, perhaps because of increased water use efficiency.) Recent research shows that water stress appears to be driving increases in background tree mortality rates in western North American forests. In addition, observations of extensive tree die-off — especially from semiarid ecosystems where woody plants are near their physiological limits of water stress tolerance — are being documented globally, for example, in Australia, Africa, west Asia, Europe, South America, and North America. Climate-induced water stress over extended time periods can exceed the physiological tolerance thresholds of individual plants and directly cause mortality through either 1) cavitation of water columns in the xylem conduits ("hydraulic failure") or 2) forcing plants to shut down photosynthesis to conserve water, leading to "carbon starvation". These individual-scale threshold responses to climate stress can trigger tree mortality that propagates to landscape and even regional spatial scales, sometimes amplified by biotic agents (like bark beetles) that can successfully attack and reproduce in weakened tree populations and generate massive insect population outbreaks with positive feedbacks that greatly increase broad-scale forest mortality.
>
> [...]
>
> Although tree mortality almost certainly occurred across much of the southwestern United States in response to the 1950s drought (and probably for previous regional-scale droughts as well), few studies exist that allow scientists to test projections about the rapidity and extent of potential vegetation die-off responses to drought. A recent drought beginning in the late 1990s and peaking in the early 2000s affected most of the western United States. This was the most severe drought in the Southwest since the 1950s. Substantial mortality of multiple tree species has been observed throughout the Southwest during this 2000s drought. For example, mortality of the piñon pine spanned major portions of the species' range, with substantial die-off occurring across at least 1,000,000 hectares from 2002 to 2004. For both droughts, much of the forest mortality was associated with bark beetle infestations, but the underlying cause of dieback appears to be water stress associated with the drought conditions.
>
> The precipitation deficit that triggered the recent regional-scale die-off of the piñon pine across the Southwest was not as severe (dry) as the previous regional drought of the 1950s, but the recent 2000s drought was hotter than the 1950s drought by several metrics, including mean, maximum, minimum, and summer (June-July) mean temperature. Although historic data from the 1950s is limited, available data suggest that piñon pine mortality in response to the recent drought has been more extensive, affected greater proportions of more age classes, and occurred at higher elevation and wetter sites than in the 1950s drought. Hence, the warmer temperatures associated with the 2000s drought may have driven greater plant water

> stress through increased evapotranspirational demand and resulted in more extensive tree die-off. Because global change is projected to result in droughts under warmer conditions (referred to as "global-change type drought") the severe piñon pine dieback from the recent drought may be a harbinger of vegetation response to future global-change type droughts. In addition to the die-off of dominant overstory tree species, high levels of dieback also were observed in other Southwestern U.S. species and life forms in response to the warm regional drought in the 2000s. These include species where bark beetles are unimportant or nonexistent, including one-seed juniper (*Juniperus monosperma*) — a co-dominant with piñon pine for much of its range; shrubs such as wavy-leaf oak (*Quercus undulate*) and mountain mahogany (*Cercocarpus montanus*); and blue grama (*Bouteloua gracilis*), the dominant herbaceous species in many of these woodland systems. In addition to direct climate-induced mortality, severe protracted drought also can cause substantial reductions in the productivity and soil surface cover of herbaceous plants, which in turn affects numerous other ecological processes. In particular, reductions in herbaceous ground cover can trigger a nonlinear increase in soil erosion once a threshold of decreased herbaceous cover has been crossed, through increased connectivity of bare soil patches. On the other hand, dieback of woody canopies tends to cause an immediate successional shift toward greater cover of understory vegetation if moisture conditions are adequate, which propagates a different set of effects.

For more, try:

- David D. Breshears *et al*, Regional vegetation die-off in response to global-change-type drought, *PNAS* **102** (2005), 15144-15148.

A quote:

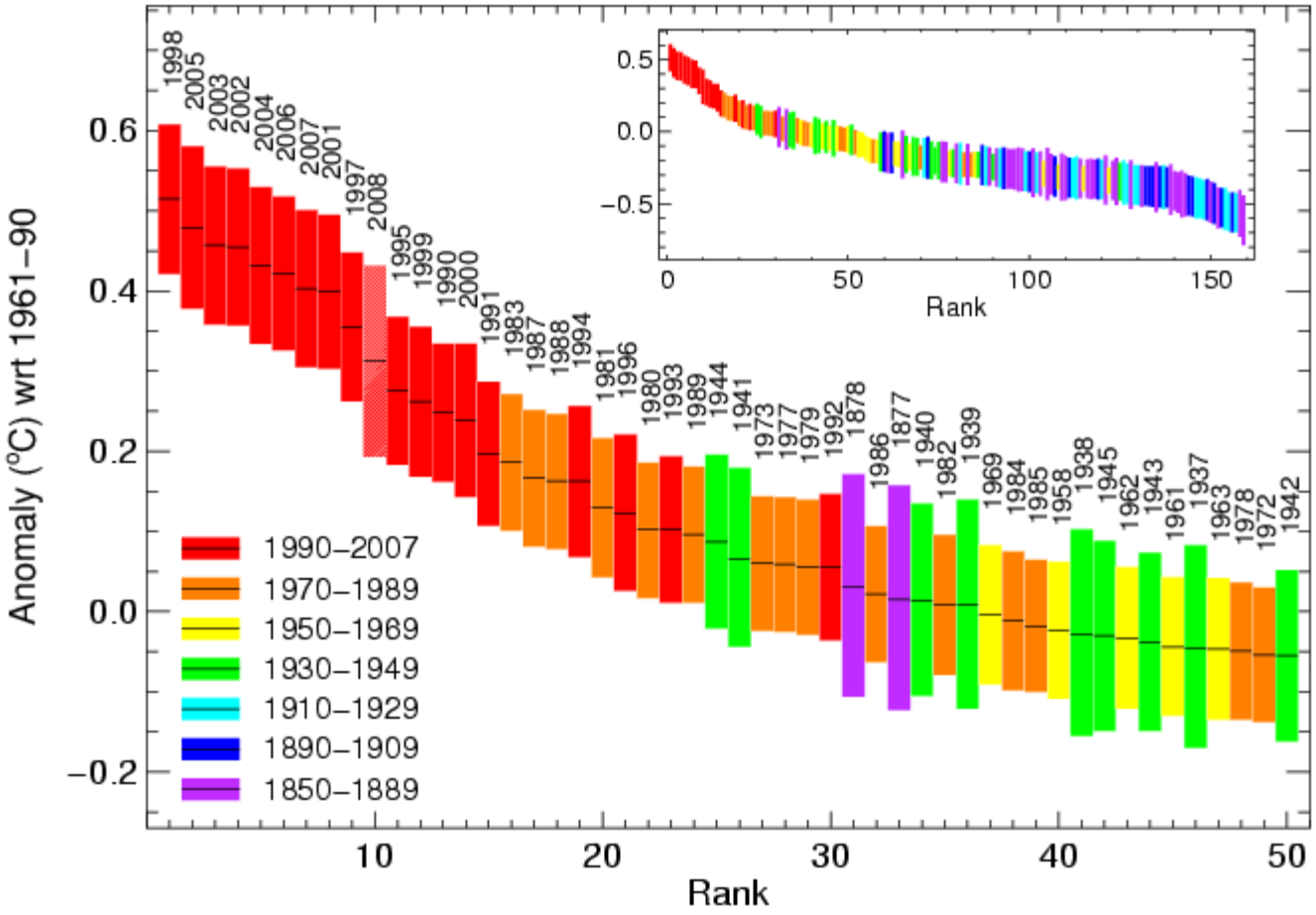
> Future drought is projected to occur under warmer temperature conditions as climate change progresses, referred to here as global-change-type drought, yet quantitative assessments of the triggers and potential extent of drought-induced vegetation die-off remain pivotal uncertainties in assessing climate-change impacts. Of particular concern is regional-scale mortality of overstory trees, which rapidly alters ecosystem type, associated ecosystem properties, and land surface conditions for decades. Here, we quantify regional-scale vegetation die-off across southwestern North American woodlands in 2002-2003 in response to drought and associated bark beetle infestations. At an intensively studied site within the region, we quantified that after 15 months of depleted soil water content, >90% of the dominant, overstory tree species (*Pinus edulis*, a piñon) died. The die-off was reflected in changes in a remotely sensed index of vegetation greenness (Normalized Difference Vegetation Index), not only at the intensively studied site but also across the region, extending over 12,000 km^2 or more; aerial and field surveys confirmed the general extent of the die-off. Notably, the recent drought was warmer than the previous subcontinental drought of the 1950s. The limited, available observations suggest that die-off from the recent drought was more extensive than that from the previous drought, extending into wetter sites within the tree species' distribution. Our results quantify a trigger leading to rapid, drought-induced die-off of overstory woody plants at subcontinental scale and highlight the potential for such die-off to be more severe and extensive for future global-change-type drought under warmer conditions.

February 26, 2010

In 2008 the World Meteorological Organization figured out the 10 warmest years since people started keeping accurate records around 1850:

1. 1998
2. 2005
3. 2003
4. 2002
5. 2004
6. 2006
7. 2007

8. 2001
9. 1997
10. 2008



Now NASA reports that 2009 is tied for the second warmest year since 1880!

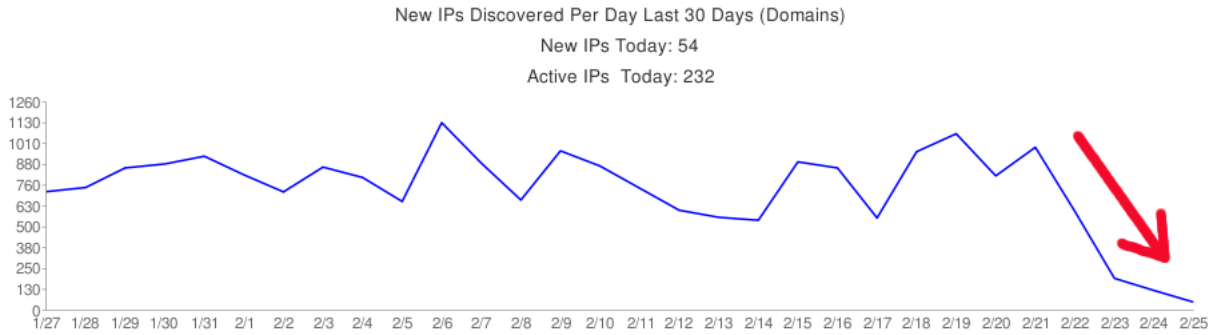
Oz sent me this link to lots of pictures and animations of the ocean's temperature:

- National Oceanic and Atmospheric Administration (NOAA) Satellite and Information Service, Coral Reef Watch.

February 27, 2010

Map of computers infected by the Waledac botnet in a recent 18-day period.
Picture from Microsoft.

Microsoft got US courts to help them launch an attack on the Waledac botnet — an army of approximately 20,000 - 30,000 computers that seem to be controlled by an outfit called the Russian Business Network, which specializes in spam, child pornography, malware, phishing and various other forms of cybercrime. Here's a graph of the number of IP addresses infected by the Waledac botnet each day in the last month — or at least the number newly discovered by the guys who keep tabs on them:



- The Official Microsoft Blog, Cracking down on botnets, February 25, 2010.
- Peter Bright, Judge's restraining order takes botnet C&C system offline, *Ars Technica*, February 25, 2010.
- Jeremy, Kudos to Microsoft with the Waledac Botnet take down!, sudosecure.net.

A quote from Bright's article:

> Botnets — large networks of malware-infected PCs remotely controlled by criminals — are a serious problem on the Internet. The spam, phishing attacks, and malware that these networks send accounts for a massive proportion, in excess of 80 percent, of e-mail traffic. One such network, known as Waledac, has been stopped in its tracks after Microsoft got a court to issue a secret temporary restraining order. The restraining order took 277 domain names used by the criminals to communicate with the botnet offline. Without these domain names, it is hoped that the controllers of the botnet will permanently lose access to the machines running their malware.
>
> The Waledac botnet is presumed to be run by Eastern Europeans and to be made up of hundreds of thousands of compromised machines. It sends hundreds of millions, if not billions, of e-mails each day, as well as distributes malware to help recruit new machines to the network. Microsoft's complaint describes in detail how the botnet is organized, with a complex hierarchical control system. At the root of the system is the command-and-control servers. The botnet uses the 277 domain names to connect to the command and

control servers to download new commands. These commands are then distributed through the different tiers of the network using peer-to-peer transmission.

By obtaining the restraining order, this command-and-control system was disrupted; with the domain names offline, the machines in the botnet were no longer able to locate their control servers, rendering them mostly harmless. The court action had to be taken in secret to avoid warning the botnet's operators; with sufficient warning, they might have been able to set up new domain names and new control systems, thereby circumventing Microsoft's efforts. The names have now been offline for three days, presumably sufficient to cause permanent disruption, and the injunction is now public.

Similar action against past botnets has been attempted by security researchers before, but the results were only temporary as new command and control servers were set up. Microsoft's intent is for this action to be more permanent. "Operation b49," as Redmond has called it internally, still has further work to do to ensure that the peer-to-peer communication between computers in the botnet is disrupted.

February 28, 2010

A lot more rain yesterday! But today the sky is utterly clear.

I'm getting ready to start a new blog that talks about what mathematicians and scientists can do about the really big issues of our day: climate change, the mass extinction event, and so on. I want people to understand what I'm saying... so these tips are handy:

- Susan Joy Hassol, Improving how scientists communicate about climate change, Climate Progress, February 28, 2010.

For my March 2010 diary, go here.

Gone.
Gone.
Through crumbled fingers gone.
Can never be recollected. - Brian Eno

baez@math.removethis.ucr.andthis.edu

home

[For my February 2010 diary, go here.]

Diary - March 2010

John Baez

March 1, 2010

Al Gore writes:

> It would be an enormous relief if the recent attacks on the science of global warming actually indicated that we do not face an unimaginable calamity requiring large-scale, preventive measures to protect human civilization as we know it.
>
> Of course, we would still need to deal with the national security risks of our growing dependence on a global oil market dominated by dwindling reserves in the most unstable region of the world, and the economic risks of sending hundreds of billions of dollars a year overseas in return for that oil. And we would still trail China in the race to develop smart grids, fast trains, solar power, wind, geothermal and other renewable sources of energy — the most important sources of new jobs in the 21st century.
>
> But what a burden would be lifted! We would no longer have to worry that our grandchildren would one day look back on us as a criminal generation that had selfishly and blithely ignored clear warnings that their fate was in our hands. We could instead celebrate the naysayers who had doggedly persisted in proving that every major National Academy of Sciences report on climate change had simply made a huge mistake.
>
> I, for one, genuinely wish that the climate crisis were an illusion. But unfortunately, the reality of the danger we are courting has not been changed by the discovery of at least two mistakes in the thousands of pages of careful scientific work over the last 22 years by the Intergovernmental Panel on Climate Change. In fact, the crisis is still growing because we are continuing to dump 90 million tons of global-warming pollution every 24 hours into the atmosphere — as if it were an open sewer.

It is true that the climate panel published a flawed overestimate of the melting rate of debris-covered glaciers in the Himalayas, and used information about the Netherlands provided to it by the government, which was later found to be partly inaccurate. In addition, e-mail messages stolen from the University of East Anglia in Britain showed that scientists besieged by an onslaught of hostile, make-work demands from climate skeptics may not have adequately followed the requirements of the British freedom of information law.

But the scientific enterprise will never be completely free of mistakes. What is important is that the overwhelming consensus on global warming remains unchanged. It is also worth noting that the panel's scientists — acting in good faith on the best information then available to them — probably underestimated the range of sea-level rise in this century, the speed with which the Arctic ice cap is disappearing and the speed with which some of the large glacial flows in Antarctica and Greenland are melting and racing to the sea.

Because these and other effects of global warming are distributed globally, they are difficult to identify and interpret in any particular location. For example, January was seen as unusually cold in much of the United States. Yet from a global perspective, it was the second-hottest January since surface temperatures were first measured 130 years ago.

Similarly, even though climate deniers have speciously argued for several years that there has been no warming in the last decade, scientists confirmed last month that the last 10 years were the hottest decade since modern records have been kept.

The heavy snowfalls this month have been used as fodder for ridicule by those who argue that global warming is a myth, yet scientists have long pointed out that warmer global temperatures have been increasing the rate of evaporation from the oceans, putting significantly more moisture into the atmosphere — thus causing heavier downfalls of both rain and snow in particular regions, including the Northeastern United States. Just as it's important not to miss the forest for the trees, neither should we miss the climate for the snowstorm.

Here is what scientists have found is happening to our climate: man-made global-warming pollution traps heat from the sun and increases atmospheric temperatures. These pollutants — especially carbon dioxide — have been increasing rapidly with the growth in the burning of coal, oil, natural gas and forests, and temperatures have increased over the same period. Almost all of the ice-covered regions of the Earth are melting — and seas are rising. Hurricanes are predicted to grow stronger and more destructive, though their number is expected to decrease. Droughts are getting longer and deeper in many mid-continent regions, even as the severity of flooding increases. The seasonal predictability of rainfall and temperatures is being disrupted, posing serious threats to agriculture. The rate of species extinction is accelerating to dangerous levels.

Though there have been impressive efforts by many business leaders, hundreds of millions of individuals and families throughout the world and many national, regional and local governments, our civilization is still failing miserably to slow the rate at which these emissions are increasing — much less reduce them.

And in spite of President Obama's efforts at the Copenhagen climate summit meeting in December, global leaders failed to muster anything more than a decision to "take note" of an intention to act.

Because the world still relies on leadership from the United States, the failure by the Senate to pass legislation intended to cap American emissions before the Copenhagen meeting guaranteed that the outcome would fall far short of even the minimum needed to build momentum toward a meaningful solution.

The political paralysis that is now so painfully evident in Washington has thus far prevented action by the Senate — not only on climate and energy legislation, but also on health care reform, financial regulatory

> reform and a host of other pressing issues.
>
> This comes with painful costs. China, now the world's largest and fastest-growing source of global-warming pollution, had privately signaled early last year that if the United States passed meaningful legislation, it would join in serious efforts to produce an effective treaty. When the Senate failed to follow the lead of the House of Representatives, forcing the president to go to Copenhagen without a new law in hand, the Chinese balked. With the two largest polluters refusing to act, the world community was paralyzed.
>
> Some analysts attribute the failure to an inherent flaw in the design of the chosen solution — arguing that a cap-and-trade approach is too unwieldy and difficult to put in place. Moreover, these critics add, the financial crisis that began in 2008 shook the world's confidence in the use of any market-based solution.
>
> But there are two big problems with this critique: First, there is no readily apparent alternative that would be any easier politically. It is difficult to imagine a globally harmonized carbon tax or a coordinated multilateral regulatory effort. The flexibility of a global market-based policy — supplemented by regulation and revenue-neutral tax policies — is the option that has by far the best chance of success. The fact that it is extremely difficult does not mean that we should simply give up.
>
> Second, we should have no illusions about the difficulty and the time needed to convince the rest of the world to adopt a completely new approach. The lags in the global climate system, including the buildup of heat in the oceans from which it is slowly reintroduced into the atmosphere, means that we can create conditions that make large and destructive consequences inevitable long before their awful manifestations become apparent: the displacement of hundreds of millions of climate refugees, civil unrest, chaos and the collapse of governance in many developing countries, large-scale crop failures and the spread of deadly diseases.

For the rest, see:

- Al Gore, We can't wish away climate change, *New York Times*, February 27, 2010.

Also, the latest news from Antarctica:

- Guy Raz, New research sheds light on Antarctic ice melting, *Morning Edition*, National Public Radio, February 28, 2010.

He interviews Jane Ferrigno from the US Geological Survey about her work. She makes a mistake: she says at least 20,000 square kilometers of Antarctic ice has been lost in the last 20 years, and that this is somewhere between the area of Texas and the area of Alaska. But the area of Texas is about 700,000 square kilometers. We probably need to dig into the data:

- Jane Ferrigno *et al*, Coastal-change and glaciological map of the Palmer Land area, Antarctica: 1947-2009, USGS Geologic Investigations Series Map I-2600-C.

March 3, 2010

Alex Sumner emails me saying:

> Dear Professor Baez
>
> I've read this weeks finds for years and would like to start by thanking you for them. It's a pity that after so long reading and enjoying your stuff I'm only now writing for the first time, and it's to say something negative. I'm sorry about that, I guess it's just human nature, or maybe it's just my nature. Anyway...
>
> There is a serious problem with the piece by Al Gore that you posted. It is true that no amount of leaked

> emails from CRU can prove that AGW is either not happening or not a problem. However these emails do show something very disturbing. Gore describes the problem as "at least two mistakes in the thousands of pages of careful scientific work" by scientists "acting in good faith". Unfortunately that will not stand. The emails reveal a culture of advocacy at the highest levels of climate science, where the need for objectivity and total honesty has been replaced by the need to find "the right balance between being effective and being honest", where independent scrutiny of published work has been obstructed and the peer review system tampered with to suppress dissenting views. This is not a small matter. I can't put it any better than have the Institute of Physics in their submission to the UK Parliamentary Committee currently investigating the matter:
>
> > The Institute is concerned that, unless the disclosed e-mails are proved to be forgeries or adaptations, worrying implications arise for the integrity of scientific research in this field and for the credibility of the scientific method as practised in this context.
>
> Because this scandal provides plenty of ammunition for anyone who opposes action to curb carbon emissions there has been a tendency to downplay it amongst those who remain convinced of the need for such action. That is what Al Gore is doing in the piece you posted, and by posting it without any critical commentary you are supporting him in this. He isn't a scientist, but you are and I think you should be careful about the practices you give the impression of supporting.
>
> Thanks again for years of good reading.
>
> Regards,
>
> Alex Sumner

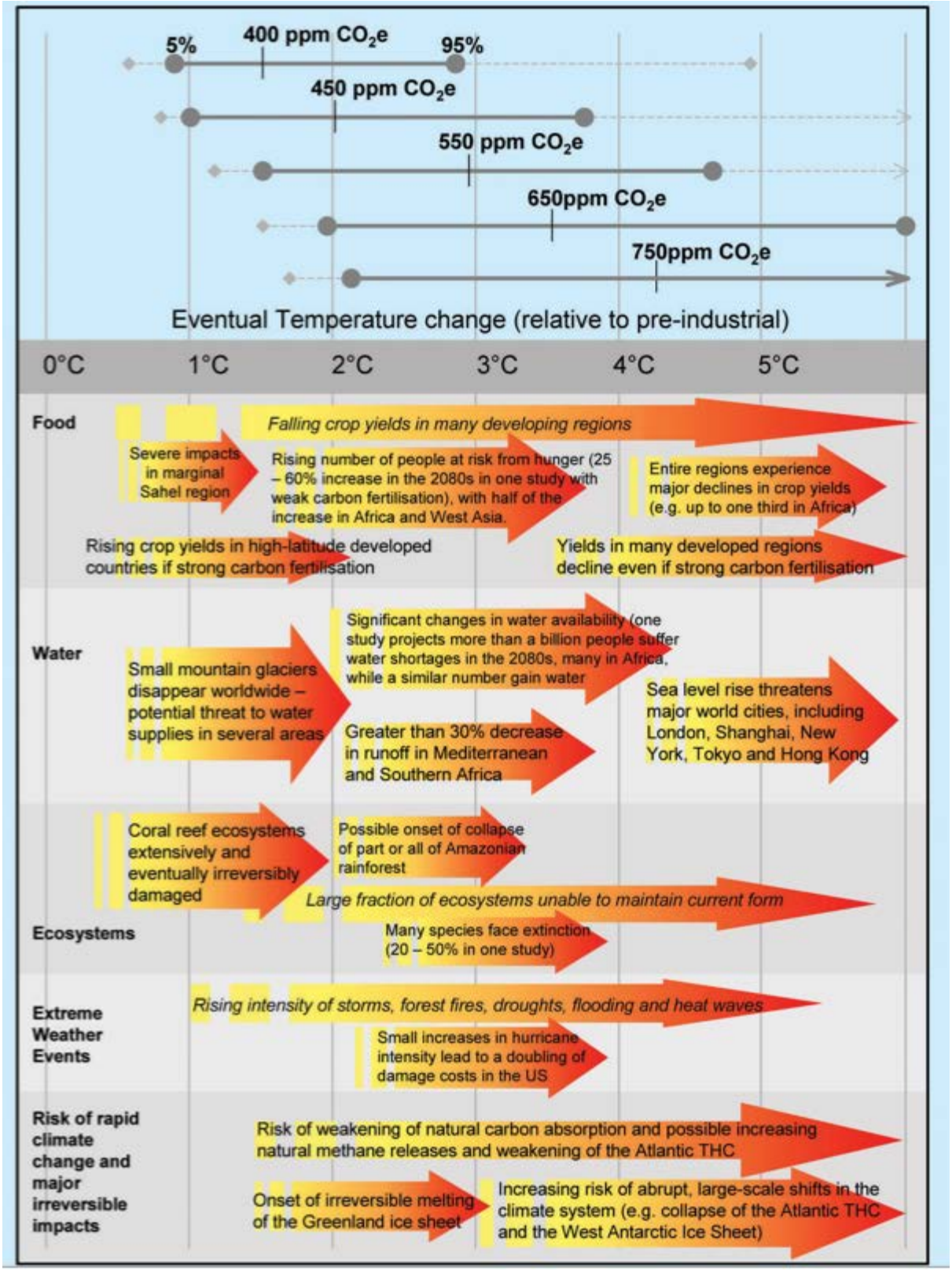
I replied:

> I haven't been following the controversy very carefully. I agree it's not a small matter, and I guess you're right that Al Gore was downplaying a crucial point: the conflict between objectivity and advocacy.
>
> I think it's almost unavoidable, when people discover — or, to take a very distanced viewpoint: "think they discover" — that a crisis is underway, that they will start acting in a way that's less objective and more focused on tackling the problem. For a great example, consider the Manhattan project, where lots of great physicists switched from doing physics to creating a weapon, and some later regretted it.
>
> So, I suspect this problem won't go away. People will need to figure out intelligent ways to address it. And I'll need to address it myself, since I'm planning to switch from working on "quantum gravity and n-categories" over to science with a more practical edge.

But of course I do think that global warming is a serious problem, that we're in a car with bad breaks driving towards a cliff in the fog, and that Al Gore is 100% right to spend tons of energy trying to wake up the world before it's too late.

March 4, 2010

Here's a nice rough way to understand the effects of various amounts of carbon dioxide in the atmosphere, taken from the *Stern Review on the Economics of Climate Change*.



Recall that MIT scientists estimate that in a business-as-usual scenario, by 2095 there will be about 890 parts per million of CO_2 in the atmosphere, and a 90% chance of a temperature increase between 3.5 and 7.3 degrees Celsius, with a median estimate of 5°. That's on the high end of this scale.

March 5, 2010

Read how bird feeders may create a new species of birds:

- Birdfeeders split blackcaps into two species, Next Nature.

It rained a tiny bit last night, and we're expecting more this weekend. It's great that people around here are *finally* getting serious about saving water:

> **Being Wise With Rain Runoff**
>
> Janet Zimmerman, Riverside Press-Enterprise
> February 8, 2010
>
> Long before Southern California's water supplies dwindled, storm runoff was something to be disposed of quickly by sending it down concrete channels to the ocean.
>
> But no more, say water officials who are coping with shortages caused by drought, population growth and environmental restrictions on imports. They want to capture every drop, especially during intense storms like those in January that dumped more than 3 inches of rain in many Inland areas.
>
> "Our 20th century thinking was, 'Storm water bad, flood water even worse.' We're now saying that's water we desperately need," said Celeste Cantu, general manager of the Santa Ana Watershed Project Authority, which plans and builds facilities to protect the water quality of the drainage basin that starts in the San Bernardino Mountains.
>
> Capturing 100 percent of the runoff from all but the most torrential storms would increase the local supply by about 25 percent, said Richard Atwater, general manager of the Inland Empire Utilities Agency in Chino.
>
> That would be enough to save up to $200 million on imported water over the next decade in Riverside and San Bernardino counties, he said, and the savings would be passed along to customers on their water bills.
>
> Efforts to harvest runoff are growing.
>
> Water agencies are expanding their use of holding ponds that allow water to percolate into the ground and recharge aquifers for later use. And more cities and counties are mandating green building construction that catches excess water in on-site cisterns or rain barrels and uses less paving, a large contributor to runoff.
>
> One of the most significant projects includes improvements on the Santa Ana River, south of the Seven Oaks Dam near Highland, that allow the capture of trillions of gallons of water once lost to Orange County.
>
> In the Chino groundwater basin, which includes parts of Riverside and San Bernardino counties, about $50 million has been spent in the past decade to expand spreading grounds that allow runoff to seep into the soil, Atwater said. The district captures enough rain to supply about 6,000 families for a year.
>
> Such projects represent progress, but officials say much more needs to be done, both regionally and at the individual level with improvements such as barrels to catch rain at homes.
>
> "We don't do a very good job with conservation, recycling or storm water management, all supplies that can be used for irrigation, dust control, fire suppression and can be treated and injected back into aquifers. We have a long way to go," said Wendy Martin, state Department of Water Resources drought coordinator.
>
> "We as a society need to demand that our water be treated with respect, and captured and used and used and used," she said.
>
> **Need Drives Change**

At the Frontier Project in Rancho Cucamonga, parking lots and walkways are made of permeable materials so that water percolates into the ground. Excess surface water is naturally cleansed in slender ditches, called swales, which direct runoff to an underground cistern for irrigating the landscape.

The building, part of a movement known as low-impact development, was finished late last year by the Cucamonga Valley Water District.

The headquarters of the Inland Empire Utilities Agency has similar features, including porous concrete and a 20-acre wetlands park fed by storm water.

"Partly why all this is changing, we're not getting more from the Colorado River, there's gridlock in the (Sacramento-San Joaquin) Delta and imported water is too expensive," Atwater said.

"Fifty years ago when the area was growing rapidly, if we had had rain barrels and designed new homes so the water stayed on site, we'd be a lot better off," he said.

The Riverside County Flood Control and Water Conservation District is also thinking capture.

In Temescal Canyon between Lake Elsinore and Corona, the district wants to purchase land in the floodplain to prevent development and protect the natural percolation and water quality there, said Steve Thomas, assistant chief engineer.

In recent years, his agency and others also have begun to rethink the concrete-lined channels that whisk water away from cities.

Earthen bottoms allow water to sink back into the ground and now are used when possible, he said. But retrofitting most channels isn't an option because housing is built right to the edge, leaving no safety margin for overflow.

Catching Water

The Santa Ana River carries snowmelt from the San Bernardino Mountains and storm runoff through nearly 100 miles of urban areas.

Improvements recently were finished on the Cuttle Weir, a small, dam-like structure a half-mile from Seven Oaks Dam that will double the amount of river water that can be diverted. The work allows local districts to catch an additional 300 acre-feet of water per day during peak runoff. One acre-foot of water can supply two average households for a year.

The water will be used to recharge the Bunker Hill Basin, which supplies San Bernardino Valley and the city of Riverside.

Under an agreement with the state, Orange County is entitled to 42,000 acre-feet of Santa Ana River water per year but had been receiving more like 190,000 acre-feet annually because the water wasn't being captured upstream, said John Rossi, general manager at Western Municipal Water District in Riverside.

Another plan to use more of the Santa Ana River is in the works by the city of Riverside, which wants to stretch a 700-foot-wide inflatable rubber dam across the water near Colton. Some water would be stored behind the 8-foot-tall dam so it could percolate into the ground, and some would flow into holding ponds on the west side of Interstate 215, south of Interstate 10.

The project would catch enough water to supply up to 24,000 families for a year, according to city planning documents.

March 6, 2010

Bruce Sterling points out some interesting blog entries on the "energy crisis" and the second law of thermodynamics:

- John Greer, Energy follows its bliss, on his blog, The Archdruid Report.
- John Greer, An exergy crisis, on his blog, The Archdruid Report.

They make for good reading, though I'm not endorsing all the conclusions! It's a bit sad that the world needs to learn its thermodynamics from a druid who talks about "exergy". Indeed, I'd never even heard of exergy before, so I initially guessed it was a synonym for Gibbs free energy. But Greer is smart enough to be interesting, and apparently exergy is a slight generalization of Gibbs free energy that includes chemical potentials. So, I can see why it deserves a catchy name. In simple terms, it's "the maximum useful work possible during a process that brings the system into equilibrium with a heat reservoir."

In the discussion of Greer's first post, William T writes:

> I think that one of the problems we have today is that we (in general) have no idea how concentrated the energy in fossil fuels really is. For instance, I recently came across a calculation that really astounded me. That is, the amount of energy being delivered into your car by the petrol bowser (assuming it pumps out at 1 L/s which is about the maximum rate they do) is equivalent to the full output of a 30MW power station - a reasonable sized hydro station. So to fill your car you're taking the full output of a small power station for about 1 minute.

John Greer writes:

> People don't realize, to give another example, that when a plane full of tourists flies from LA to Cairo so they can visit the Great Pyramid, that one flight uses as much energy as it took to *build* the Great Pyramid.

I haven't checked these calculations, and I should. But they don't seem ridiculous to me. I remember being shocked as a kid when my uncle, the physicist Albert Baez, told me that to heat a bathtub of water to a nice hot temperature takes as much energy as lifting that water to a ridiculous height. But by now it seems obvious: heating things a little means speeding up molecules a fair amount. Heat is random motion of molecules, but if they were all moving the same direction, you'd see how fast they were going.

Let's do the math. By definition, it takes one kilocalorie to raise the temperature of one kilogram of water by 1 degree Celsius. But a kilocalorie is 4184 joules. Kinetic energy goes like $mv^2/2$, and here the mass is 1, so we've got $v^2/2 = 4184$ (meters/second)^2, or $v = \sqrt{8368}$ meters/second = 91 meters/second.

So using the energy it takes to raise water one degree, we could also shoot it out of a cannon at a speed of 91 meters per second! That's about 200 miles per hour, for us Americans, or 325 kilometers per hours, for Europeans. And if we think how much energy goes into waste heat when driving a car, or flying an airplane from here to Egypt... well, then the above remarks don't seem ridiculous. But I should do the calculations myself sometime.

There's a lot of talk about this book by Greer:

- Frank Kaminski, Review: *The Long Descent* by John Michael Greer, Energy Bulletin, August 31, 2008.

A quote:

> If you've been following the peak oil debate, you're well aware of Greer's mantra. In discussions about the future of industrial society, Greer has long complained, too many people remain fixated on only two possible outcomes: business as usual and imminent apocalypse. People cling to these two polar opposites because of how well they jibe with existing cultural narratives — namely the myth of progress and the myth of apocalypse — that exert tremendous emotional power over us. But there are a vast number of middle-ground scenarios in between these two extremes, and these latter possibilities represent the most likely

future course of our civilization.

The middle ground that Greer foresees is a period of glacial deterioration that he calls *The Long Descent*, driven by a process that he refers to as catabolic collapse.

The Long Descent is Greer's attempt to help the average reader make sense of this coming age of decline. He begins the book with a bit of background on peak oil, the Club of Rome's *The Limits to Growth* study, some lessons from past societal collapses and the difference between problems (which are solvable) and predicaments (which aren't). He makes a strong case for peak oil being a predicament rather than a problem.

Having laid down this background material, Greer then explores the habits of mind that blind us to our predicament. He explains why the myth of progress and that of apocalypse truly are myths (they're literally no different from those once circulated among ancient cultures), and warns of the dangers inherent in continuing to force the proverbial round pegs of reality into the square holes of our myths of choice.

Drawing on the theory of catabolic collapse touched on earlier, Greer next outlines in detail how our predicament is likely to play out during the decades and centuries ahead. Greer's theory of catabolic collapse — well-known within peak oil circles— shows how civilizations headed for collapse tend to decline in a gradual, downward stairstep of repeated crises and recoveries. They don't undergo the sudden, catastrophic free fall envisioned by diehard peak oil doomers. This theory makes for truly fascinating reading, and is included in its entirety as an appendix.

How will our own society's catabolic collapse proceed? Greer sees us on the verge of a couple of decades of economic contraction, chronic energy shortages, declining public health, political turmoil and vanishing knowledge and cultural heritage. This crisis period, he predicts, will be followed by a respite of perhaps 25 years or so, during which industrial civilization's newfound relief from the lavish energy demands of universal motoring and electrification, climate-controlled buildings, modern medicine and other present-day amenities will buy it a little breathing room. But this respite will, in turn, be followed by another round of crises that will rid our civilization of further layers of social complexity, and so on.

Eventually, the developed world will assume an agrarian lifestyle built around local communities and sustainable resources. But this change will happen so slowly that no one alive today will be around to witness the end result. Thus, Greer maintains, our energies should be focused not on surviving the end of industrial civilization, but on making it through the imminent crisis period that will be but one brief interval within that larger context.

To this end, Greer lays out some strategies and technologies for weathering the coming decades of crisis.

The appropriate response to the challenges we face, Greer believes, is not to set up survivalist enclaves or lifeboat communities, but to reshape our existing cities, towns and rural neighborhoods in order to better meet those challenges. Greer sees renewed participation in fraternal orders like the Freemasons and Odd Fellows as a vital part of restoring the former institutions of civil society that so successfully weathered past periods of dramatic social change.

On an individual level, everyone needs to sharply curtail energy usage and find low-tech ways of doing things, in order to prepare for the inevitable shortages. We also need to position ourselves into occupational niches that meet actual human needs, since these are the jobs that are likely to stay in demand. In the face of declining public health, each person should learn to take charge of his or her own health. Lastly, we must help foster local community networking, which will be essential in preserving basic services like public safety and sanitation when the federal government proves ineffectual.

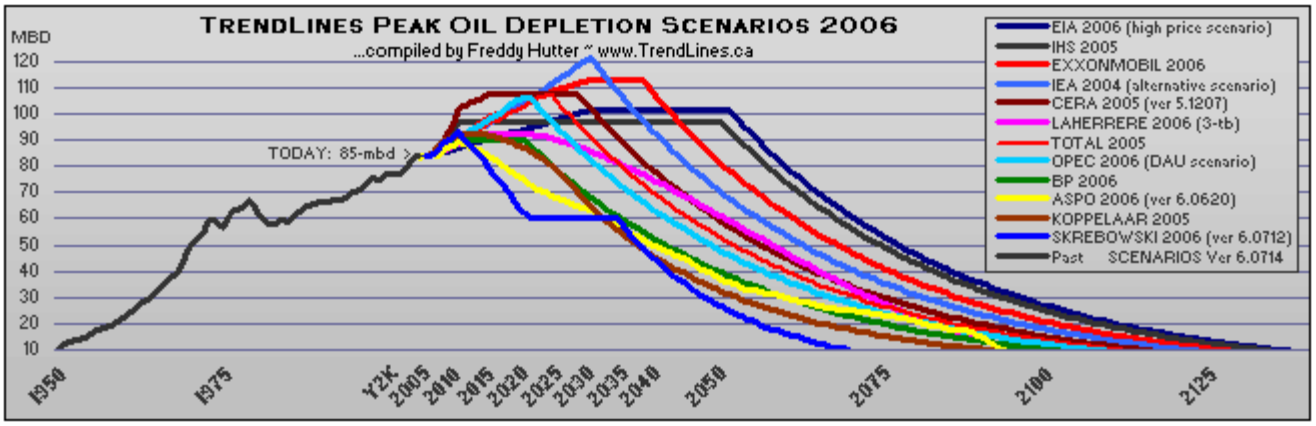
Greer discusses at length the tools and technologies needed in order to bring about these changes. Many of these tools, he points out, could easily be salvaged from present-day technologies that are bound to fall into disuse as profligate energy use becomes prohibitively expensive. For example, alternators from automobile engines could be used to build waterwheel-based micro-hydro plants.

We could also profit greatly from revitalizing antique tools, such as wooden ships and fireless cookers, that are better suited to energy conservation, and less reliant on electronic gadgetry, than their modern-day counterparts are. Two other technologies that could serve us well in the deindustrial future are organic intensive farming and the farmers market movement (the latter being an example of a "social technology").

The final part of the book examines the spiritual dimension of the changes ahead. At the heart of our coming spiritual transformation, Greer believes, is a shift away from the "prosthetic society" in which machines perform an ever-increasing number of tasks that were once done by humans. As human labor once again becomes cheaper than machine labor, people will relearn a host of now-forgotten skills, and will abandon consumerism in favor of more spiritually fulfilling pursuits.

More fundamentally, people will lose faith in the religion of progress — and it is a religion, Greer convincingly argues — as it proves less and less capable of delivering on its promises. Greer makes a few educated guesses as to which religious faiths might prosper in its wake.

Here's my gut reaction. I think it's great to envision scenarios that lie between utopia and apocalypse. And I think we can learn something by examining the past, even though the future will be different in some important ways. I would love to read a careful analysis of declining civilizations. I wouldn't be at all surprised if they typically feature a "gradual, downward stairstep of repeated crises and recoveries". I've read extensively on the decline and fall of the Roman Empire, and it's a haunting and compelling story precisely because of this pattern. I can easily imagine that civilization as we know it will undergo such a "long descent" or "catabolic collapse" as we pass the phase of peak oil— but apparently unlike Greer, I can easily imagine this collapse being averted for a long, long time by switching to nuclear power.



I can also easily imagine various other scenarios, without feeling much confidence in any of them! I have trouble imagining that we will return to traditional lifestyles from the agrarian past: I think we know more now, and not all this knowledge will be lost, and not all of it requires lots of energy to be useful. (Actually, after reading more of his stuff, it seems Greer agrees with me here.)

I also have trouble imagining that people will "abandon consumerism in favor of more spiritually fulfilling pursuits", attractive as that sounds. They *may* abandon consumerism because they can't afford it.

But we'll see. Or at least our descendants will see.

For more, try:

- John Michael Greer, The long road down: decline and the deindustrial future, December 4, 2004.
- John Michael Greer, How civilizations fall: a theory of catabolic collapse, 2005.

Actually, now that I think about it, the big difference between John Greer and some other futurists is that he doesn't believe in nuclear power. There are lots of people who think nuclear power is too dangerous, but he seems to take a different tack:

> Fissionable uranium is well down its own depletion curve, and it's worth noting that the enthusiastic claims sometimes made for breeder reactors, the use of thorium as a nuclear fuel, and other alternatives to conventional fission plants are very rarely to be heard from people who have professional training in the fields concerned.

If nuclear power is too dangerous, people will still use it. But if it *runs out*, that's a different matter.

Will it? Compare for example this quote from James Hansen's new book, *Storms of My Grandchildren*. Hansen thinks fast nuclear reactors, also known as "breeder" reactors, have a bright future:

> Nuclear experts at the premier research laboratories have long realized that there is a solution to the waste problems, and the solution can be designed with some very attractive features.
>
> I am referring to "fast" nuclear reactors. Fast reactors allow the neutrons to move at higher speed. The result in a fast nuclear reactor is that the reactions "burn" not only the uranium fuel but all of the transuranic actinides — which form the long-lived waste that causes us so much heartburn. Fast reactors can burn about 99 percent of the uranium that is mined, compared with the less than 1 percent extracted by light-water reactors.
>
> [...]
>
> The United States is presently storing about six hundred thousand tons of uranium hexafluoride, a by-product of nuclear weapons production. A reasonable assessment of the value of this material as fuel, if fast reactors were deployed as the energy source for power plants, is about $50 trillion. Yes, trillion. But it will take almost a thousand years to use all that fuel, so don't expect a customer to buy it all at once.
>
> [...]
>
> In fact, given that fast reactors make it economical to extract uranium from seawater, we now have enough fuel, in theory, to run nuclear power plants for several billion years. In other words, nuclear fuel is inexhaustible, putting it in the same category as renewable solar energy.

Hansen and Greer can't both be right.

March 7, 2010

Lisa and I went on a walk in the local hills with two philosophers: Franklin Perkins and Robin Wang. Lisa is going to China from the 14th to the 31st, spending some time in Shenzhen, some time in Shanghai, and some time at the Daoist Salon in Zhengzhou — a get-together which is being organized by Franklin and Robin.

The hills are full of green plant life, mainly grass. It's been raining a lot lately! And indeed, it started to rain just as we got back to the car.

David Wohlert read my remark "I would love to read a careful analysis of declining civilizations" and pointed me to this book:

- Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed*, Viking, New York, 2005.

I actually own this; I read several chapters, then I got distracted and my wife took it. I should finish it! It focuses on what might be called "physical" causes of civilizational collapse:

1. Deforestation and habitat destruction
2. Soil problems (erosion, salinization, and soil fertility losses)
3. Water management problems
4. Overhunting
5. Overfishing
6. Effects of introduced species on native species
7. Increased per-capita impact of people

I would also like a book with more political history, or even more narrative — for example, something that would flesh out the short narrative at the end of this passage by Greer a bit more:

> Like modern industrial society, the Maya built their civilization on a nonrenewable resource base. In their case it was the fertility of fragile tropical soils, which couldn't support intensive corn farming forever. On that shaky foundation they built an extraordinary civilization with fine art, architecture, astronomy, mathematics, and a calendar more accurate than the one we use today. None of that counted when the crops began to fail. Mayan civilization disintegrated, cities were abandoned to the jungle, and the population of the Mayan heartland dropped by 90%.
>
> The parallels go deeper, for the Maya had other options. They could have switched from corn to more sustainable crops such as ramon nuts, or borrowed intensive wetland farming methods from their neighbors to the north. Neither of these happened, because corn farming was central to Maya political ideology. The power of the *ahauob* or "divine lords" who ruled Maya city-states depended on control of the corn crop, so switching crops or farming systems was unthinkable. Instead, Maya elites responded to crisis by launching wars to seize fields and corn from other city-states, making their decline and fall far more brutal than it had to be.
>
> Even so, the Maya decline wasn't a fast process. Maya cities weren't abandoned overnight, as archeologists of two generations ago mistakenly thought, but went under in a "rolling collapse" spread across a century and a half from 750 to 900. Outside the Maya heartland, the process took even longer. Chichen Itza far to the north still flourished long after cities such as Tikal and Bonampak were overgrown ruins, and Mayan city-states on a small scale survived in corners of the Yucatan right up to the Spanish conquest.
>
> Map the Maya collapse onto human lifespans and the real scale of the process comes through. A Maya woman born around 730 would have seen the crisis dawn, but the *ahauob* and their cities still flourished when she died of old age seventy years later. Her great-grandson, born around 800, grew up amid a disintegrating society, and the wars and crop failures of his time would have seemed ordinary to him. His great-granddaughter, born around 870, never knew anything but ruins sinking back into the jungle. When she and her family finally set out for a distant village, the last to leave their empty city, it would never have occurred to her that her quiet footsteps on a dirt path marked the end of a civilization.

Actually Diamond talks about the Maya, and I haven't read that chapter — I should. But apparently this book says more:

- Joseph Tainter, *The Collapse of Complex Societies*, Cambridge U. Press, Cambridge, 1990.

I've read the first volume of this Penguin edition classic, which is 1232 pages long, and someday I may read the second and third, but I hear it's all downhill after the Goths:

- Edward Gibbon, *The History of the Decline and Fall of the Roman Empire*, Penguin Classics, 3 volumes, London, 1996.

It's a ripping good yarn — I recommend it. You don't need to read the whole thing.

I've been corresponding a bit with my former grad student Jeffrey Morton, who just got a postdoc position at the Universidade Technica de Lisboa. I told him I was getting interested in environmental stuff, and he wrote:

> I'm also very interested in this subject, but so far I haven't had the impetus to try to address it professionally, as most of the mathematical aspects of that stuff I know anything about are all about modelling, dynamical systems, etc. which is not really my bag.
>
> However, I will advocate to anyone who'll listen for moving off a terrestrial-resource economy to a solar-resource economy. Immediately, that means a transition to solar power, but more to the point, something to replace agriculture would be nice — we haven't had a fundamental revolution in food production in, what, ten thousand years? No wonder we're stressing ecosystem resources... And of course cities should be comprehensively recycling all their water.
>
> Since the Obama administration is canning the human space-exploration program while also increasing NASA's budget, I'm hoping they'll be putting funds into developing space-based solar power. A square kilometre of thin-film solar cells could probably pack up into a single cargo with a good design, and it would produce on the order of a gigawatt of power with no further inputs. Launch costs are bound to start falling soon, and surely once a design exists, the unit production costs couldn't be too high — it's just that initial overhead that's the trouble.

I replied:

> Jeffrey wrote:
>
> > *I'm also very interested in this subject, but so far I haven't had the impetus to try to address it professionally, as most of the mathematical aspects of that stuff I know anything about are all about modelling, dynamical systems, etc. which is not really my bag.*
>
> That's what a lot of smart mathematicians say, including me! So I figure it's my job to help change the situation, either by finding stuff for folks like us to do, or at least writing issues of This Week's Finds that get kids interested in doing stuff that can do some good — instead of getting them interested in octonions, n-categories etc.
>
> > *However, I will advocate to anyone who'll listen for moving off a terrestrial-resource economy to a solar-resource economy. Immediately, that means a transition to solar power, but more to the point, something to replace agriculture would be nice — we haven't had a fundamental revolution in food production in, what, ten thousand years?*
>
> Suggestions for how the revolution should work?
>
> This may not be practical, and maybe not revolutionary enough for you, but it's kinda cute:
>
> - Lisa Chamberlain, Skyfarming, *New York*, April 1, 2007. (No joke.)

> *And of course cities should be comprehensively recycling all their water.*

Here in Southern Ca. we're finally starting to get serious about catching runoff...

> *Since the Obama administration is canning the human space-exploration program while also increasing NASA's budget, I'm hoping they'll be putting funds into developing space-based solar power. A square kilometre of thin-film solar cells could probably pack up into a single cargo with a good design, and it would produce on the order of a gigawatt of power with no further inputs. Launch costs are bound to start falling soon, and surely once a design exists, the unit production costs couldn't be too high — it's just that initial overhead that's the trouble.*

How practical is it getting the power down to the ground?

He replied:

> *Suggestions for how the revolution should work?*

Those vertical farms would be a decent start — the technology basically exists. I would imagine this "revolution" happening at such a lightning fast pace that within a few centuries it might start to settle into some kind of established form once there's been time to test and find out what works best.

The first essential thing would be to get farms off of fertile land to allow room for more diverse, and possibly even natural, ecosystems to take over. See:

- Land Commodities, Investment fundamentals.

Beyond that, I see a few key areas for improvement, which I assume would happen incrementally, separately, and eventually be combined together.

I basically assume there would be a transition from growing plants, to some form of more or less direct chemosynthesis of food, if only for reasons of efficiency. (It's also not clear to me there isn't a reasonable ethical argument against using plants for food, as there is against using animals, but given that most people

don't accept the latter, this is probably irrelevant — I'm not even vegan myself). Most likely some intermediate stage involving getting bacteria to produce the proteins, vitamins, etc. would be involved as well (as a bonus, I find it hard to get ethically worked up about exploiting bacteria when all you want them to do is replicate). Making sure the result is actually nutritious would be a big bioengineering challenge. Making it taste good is probably all too easy.

The first big inefficiency even in a sealed vertical farm: photosynthesis is fairly inefficient at capturing sunlight. Depending on conditions, it captures anything from <1% to around 5% of energy. Commercial photocells capture 20% and experimental ones up to 40%. A big Sterling engine and some mirrors can manage up to 30%. So there's about an order of magnitude in efficiency to play with there. I don't know all the engineering constraints, but clearly around two orders of magnitude is the most one can expect to get here.

However, the second thing is that in any given food crop, only about 10% of that captured energy actually gets converted into food energy usable by humans. Presumably some of that is a really irreducible requirement, and even a manufacturing "plant" would also need energy to operate it. But I would guess there's about a factor of about 5 to gain here.

Then there's the fact that a huge proportion of the plant-based foods that are produced, currently, are just fed to livestock that are used to produce meat, dairy, eggs, etc. Quite apart from ethical considerations, this is about another reduction of human-available food energy produced from a given solar energy budget by about a factor of 10. So by this stage, we've lost 99.9% to 99.99% of the original solar energy. So a reasonably conservative estimate would be that agriculture as a means to run humans off solar energy can be improved by probably a couple of orders of magnitude, depending on what assumptions you make about the originial eating habits. Not to mention the habitats freed up by decomissioning all that farmland.

Speaking of the practice of eating animal products, there's a nice graphic in here that pretty much sums up a big class of perverse incentives that prop up the industry:

- Good Medicine, Health vs. pork: Congress debates the farm bill.

  How practical is it getting the power down to the ground?

Well, actually, I regard this as a good argument for not putting energy-intensive industry on the ground (at the bottom of a gravity well, in the middle of a biosphere, is probably a bad place for heavy industry anyway, a priori). But in any case, transmission could be an issue wherever you need to use the energy...

I understand there is some good work on microwave energy transmission. Actually, a little Wikipedia lookup suggests that my initial figure of a square-kilometer panel is probably below the threshold at which the marginal returns make sense. They suggest that a one-kilometer transmission rectifier-antenna combination in, say, geosynchronous orbit could focus a beam sufficiently to get a 10-kilometer footprint on the ground, and that a power density of about 20 milliwatts per cm^2, for a total of about 10 gigawatts per installation, would be human-safe. (Especially if the microwaves are properly tuned not to dump too much energy into, for instance, water, which is desirable even apart from safety concerns). That implies a collector surface of about 10 km^2, which is smaller than the antenna. I wonder if, safety aside, it would be practical to give the beam a higher power intensity than that from the ambient insolation. Anyway, putting the collector in space would presumably make it more reliable, less weather-dependent, and able to operate at night...

I have looked a little at some of the papers by Mitani and Shinohara et al. about this. They were describing actual experiments in power beaming that seem to work. This technology probably needs more R&D than the solar cells, though.

Anyway, cheers!

March 8, 2010

March 9, 2010

Two thirds of US corporations pay no income tax. Of US corporations with at least $250 million in assets or annual sales of at least $50 million, a quarter paid no income tax.

March 11, 2010

The basic physics of vision and hearing is pretty well-understood, I believe. But nobody knows the exact mechanism behind our sense of *smell*. Subtle quantum effects may be involved, though it's controversial. A clue: fruit flies can smell the difference between isotopes! Can people? Different experiments give different answers.

- Richard Ball, Rogue theory of smell gets a boost, *Biomed Online*, December 7, 2006.
- Jennifer C. Brookes, Filio Hartoutsiou, A. P. Horsfield, A. M. Stoneham, Could humans recognize odor by phonon assisted tunneling?
- Marshall Stoneham, Making sense of scent, *Materials Today*, May 2007, p. 56.

March 13, 2010

Yesterday John Huerta and I finished up our second paper on supersymmetry and division algebras to the point where I felt happy to throw it onto the *n*-Category Café for comments. It's incredibly cool: using the octonions, we can describe both vectors and spinors in 11-dimensional spacetime, and prove an identity which is crucial for the theory of 2-branes in that dimension — widely considered to be part of "M-theory". But even better, the deep meaning of this identity is that it lets us extend the Poincaré Lie superalgebra to the "supergravity Lie 3-superalgebra" introduced by Urs Schreiber. It's great that John Huerta's octonionic skills have reached the point of tackling these issues.

Now we can return to finishing off our invitation to higher gauge theory, a closely linked paper which, alas, is overdue! It's based on the notes of my Corfu talk last summer, but I want to expand them to a full-fledged course on higher gauge

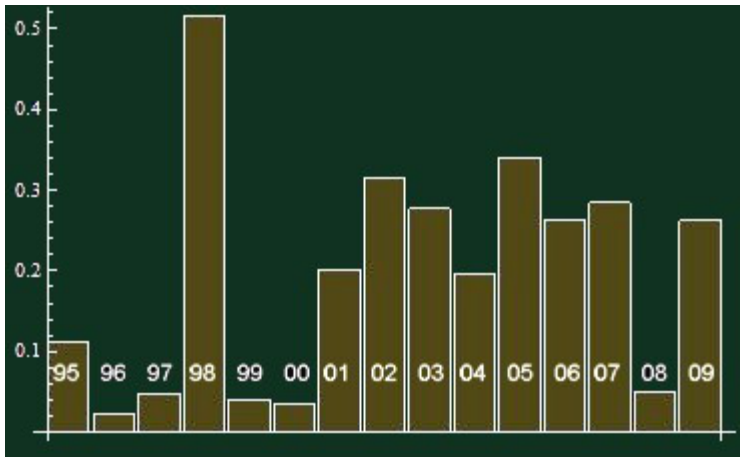
theory.

Lisa is taking off for China tomorrow night. So, today I decided to come with her to Temple City while she does tai chi in the park. We'll have dim sum and shop when she's done. Right now I'm taking a little break. I'm sitting here at the Roadhouse Coffee Stop. It's a friendly, homey place with free wireless. Cool and grey here, sunny back in Riverside.

A correspondent who is a bit of a "climate change skeptic" told me that "there's been no significant warming in the last 15 years" I asked him for evidence and he pointed me to this:

- Lubos Motl, No statistically significant warming since 1995.

This guy takes satellite data from the University of Alabama in Huntsville recording the temperature over the last 15 years... I'm not sure precisely which data, maybe this. But anyway, this guy plots these temperature data points:



He draws a best-fit straight line through them: it slopes upwards at 0.95°C per century. Then he does a little statistical analysis of a standard sort. He assumes the difference between the line and the actual points is randomly distributed in a Gaussian way with zero mean. He works out the standard deviation of this Gaussian — and based on these assumptions, he concludes that there's an 86% chance that if you picked new points according to the same probability distribution, the line would still slope upwards.

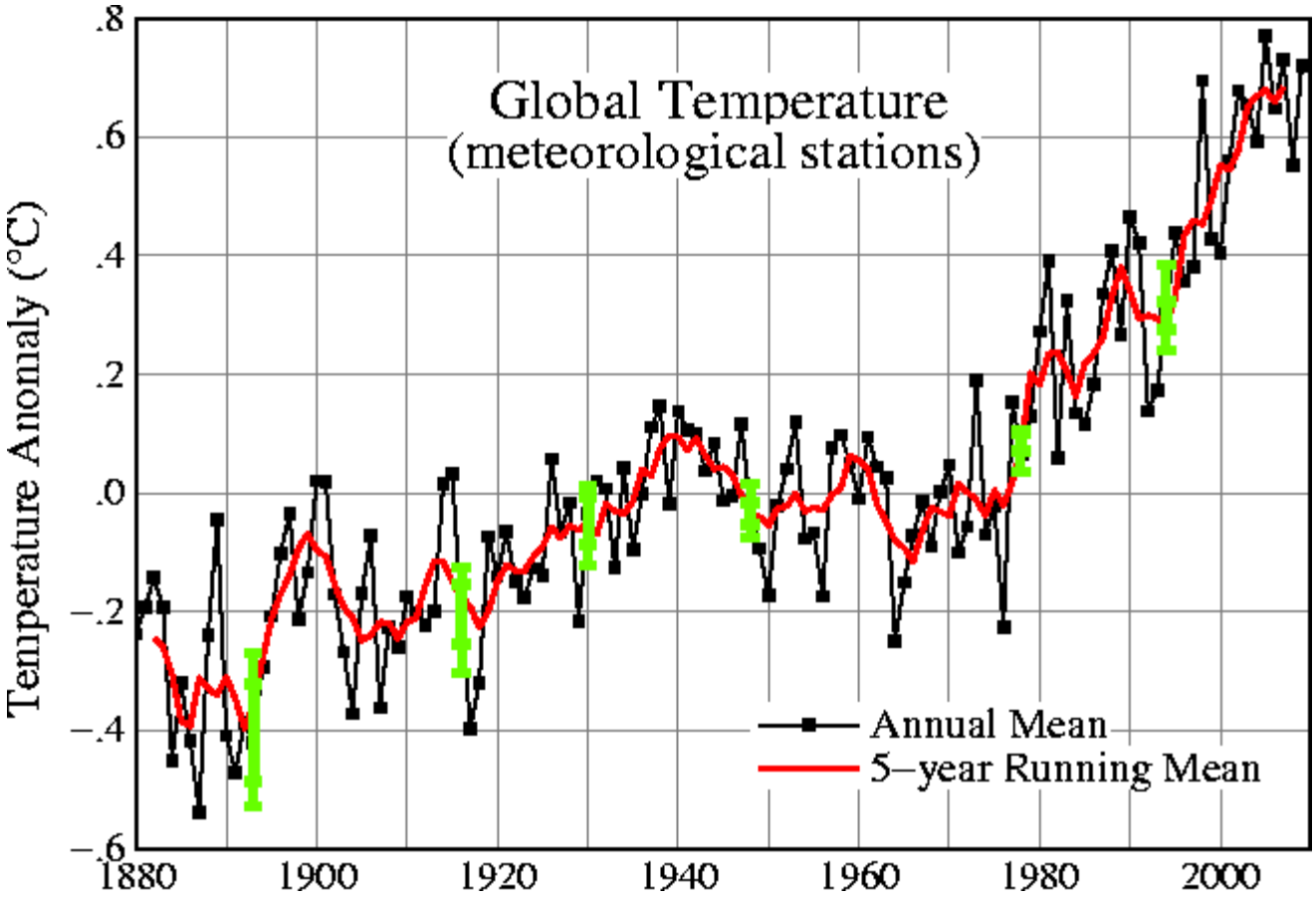
Now, if the weather report said there was an 86% chance that it would get warmer tomorrow, you'd probably say "it's getting warmer". But this doesn't count as statistically significant according to standard practice. So, this guy rightly concludes it's only "somewhat more likely than not" that these points indicate a warming trend.

Here's my gut reaction to all this:

Satellites have only been measuring the temperature of the upper atmosphere over a short period of time. If we restrict our attention to satellite data, we're going to have a lot of trouble spotting long-term trends. For example, assuming the data is accurate, 1998 was an exceptionally hot year. It'll completely swamp any conclusions we draw from such a small data set. More importantly, *any* fluctuation will have a huge effect. The weather is just too noisy to draw any firm conclusions from little data.

Of course, this could be precisely what my correspondent was trying to say! But when you say "there's been no significant warming in the last 15 years," it sounds different than when you say "you can't draw firm conclusions from these particular 15 data points".

What if we use more data, over a longer time span? If we use the Goddard Institute for Space Science data taken from meteorological stations since 1880, we see this:



Now it really looks like the planet is warming up. On the other hand, my correspondent points out that some people have questioned data from the Goddard Institute:

- Steven Goddard, Divergence between GISS and UAH since 1980, Watts Up With That?

Doubtless someone on the other side of the climate war has responded to this article, but I haven't seen that response yet. It's certainly good to straighten out these issues. I'm not sure I'm the one to do it. But if I get involved climate change issues, I may need to become a bit more of an expert on all this stuff. There have been lots of arguments about satellite temperature records. Maybe when I start my new blog I'll invite some experts to talk about this stuff. Maybe after the blog gets rolling, so that — with luck " experts will want to visit it.

For more on this issue, see:

- National Oceanic and Atmospheric Administration (NOAA), Short-term cooling on a warming planet.

It's got a lot of good graphs and discussion.

Robert Smart blogged about this diary entry.

March 14, 2010

I wrote a bunch about the Silk Road starting on November 19th and going on into December. Like many people, I'm fascinated by that part of the world, which seems like the back of beyond from an American point of view. But I just read about a history that takes this part of the world as central:

- Christopher I. Beckwith, *Empires of the Silk Road: A History of Central Eurasia from the Bronze Age to the*

Present, Princeton U. Press, 2009.

I'd like to read it. You can see the introduction online.

Doing my taxes, I discovered that I spent 109 days away from home in 2009:

- DC, Joint Mathematics Meetings January 3 - 10 (8 days)
- Georg-August-Universität, Göttingen, Germany February 3 - 8 (5 days)
- University of Glasgow, Scotland April 12 - 17 (6 days)
- University of Wisconsin April 18 - 20 (3 days)
- University of Ottawa April 30 - May 4 (5 days)
- Université Paris 7, France June 10 - August 11 (63 days)
- UCLA August 12 - 13 (2 days)
- Texas Christian University September 7 - 10 (4 days)
- Corfu Summer Institute September 11 - 22 (12 days)

Even looking at this list makes me tired. I wore myself out last year. It was really the combination of travel and finishing half-completed projects.

The longest trips were not the most tiring ones. Spending a long time in Paris was not tiring. The most tiring trip of all, at least in my memory, was the 5-day trip to Göttingen. I went with my student Chris Rogers. One leg of our flight was late so we wound up missing the next; we got into Frankfurt too late for the last train to Göttingen, so we had to spend a night in a hotel at the airport; then we caught an early train the next day.

I want to minimize short trips where I spend most of my time travelling. I've been doing a good job so far this year. Of course in July I'll be going to Singapore for a year! And I want to travel around there a bit — but luckily, there are lots of interesting places quite nearby. So, with luck I'll keep myself from getting overstretched and worn out.

Reading my last diary entry, you may wonder why I'm doing all this work on higher gauge theory and supersymmetric membranes. Didn't I say would switch to math that'll help the planet's ecosystem?

Yes, but...

Doing research with five grad students is like being the engineer on a big powerful locomotive! It takes an enormous amount of time and effort to build up speed: at first there's a lot of huffing and puffing with almost imperceptible progress. But once the research gets rolling, it easily crashes through roadblocks that might stop a solo effort. When I get stuck on a project working on my own, I just switch to another one. But when I'm working with a grad student, it's harder to change direction: it's more efficient to just push ahead, if at all possible.

It's also hard to *stop* research when you're doing it with a team of grad students! You can't just leave them in the lurch. So, while I'm trying to stop working on n-categories and other forms of fancy mathematical physics, it's going to take a year or two. The breaks are squealing like mad, but right now we're still barrelling ahead.

After my students get their PhDs, I think I'll enjoy being a lighter, more maneuverable unit — at least for a while. It's probably not even wise to take on students in biomathematics, or climate modelling, or anything like that until I have a bit of a reputation. They'll want jobs, after all.

Without grad students, I could veer recklessly between quantum computation, condensed mattter physics, biomathematics, climate change, and pure math — working with James Dolan on the last of these, I hope. That sounds fun. But as usual, unless I'm careful I'll probably get too busy. I need to learn restraint.

March 15, 2010

I used Google's video service to remotely attend the oral exam of Ross Tate, a computer science grad student at U.C. San Diego who is interested in using a certain generalization of monads to study "effects" in functional programming. It

took me forever to understand what computer scientists mean by "effects" and what these had to do with monads — even though monad are a concept from category theory that I already knew and loved.

In a nutshell, the idea is this. The word "side-effect" probably comes closer to the right intuitive idea than the word "effect". When we write a program to do something, that program may have side-effects! The stuff we're really focusing on may interact with its environment. For example, when we think we are computing a function

$$X \to Y$$

our program may mess around with the values of other variables in the memory, so a more complete treatment would treat it as a function

$$X \times S \to Y \times S$$

Here X and Y are the input and output we're focusing on, while S is the "environment" — the stuff we might prefer to ignore. In computer science, people often rewrite the above function as a function

$$X \to Y \times \mathrm{hom}(S,S)$$

where hom(S,S) is the set of all functions from the set S to itself. The operation of taking a set Y and forming its product with hom(S,S) has special properties, which make it a monad. And that's where monads get into the game. In fact this is just one example of an "effect" in computer science, and different effects correspond to different monads. This particular effect is called "state". Why? Well, the set S is the set of possible "states" of the environment.

But never mind the monad business. Here's another idea. Just focus on the function

$$X \times S \to Y \times S$$

We see this sort of function whenever we're trying to study a dissipative system in classical mechanics! What we really have there is a system with some set of states X coupled to a "heat bath" with some set of states S. There's a deterministic time evolution rule

$$X \times S \to X \times S$$

(Note that in this example Y = X, but we could do a more general once where it's not.) But we often try to ignore the heat bath, or think about it as little as possible. If we assume some probabilistic model of the state of the heat bath, then we get a nondeterministic time evolution rule

$$X \to X$$

for the system we're really interested in. In other words, just like a sloppy programmer, we would like to ignore the "side-effects". But if we do so, we get punished in similar ways: nondeterminism, or even worse if our model of the state of the heat bath was wrong.

And here's another example: decoherence in quantum mechanics! Here when we try to ignore the system's coupling to the environment we are punished by having a perfectly deterministic unitary time evolution seem like a nondeterministic "collapse of the wave function".

So, these three problems — side-effects, dissipation, and decoherence — are all mathematically rather similar when you view them in terms of a general theory of systems and processes.

And here's a fourth example: "externalities" in economics, where we ignore side-effects like the pollution caused by burning coal. Again we're trying to ignore the environment, and again we get punished for this.

On a wholly other note: I want to learn more about Milankovich cycles as a cause of glacial periods, and why the amount of CO in the atmosphere seems to be highly correlated to the temperature, but seems to *lag behind* it. A couple

of links, just so I don't forget them:

- Jeff Severinghaus, What does the lag of CO_2 behind temperature in ice cores tell us about global warming?, RealClimate.
- Eric Steig, The lag between temperature and CO_2. (Gore's got it right.), RealClimate.

March 16, 2010

This woman, Katie Spotz, just finished a 70-day trip rowing solo across the Atlantic from Senegal to Guyana.

She's the youngest person to have done it! Three cheers!

Nathan Urban has some helpful comments on my March 13 and March 15 entries on climate change:

> John,
>
> A few comments on your recent diary entries:
>
> **1. Recent temperature trends**
>
> I pretty much agree with your gut reaction: there's an (ahem) significant difference between "there has been warming which is not statistically significant" and "global warming has stopped". Over a 15 year period it's hard for a trend to achieve statistical significance even if it's really there, given the amount of natural variability present. That's why "climatological periods" for trend analysis are often taken to be about 30 years, although that's somewhat ad-hoc and maybe you can get by with 20-25, I don't know. Of course, the more warming you expect, the quicker you expect it to achieve significance.
>
> Actually, it's even harder to determine statistical significance of a short temperature trend than a simple regression analysis may indicate. Standard ordinary least squares (OLS) regression assumes that the error process is independent identically distributed normal. In reality, the residuals of a linear fit to a global temperature time series are not independently distributed: they are highly autocorrelated. If you take this into account using generalized least squares (GLS) regression, the confidence intervals get even wider

because there are effectively fewer independent data points, and it takes and even stronger signal to rise to significance.

All this, by the way, assumes simple linear trend analysis with no covariate information. We don't expect the climate to be perfectly linear. A more sophisticated analysis would do multiple regression on covariates such as forcings. For example, where are we in the 11-year solar cycle, have there been any big volcanoes (no in the last 15 years), can we subtract out known random effects like the 1998 El Nino, etc. An even more sophisticated analysis would run these data through a climate model to see what temperature behavior is predicted — it's not going to be a perfect line. (Some people try to do this with the big IPCC climate models, the AOGCMs, but this is delicate for recent temperatures because they were mostly run using guesses for forcings past 2000, rather than the actual forcings.) Some people have looked at pieces of this type of analysis but I don't know if anyone has looked at all of them together.

2. Bias in the GISS data

In general you should take any claims on Watts Up With That? with a very large grain of salt, because they have a history of posting ... questionable ... quantitative analysis.

Disclaimer: I'm no expert on temperature data products either.

However, in this case, they're correct: GISTEMP shows a greater recent warming trend than UAH. It's well known that UAH shows a lower warming trend, which is one reason why skeptics prefer it.

As a check, I quickly redid the analysis using the data in the link they provided.

(The analysis is just a few lines of code in the R statistical language, which is truly excellent for data analysis. If you're interested in playing around with data like this yourself, I could send you my R script.)

Using their data, I find that GISTEMP and UAH diverge since 2008 at a rate of 0.28 ± 0.08 °C/century, using OLS regression. This is slightly less than the 0.32 reported on Watts Up With That?, maybe because of an extra year of data since then, or data set revisions (both data sets are constantly tweaked). This divergence is statistically significant.

If I use GLS regression assuming AR(1) autocorrelation, I get a GISTEMP-UAH divergence of 0.27 ± 0.13 °C/century. This is also statistically significant, but only barely.

There is a key point being overlooked here. The Watts Up With That? post author would have you believe that if there is a divergence between GISTEMP and UAH, it's because GISTEMP is biased high. (He concludes that there are problems with both GISTEMP and the NOAA NCDC datasets.) However, the possibility remains that UAH is biased low.

What skeptics often don't mention is that just as there are multiple surface temperature data products (GISTEMP, NCDC, HADCRUT3), there are also multiple satellite temperature data products: UAH and RSS. The surface temperature products all ostensibly use pretty much the same data sources, but process them differently (e.g., bias adjustments). Likewise, the satellite products are based on the same satellites, but are processed differently, and make different adjustments. Notably, there was a change in satellites in 1992, and the UAH and RSS groups disagree in how to handle between-instrument calibration over that discontinuity.

For some reason many skeptics seem to latch onto the idea that the surface records are biased because of adjustments or station placement or whatever, but ignore the possibility that the satellite records could also be biased because of adjustments, errors in retrievals, etc.

It turns out that the RSS satellite record is much more similar to the surface station records, leaving UAH as the outlier. You can see this on the same "Wood for Trees" site where Watts Up With That? got the data:

- WoodForTrees.org: notes.
- WoodForTrees.org: graphs comparing temperature records.

This has GISTEMP, HADCRUT3, UAH, and RSS (omitting NCDC which isn't in their database). You can see that the HADCRUT3 and RSS trends are virtually indistinguishable, GISTEMP is slightly higher, and UAH is much lower. I have not calculated the divergence trends between these other time series and UAH but judging by the graph they should be similar to the GISTEMP-UAH trend.

In conclusion, it's rather hasty to assume that either GISTEMP or the surface temperature records in general are biased high. Whether they are or not requires a deeper analysis than that presented in the Watts Up With That? piece.

Glacial-interglacial temperature-CO_2 relationship

I'm interested in this too but haven't found time to get too deeply into it yet.

In the meantime, here are some references off my reading list. I haven't checked to see if any of them are discussed in the links you gave. Some of these papers may supersede earlier papers on my list.

- On the nature of lead-lag relationships during glacial-interglacial climate transitions.
- Atmospheric CO_2 and climate on millennial time scales during the last glacial period.
- Glacial greenhouse-gas fluctuations controlled by ocean circulation changes.
- Southern hemisphere and deep-sea warming led deglacial atmospheric CO_2 rise and tropical warming.
- Timing of atmospheric CO_2 and Antarctic temperature changes across Termination III.
- New constraints on the gas age-ice age difference along the EPICA ice cores, 0.50 kyr.
- What caused Earth's temperature variations during the last 800,000 years? Data-based evidence on radiative forcing and constraints on climate sensitivity.
- Glacial cycles and carbon dioxide: A conceptual model.
- Atmospheric CO_2 concentrations over the last glacial termination.
- The 100,000-year ice-age cycle identified and found to lag temperature, carbon dioxide, and orbital eccentricity.

In addition to your RealClimate links, there are also some references here:

- Skeptical Science, CO_2 lags temperature — what does it mean?

— Nathan

In case you forgot, the RealClimate links he was talking about are these:

- Jeff Severinghaus, What does the lag of CO_2 behind temperature in ice cores tell us about global warming?, RealClimate.

- Eric Steig, The lag between temperature and CO_2. (Gore's got it right.), RealClimate.

March 17, 2010

Here are the papers I need to finish, in various stages of preparation:

- With John Huerta: An invitation to higher gauge theory. Lecture notes from my Corfu talks, vastly expanded.

Overdue for an issue of *Class. Quant. Grav.* Today I finally finished a big calculation near the end of the paper, and tomorrow I should be able to wrap it up and throw it on the arXiv.

- With John Huerta: Division algebras and supersymmetry II. No huge rush on this, but I think it's ready to put on the arXiv, and I'd like to do that now, so I can refer to it in the previous paper.

- With Alex Hoffnung and Christopher Walker: Higher-Dimensional Algebra VII: Groupoidification. This was accepted for *Theory and Applications of Categories* subject to some revisions. I need to do the revisions.

- With Alex Hoffnung: Higher-Dimensional Algebra VIII: the Hecke bicategory. This will take a huge amount of work to finish up (the version I've linked to is very preliminary), but we need to get it done by the end of May.

- With John Huerta: a *Scientific American* article on the octonions. Supposedly due April 12th, but that seems unlikely and we haven't signed the contract saying we'll get it done by then! We've written an outline, and it should be easy to write, since it's short.

- With Aristide Baratin, Laurent Freidel and Derek Wise, Infinite-dimensional representations of 2-groups. Accepted for publication as a small book in *Memoirs of the AMS*, subject to revisions. We mainly need to expand the introduction to say more about what this stuff is good for. Luckily Aristide and Derek have already gone ahead and written a short paper about the applications to spin foam models.

- With Dan Christensen: an *AMS Notices* article on the the beauty of roots. It was solicited, with no known deadline. The main thing holding me back (apart from all these other bloody papers!) is that I need to understand the relation between Mandelbrot and Julia sets well enough to describe how similar ideas explain the beautiful patterns in the pictures drawn by Sam Derbyshire. This just requires having a couple of days without any distractions.

- With Paul-André Melliès: Theories with duality. This one will take a lot more thought! I feel very guilty about having not worked on it lately.

- With Mike Stay: a paper on compact closed symmetric monoidal bicategories. Mike is working on this, and at some point I'll need to jump in. Ideally it would be done enough by late May that I can point to it in my talk on "duality in logic and physics" at the Quantum Physics and Logic workshop. This is closely related to the paper with Paul-André.

- With Mike Stay: Algorithmic thermodynamics. We just need to polish this up a bit more. It's due in October for a special issue in *Mathematical Structures in Computer Science*. So, we can sit on it for a while.

It's scary to list these all at once. I usually compartmentalize my brain and think about only a few at a time. But I'n not too scared about being able to handle them all.

March 18, 2010

Here's an article on extinction in England:

- George Monbiot, The naming of things, published in *The Guardian*, March 15, 2010.

Let me quote a bit:

> The names alone should cause anyone whose heart still beats to stop and look again. Blotched woodwax. Pashford pot beetle. Scarce black arches. Mallow skipper. Marsh dagger. Each is a locket in which hundreds of years of history and thousands of years of evolution have been packed. Here nature and culture intersect. All are species that have recently become extinct in England.

Marsh dagger
photo by Graham Wenman

I cannot claim that I've been materially damaged by their loss, any more than the razing of the Prado would deprive me of food or shelter. But the global collapse of biodiversity hurts almost beyond endurance. The sense that the world is greying, its wealth of colour and surprise and wonder fading, is so painful that I can scarcely bear to write about it. Human welfare, as measured by gross domestic product, is doubtless enhanced by the processes which drive extinction. Human welfare, as measured by the heart and the senses, is diminished. We have no use for most of the world's natural exuberance; it cannot be commodified or reproduced. Biodiversity does not belong to us: that is why it is worth preserving.

In Doha today, governments are engaged in their annual festival of frustration: the endless arguments over the Convention on International Trade in Endangered Species. They are struggling against what often looks like an inexorable assault by technology, economic growth and sheer bloody idiocy. The latter is exemplified by the battle over the Atlantic bluefin tuna. Many governments want to ban the trade in this species for several years, but Japan is resisting furiously. Whether or not a ban is imposed, the effect on Japanese industry will be roughly the same, as the species is likely to become commercially extinct next year if current fishing levels continue. But the government would prefer one more year of raw exploitation to indefinite supplies in the future. There is no reasoning with this madness.

But it's the new report by Natural England which hit me hardest. English plant and animal species are still disappearing at the rate of two a year. All the goodwill, the billions of pounds and millions of hours poured into conservation work, the global treaties and concordats seem to be no match for the amplification of our presence on earth. If we can't even get this right in England, where the two biggest membership organisations are both conservation groups, where does hope lie?

There were several shocks in the report, but it was a different set of names that hammered into my mind. Some of the most endangered species have very ordinary, even — if I might be so rude — common names. The common frog, common gull, common skate and common smoothhound are all in trouble. The common eel is now listed as critically endangered everywhere. I remember, years ago, sitting beside a chalkstream whose entire bed was a writhing black conveyor belt of eels moving upriver. The eel was a universal, indestructible species. It can live almost anywhere, even stagnant water in which no other fish can survive, it can eat any old carrion and travel overland between ponds on dewy nights. Nobody valued them because they were everywhere. Had someone told me, on the bank of that river, that within my lifetime they would be threatened with extinction, I would have laughed out loud. If the common eel is now critically endangered, is any species safe?

He suggests giving more species plain English names so people can get to know them and maybe love them more than if they only have scientific names. How about saving their DNA while we're at it? Remember Betsy Dresser from my January 10th entry? Admittedly, baby cloned moths would not make so charismatic picture as baby cloned African wildcats. But maybe someday, as biotechnology gets cheaper, hobbyists will want to revive more and more extinct species? An alternative possibility is that they'll prefer to engineer new ones. Let us hope that while some biohackers create glow-in-the-dark monkeys, the height of good taste and refinement will be to recreate extinct species.

Betsy Dresser with cloned African wildcat kittens

I got an email from Søren Jensen about the statistical analysis of temperature series data:

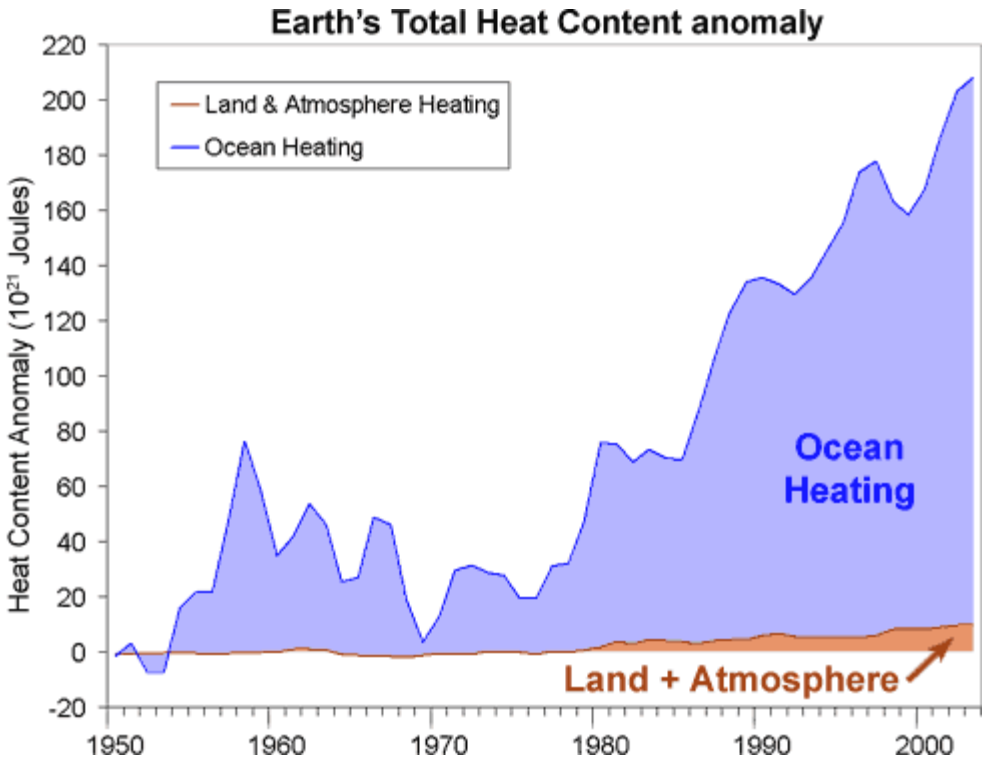
> Hi John
>
> I just saw your entry for the 13th of March, and in that connection I would like to point you to this blog post:
>
> Tamino, How long?, Open Mind, December 15, 2009.
>
> where the question is examined in detail by a professional statistician. I have redone some of the graphs in Matlab, and can send my scripts to you if you want.
>
> The analysis is done in a similar way here, by a guy from the skeptic side:
>
> - Jeff Id, No warming for fifteen years?, The Air Vent, November 12, 2009.
>
> By the way, Motl is in error when he assumes that the noise on the temperature data is white noise, as explained by Tamino.
>
> Here is a link to a blog that examines controversial questions in climate science in good way:
>
> - The Blackboard.
>
> Good luck with your journey into climate science,
>
> Best regards,
> Søren R. Jensen

March 19, 2010

From Mike Stay: cell-free artificial photosynthesis in foam made from frog goop, with "chemical conversion efficiencies" approaching 96%! I'm not sure what that means, but it sounds good:

- David Wendell, Jacob Todd and Carlo Montemagno, Artificial photosynthesis in ranaspumin-2 based foam, *Nano Letters*, March 5, 2010.

If the Earth is warming, it's not the atmosphere we should be focused on. It's the oceans! Water has a high specific heat, so that's where most of the heat energy goes — and the short-scale temperature fluctuations, which I've been writing about above, are much smaller.



Tonight I had dinner with Stephen Jordan, a postdoc at the Institute for Quantum Information who has some connection to the Singularity Institute through his friend Michael Vassar. I want to examine radically different alternative views about the near future for the new This Week's Finds, and interview scientists about their work. For this, it would be great to talk to Eliezer Yudkowsky or someone....

March 20, 2010

There's been some new genetic research that suggests that dogs were first domesticated in the Middle East:

- Joe Palca, Dogs likely descended from Middle Eastern wolf, *Morning Edition*, National Public Radio, March 18, 2010.
- UCLA newsroom, Dogs likely originated in the Middle East, new genetic data indicate.

Together with his colleagues from UCLA, Robert Wayne studied the DNA from over 200 wild gray wolves, found some markers of distinct populations, and looked for these in the DNA of 900 dogs from 85 different breeds. Most dogs shared markers with Middle Eastern wolves, though some dog breeds were related to different wolf populations. Previous papers had suggested that dogs came from east Asia. Quoting the UCLA website:

> "This study is unique in using a particular technology called a single nucleotide polymorphism, or SNP, genotyping chip; these chips interrogate the nucleotides at 48,000 locations in the genome," said John

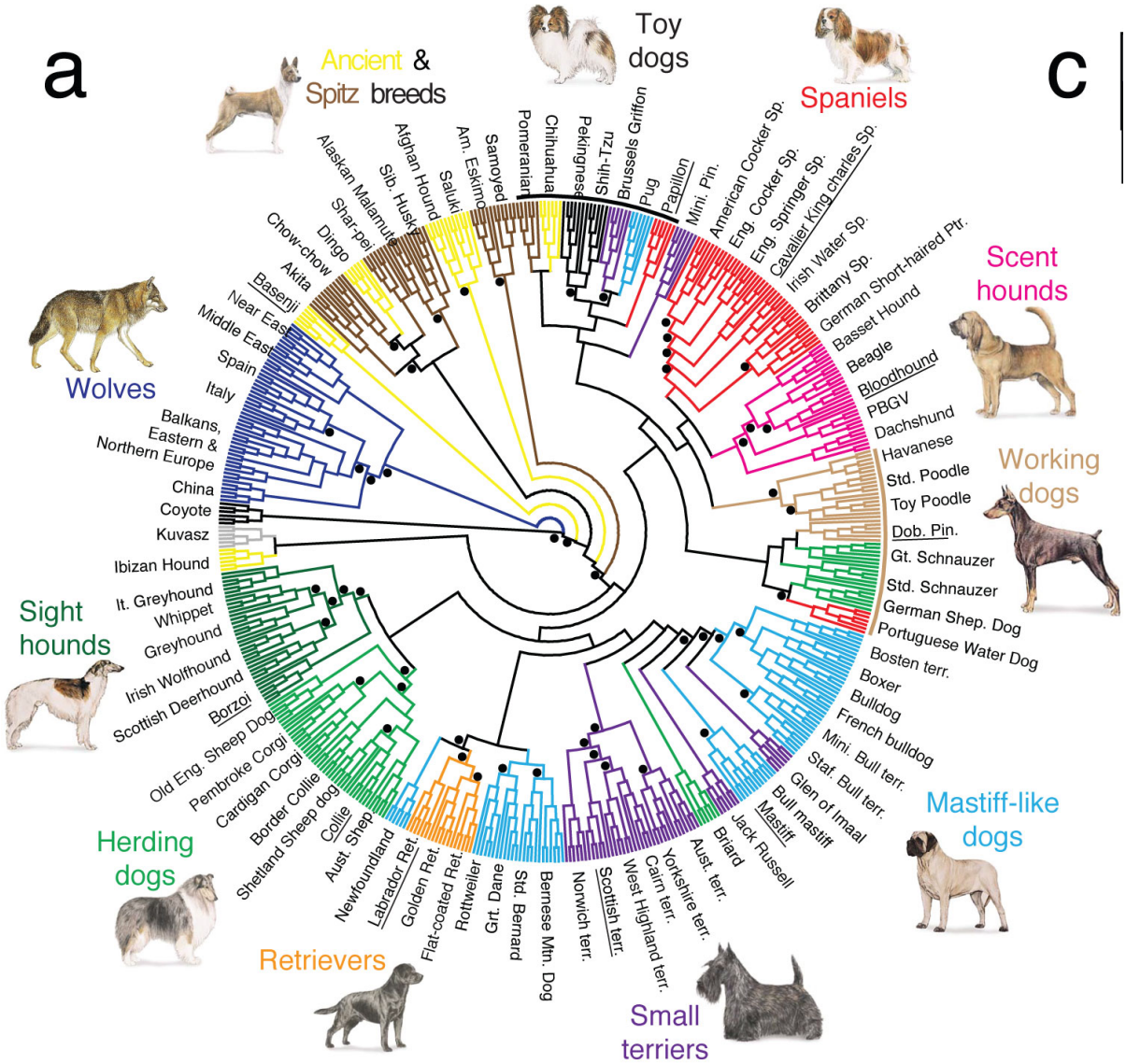
Novembre, UCLA assistant professor of ecology and evolutionary biology and a member of UCLA's Interdepartmental Program in Bioinformatics. "We are able to compare dogs looking at not just one small part of the genome, but at 48,000 different locations. That gives us the fine-scale resolution to analyze how these breeds are related to one another and how they are related to wolves."

Previous genetic research had suggested an East Asian origin based on the higher diversity of mitochondrial sequences in East Asia and China than anywhere else in the world. (Mitochondria are tiny cellular structures outside the nucleus that produce energy and have their own small genome.) However, that research was based on only one sequence, a small part of the mitochondrial genome, Wayne noted.

"That research made extrapolations about how the domestic dog has evolved from examination of one region in the mitochondrial genome," Wayne said. "This new Nature paper is a much more comprehensive analysis because we have analyzed 48,000 markers distributed throughout the nuclear genome to try to conclude where the most likely ancestral population is.

"What we found is much more consistent with the archaeological record," he said. "We found strong kinship to Middle Eastern gray wolves and, to some extent, European gray wolves . but much less so to any wolves from East Asia. Our findings strongly contradict the conclusions based on earlier mitochondrial DNA sequence data."

Here is the chart that Wayne's team came up with:

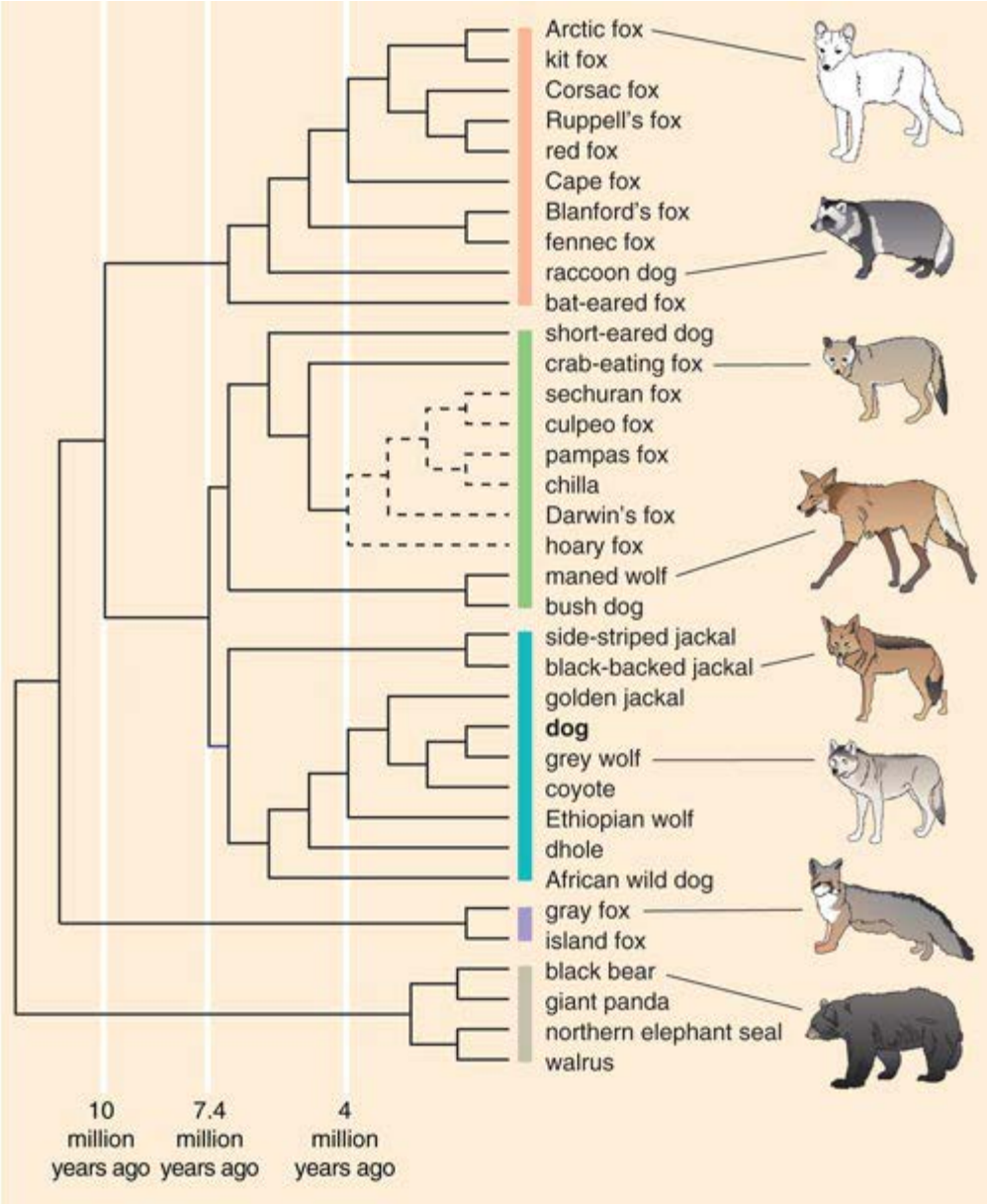


I've written about the domestication of dogs earlier, in my September 28, 2007 and August 30, 2009 diary entries. But let me remind you of that stuff here, so you don't have to go doggedly clicking to read it all.

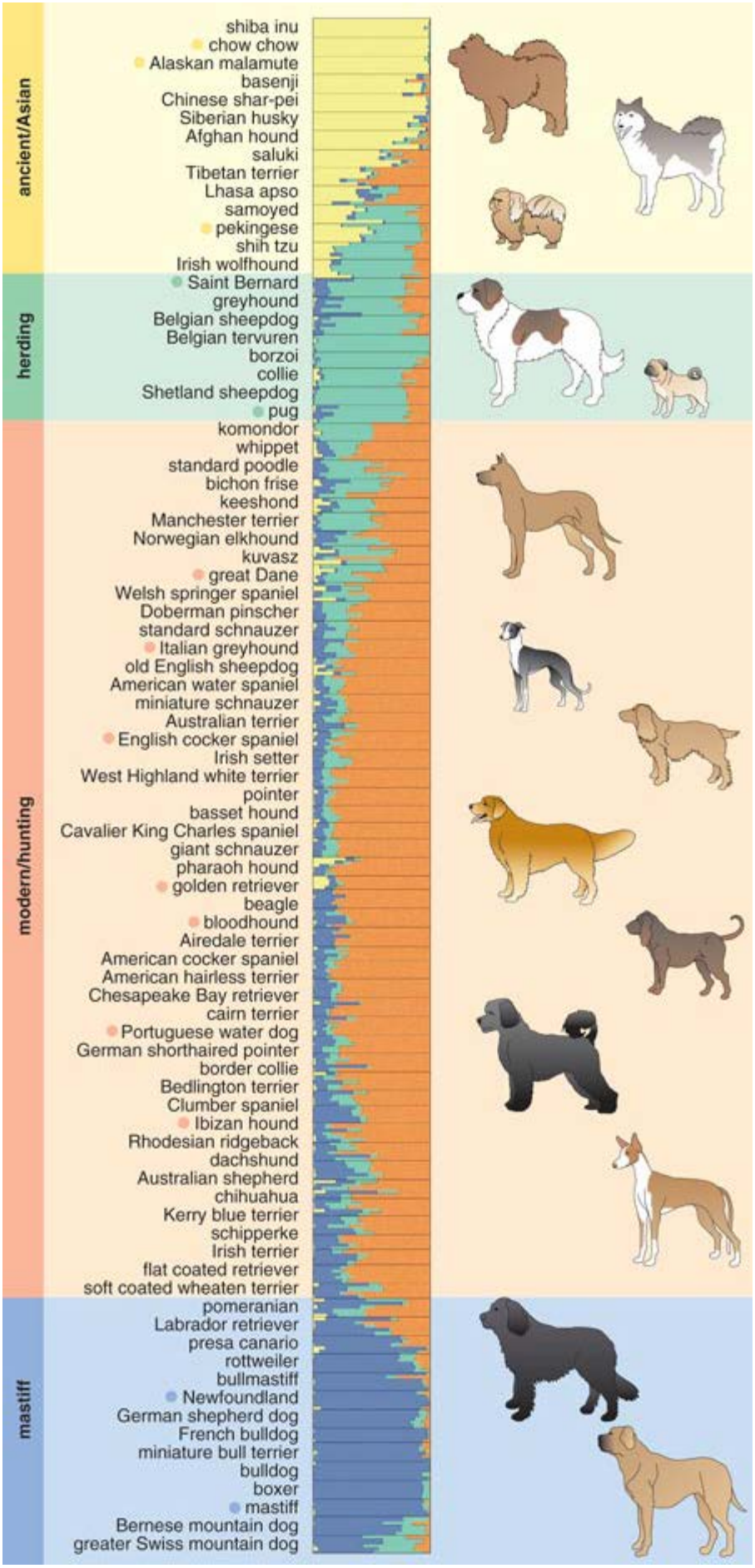
First of all, in 2007, Elaine Ostrander studied the DNA of lots of dogs and cats:

- Elaine A. Ostrander, Genetics and the shape of dogs, *American Scientist*, September-October 2007.

Dogs are now considered a subspecies of the gray wolf, which in turn is one of many closely related species of canids:



Ostrander argued that there are four general kinds of dogs, genetically speaking:



Another interesting question is when the domestication happened. Wolf remains have been found in association with

hominid remains as far back as 400,000 years ago. The precise time at which some wolves became domesticated "dogs" will probably be argued forever. One has to wonder, what's the *definition* of when a "wolf" becomes a "dog"? Dogs can and still do interbreed with wolves and other canids, after all. Indeed, Robert Wayne has argued that this is why half of North American wolves are black.

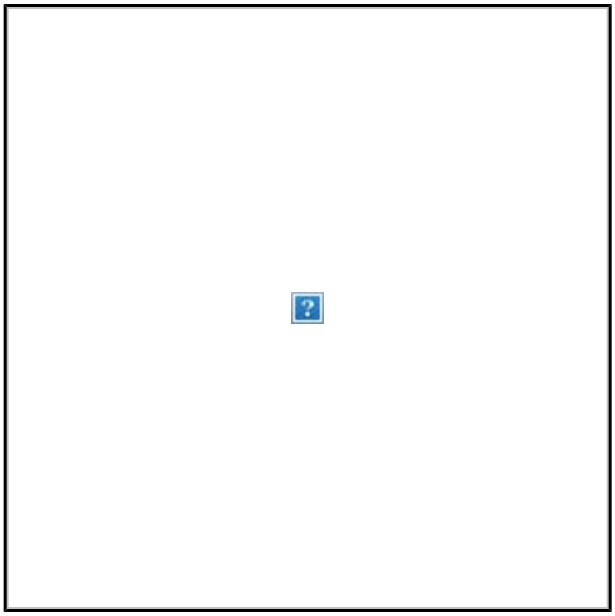


photo by Monty Sloan

One interesting possibility is that a canid counts as domestic when it will eat in the presence of humans.

Personally, not being at all expert on this subject, I suspect a much earlier date for domestication. It's easy for me to imagine wolves being domesticated as soon as hominids started using fire to cook meat. The use of fire dates back to around 1.4 million years ago, long before *Homo neanderthalensis* showed up.

Some Russian biologists did an interesting experiment that sheds some light on the process of domestication. They kept a colony of silver foxes and bred them to be less scared of people, less aggressive.

After just 10 generations, 18% of the foxes sought human contact and showed little fear! And after about 30 generations, a true "domesticated fox" had developed. At the end, the Russians had 700 domesticated foxes — but they ran out of money when the USSR collapsed, and had to sell 600 of them as pets. At last report, "Most of the project expenses are covered by selling the foxes as pets, but the project remains in a difficult situation, looking for new sources of revenue from outside funding".

Anyway: domestication can happen quickly under laboratory conditions, but that only sets a lower bound on how long it took for wolves to become dogs.

Anyway, this article summarizes our rather sketchy state of knowledge of when wolves were first domesticated:

- Pat Shipman, The woof at the door, *American Scientist* **97** (July-August, 2009), 286-289.

Let me quote a bit:

> Another way of estimating the time at which domestic dogs originated is to consider their genetic differences from wolves. One prominent group of researchers, including Robert Wayne, along with Carles Vilà of the Uppsala University in Sweden and their collaborators, initially estimated in 1997 that dogs diverged from gray wolves 100,000 to 135,000 years ago. After more study, they revised their divergence date to between 40,000 and 100,000 years ago. Another group, led by Peter Savolainen of the Royal Institute of Technology in Sweden, favored the Chinese wolf, a subspecies of the gray wolf, as the probable ancestor and estimated in 2002 that it was domesticated between 15,000 and 40,000 years ago.
>
> How do these genetic estimates stack up against the fossil record? Until 2009, the oldest known remains of domestic dogs were two adult skulls dated to between 13,000 and 17,000 years ago, from Eliseevichi, a region in Russia. Both had the relatively broad, short snout typical of dogs, and both were large, heavy animals, nearly the size of great Danes.
>
> Then a team led by Mietje Germonpré of the Royal Belgian Institute of Natural Sciences reported a stunning new finding in the February 2009 issue of *Journal of Archaeological Science*: a nearly complete fossil dog skull dated to 31,680 ± 250 years ago.

The article then describes Germonpré's research in more detail: studies of canine skulls from various Paleolithic sites in Europe, studies of mitochondrial DNA in ancient canine bones, and best of all, how this work led to the realization that a fossilized dog from Goyet Cave in Belgium was about 31,680 years old! This is about the time of the earliest cave paintings in Europe. For example, the Chauvet Cave in France has paintings about 32,900 ± 490 years old, and also *the footprints of a human child, along with dog footprints that seem to be following her!*

Carbon dating of charcoal from "a torch the child carried" — but how do they know that? — says it's about 26,000 years old.

March 21, 2010

the sun is up
the world is flat
damn good address for a rat
the smell of blood
the drone of flies
you know what to do if
the baby cries

hoist that rag
hoist that rag

well we stick our fingers
in the ground,
heave and turn
the world around
smoke is blacking
out the sun
at night I pray
and clean my gun
the cracked bell rings
as the ghost bird sings
and the gods go begging here

so just open fire

as you hit the shore
all is fair in love
and war

hoist that rag
hoist that rag
hoist that rag
hoist that rag

A friend warned me against getting involved in the *politics* of global warming, urging me to stick to the *science*. I had trouble sorting this out at first. I think this remark from Eliezer Yudkowsky's essay Politics is the Mind-Killer helped me get the point:

> Politics is an extension of war by other means. Arguments are soldiers. Once you know which side you're on, you must support all arguments of that side, and attack all arguments that appear to favor the enemy side; otherwise it's like stabbing your soldiers in the back — providing aid and comfort to the enemy.

I think it's this mindset that I need to avoid. Gotta be careful: it creeps up on you!

March 22, 2010

Here's a very good review of climate change, readable by nonexperts, and I think quite fair:

- The clouds of unknowing, *The Economist*, March 18, 2010.

Let me quote the beginning and the end, skipping the technical heart of it. You should really read the whole thing! It studies both the mainstream ideas and those of skeptics like Richard Lindzen of MIT. Here's the beginning:

> For anyone who thinks that climate science must be unimpeachable to be useful, the past few months have been a depressing time. A large stash of e-mails from and to investigators at the Climatic Research Unit of the University of East Anglia provided more than enough evidence for concern about the way some climate science is done. That the picture they painted, when seen in the round — or as much of the round as the incomplete selection available allows — was not as alarming as the most damning quotes taken out of context is little comfort. They offered plenty of grounds for both shame and blame.
>
> At about the same time, glaciologists pointed out that a statement concerning Himalayan glaciers in the most recent report of the Intergovernmental Panel on Climate Change (IPCC) was wrong. This led to the discovery of other poorly worded or poorly sourced claims made by the IPCC, which seeks to create a scientific consensus for the world's politicians, and to more general worries about the panel's partiality,

transparency and leadership. Taken together, and buttressed by previous criticisms, these two revelations have raised levels of scepticism about the consensus on climate change to new heights.

Increased antsiness about action on climate change can also be traced to the recession, the unedifying spectacle of last December's climate-change summit in Copenhagen, the political realities of the American Senate and an abnormally cold winter in much of the northern hemisphere. The new doubts about the science, though, are clearly also a part of that story. Should they be?

In any complex scientific picture of the world there will be gaps, misperceptions and mistakes. Whether your impression is dominated by the whole or the holes will depend on your attitude to the project at hand. You might say that some see a jigsaw where others see a house of cards. Jigsaw types have in mind an overall picture and are open to bits being taken out, moved around or abandoned should they not fit. Those who see houses of cards think that if any piece is removed, the whole lot falls down. When it comes to climate, academic scientists are jigsaw types, dissenters from their view house-of-cards-ists.

The defenders of the consensus tend to stress the general consilience of their efforts.the way that data, theory and modelling back each other up. Doubters see this as a thoroughgoing version of "confirmation bias", the tendency people have to select the evidence that agrees with their original outlook. But although there is undoubtedly some degree of that (the errors in the IPCC, such as they are, all make the problem look worse, not better) there is still genuine power to the way different arguments and datasets in climate science tend to reinforce each other.

The doubters tend to focus on specific bits of empirical evidence, not on the whole picture. This is worthwhile — facts do need to be well grounded — but it can make the doubts seem more fundamental than they are. People often assume that data are simple, graspable and trustworthy, whereas theory is complex, recondite and slippery, and so give the former priority. In the case of climate change, as in much of science, the reverse is at least as fair a picture. Data are vexatious; theory is quite straightforward. Constructing a set of data that tells you about the temperature of the Earth over time is much harder than putting together the basic theoretical story of how the temperature should be changing, given what else is known about the universe in general.

And here's the end:

Adding the uncertainties about sensitivity to uncertainties about how much greenhouse gas will be emitted, the IPCC expects the temperature to have increased by 1.1ºC to 6.4ºC over the course of the 21st century. That low figure would sit fairly well with the sort of picture that doubters think science is ignoring or covering up. In this account, the climate has natural fluctuations larger in scale and longer in duration (such as that of the medieval warm period) than climate science normally allows, and the Earth's recent warming is caused mostly by such a fluctuation, the effects of which have been exaggerated by a contaminated surface-temperature record. Greenhouse warming has been comparatively minor, this argument would continue, because the Earth's sensitivity to increased levels of carbon dioxide is lower than that seen in models, which have an inbuilt bias towards high sensitivities. As a result subsequent warming, even if emissions continue full bore, will be muted too.

It seems unlikely that the errors, misprisions and sloppiness in a number of different types of climate science might all favour such a minimised effect. That said, the doubters tend to assume that climate scientists are not acting in good faith, and so are happy to believe exactly that. Climategate and the IPCC's problems have reinforced this position.

Using the IPCC's assessment of probabilities, the sensitivity to a doubling of carbon dioxide of less than 1.5ºC in such a scenario has perhaps one chance in ten of being correct. But if the IPCC were underestimating things by a factor of five or so, that would still leave only a 50:50 chance of such a desirable outcome. The fact that the uncertainties allow you to construct a relatively benign future does not allow you to ignore futures in which climate change is large, and in some of which it is very dangerous indeed. The doubters are right that uncertainties are rife in climate science. They are wrong when they

present that as a reason for inaction.

The political battle is heating up, as can be seen from this editorial in *Nature*. I present it here because it illustrates the mood, and because you'd otherwise need a subscription to read it! It's pathetic that *Nature* is talking about such important and controversial issues behind the wall of "for subscribers only".

Climate of Fear

The integrity of climate research has taken a very public battering in recent months. Scientists must now emphasize the science, while acknowledging that they are in a street fight.

Climate scientists are on the defensive, knocked off balance by a re-energized community of global-warming deniers who, by dominating the media agenda, are sowing doubts about the fundamental science. Most researchers find themselves completely out of their league in this kind of battle because it's only superficially about the science. The real goal is to stoke the angry fires of talk radio, cable news, the blogosphere and the like, all of which feed off of contrarian story lines and seldom make the time to assess facts and weigh evidence. Civility, honesty, fact and perspective are irrelevant.

Worse, the onslaught seems to be working: some polls in the United States and abroad suggest that it is eroding public confidence in climate science at a time when the fundamental understanding of the climate system, although far from complete, is stronger than ever. Ecologist Paul Ehrlich at Stanford University in California says that his climate colleagues are at a loss about how to counter the attacks. "Everyone is scared shitless, but they don't know what to do," he says.

Researchers should not despair. For all the public's confusion about climate science, polls consistently show that people trust scientists more than almost anybody else to give honest advice. Yes, scientists' reputations have taken a hit thanks to headlines about the leaked climate e-mails at the University of East Anglia (UEA), UK, and an acknowledged mistake about the retreat of Himalayan glaciers in a recent report from the Intergovernmental Panel on Climate Change (IPCC). But these wounds are not necessarily fatal.

To make sure they are not, scientists must acknowledge that they are in a street fight, and that their relationship with the media really matters. Anything strategic that can be done on that front would be useful, be it media training for scientists or building links with credible public-relations firms. In this light, there are lessons to be learned from the current spate of controversies. For example, the IPCC error was originally caught by scientists, not sceptics. Had it been promptly corrected and openly explained to the media, in full context with the underlying science, the story would have lasted days, not weeks. The IPCC must establish a formal process for rapidly investigating and, when necessary, correcting such errors.

The unguarded exchanges in the UEA e-mails speak for themselves. Although the scientific process seems to have worked as it should have in the end, the e-mails do raise concerns about scientific behaviour and must be fully investigated. Public trust in scientists is based not just on their competence, but also on their perceived objectivity and openness. Researchers would be wise to remember this at all times, even when casually e-mailing colleagues.

US scientists recently learned this lesson yet again when a private e-mail discussion between leading climate researchers on how to deal with sceptics went live on conservative websites, leading to charges that the scientific elite was conspiring to silence climate sceptics (see page 149). The discussion was spurred by a report last month from Senator James Inhofe (Republican, Oklahoma), the leading climate sceptic in the US Congress, who labelled several respected climate scientists as potential criminals — nonsense that was hardly a surprise considering the source. Some scientists have responded by calling for a unified public rebuttal to Inhofe, and they have a point. As a member of the minority party, Inhofe is powerless for now, but that may one day change. In the meantime, Inhofe's report is only as effective as the attention it receives, which is why scientists need to be careful about how they engage such critics.

> The core science supporting anthropogenic global warming has not changed. This needs to be stated again and again, in as many contexts as possible. Scientists must not be so naive as to assume that the data speak for themselves. Nor should governments. Scientific agencies in the United States, Europe and beyond have been oddly silent over the recent controversies. In testimony on Capitol Hill last month, the head of the US Environmental Protection Agency, Lisa Jackson, offered at best a weak defence of the science while seeming to distance her agency's deliberations from a tarnished IPCC. Officials of her stature should be ready to defend scientists where necessary, and at all times give a credible explanation of the science.
>
> These challenges are not new, and they won't go away any time soon. Even before the present controversies, climate legislation had hit a wall in the US Senate, where the poorly informed public debate often leaves one wondering whether science has any role at all. The IPCC's fourth assessment report had huge influence leading up to the climate conference in Copenhagen last year, but it was always clear that policy-makers were reluctant to commit to serious reductions in greenhouse-gas emissions. Scientists can't do much about that, but they can and must continue to inform policy-makers about the underlying science and the potential consequences of policy decisions — while making sure they are not bested in the court of public opinion.

March 23, 2010

Since the UCR math department is short of space, someone will be using my office while I'm gone. This gives me a reason — one might even say an excuse — to get rid of a lot of old reprints that have been sitting unused in my file cabinet for years. And my planned shift in career direction makes it easier to throw things out. It's interesting to see which items trigger that twinge of emotion that makes me reluctant to get rid of them. Most of the papers on n-categories and quantum gravity seem quite disposable: they're all available online, they're too new for me to feel particularly nostalgic them, and tossing them makes me feel like I'm preparing for a new life.

But an old xeroxed typewritten manuscript by Yvonne Choquet-Bruhat, on the existence of global solutions for the Yang-Mills equations, brings back the bygone age when I was struggling to find my feet after grad school, working on nonlinear partial differential equations, not really sure what I wanted to do. It reminds me of hearing her give a talk about this subject at MIT: a short elderly woman with a very strong French accent, one of Irving Segal's few mathematical friends at that time, standing in front of a blackboard, explaining the estimates necessar to prove global existence of solutions of the Yang-Mills equations with sufficiently small initial data.

Out with it — I don't really need it, and I'm sure the published version is available online. But it was good to be reminded of that scene.

Others seem too precious to throw out. An enormous xeroxed copy of Grothendieck's *Pursuing Stacks*. A nicely bound copy of Martin Neuchl's thesis. Some old reprints by Peter May. My handwritten notes from a graduate course on symplectic geometry, taught by Victor Guillemin. I don't think I *need* these, but they are irreplaceable — in some sense — and they have a lot of emotional significance.

There are even some lost treasures: Todd Trimble's notes on the Lie operad, for example! People have been seeking these for years. I scanned them in and put them on my Trimble webpage. Unfortunately my printed copy was missing page 16.

March 27, 2010

My sister Alex has been visiting — that's short for Alexandra. On Tuesday she made it from Dulles to Denver, where her next flight was cancelled due to a snowstorm — 9 inches of the stuff! So, she had to spend a night on the airport floor. On Wednesday morning she called me at 7. They put her on a flight to Los Angeles instead of Ontario (the airport nearer to Riverside). I roused myself and drove down there to catch her by 9:30. I was just a bit late, but her flight was later: they delayed it until 10:23. When she showed up, her luggage had been misplaced. We took advantage of our misfortune by wandering around Playa Vista, a beach near the LA airport. Thursday we went to Palm Canyon with Simon Willerton; upon our return they'd delivered her luggage. On Friday we all went to Joshua Tree. Today I handed

her off to my aunt in Pasadena.

Now back alone... I should prepare my Rosetta Stone talk for Cal State Fresno, and polish up what John Huerta has written about the octonions — we're doing an article for *Scientific American*. As usual, I can think of all sorts of equally fun things to do, and I feel like doing them first. But I'll resist... as soon as I'm done with this diary entry.

Mike Stay points out this blog entry:

- Eric Drexler, Greenhouse gases and advanced nanotechnology.

I want to interview some people about global warming, other environmental problems, and work they're doing to understand and solve these problems. I should make a list of these people, and Drexler is certainly one. I definitely want to consider possible high-tech solutions to global warming. Drexler points out that these may be necessary:

> Carbon stays in the atmosphere for a long time.
>
> To many readers, this is nothing new, yet most who know this make a simple mistake [see below]. They think of carbon as if it were sulfur, with pollution levels that rise and fall with the rate of emission: Cap sulfur emissions, and pollution levels stabilize; cut emissions in half, cut the problem in half. But carbon is different. It stays aloft for about a century, practically forever. It accumulates. Cap the rate of emissions, and the levels keep rising; cut emissions in half, and levels will still keep rising. Even deep cuts won't reduce the problem, but only the rate of growth of the problem.
>
> In the bland words of the Intergovernmental Panel on Climate Change, "only in the case of essentially complete elimination of emissions can the atmospheric concentration of CO_2 ultimately be stabilised at a constant [far higher!] level". This heroic feat would require new technologies and the replacement of today's installed infrastructure for power generation, transportation, and manufacturing. This seems impossible. In the real world, Asia is industrializing, most new power plants burn coal, and emissions are accelerating, *increasing the rate of increase of the problem*.
>
> In fact, the mistaken idea that CO_2 behaves like a typical pollutant seems deeply entrenched in people's thinking (if you find it in your thinking, please make an effort to dig it out). I was disturbed to read a recent article in *Science*:
>
> - John Sterman, Risk communication on climate: mental models and mass balance, *Science*, 24 October 2008, 532-533.
>
> in which John Sterman describes a study in which a group of MIT students (from my own school!) flubbed this completely. After reading a description excerpted from the IPCC's *Summary for Policymakers*, they still misunderstood the problem, mistakenly thinking that limiting emissions would limit CO_2 levels. From the *Science* article, with emphasis added:
>
> > **The dynamics are easily understood using a bathtub analogy** in which the water level represents the stock of atmospheric CO_2. Like any stock, atmospheric CO_2 rises when the inflow to the tub (emissions) exceeds the outflow (net removal), is unchanging when inflow equals outflow, and falls when outflow exceeds inflow. Participants were informed that anthropogenic CO_2 emissions are now roughly double net removal, so the tub is filling.
> >
> > Yet, 84% drew patterns [graphs of emission control policies and their effects] that violated the principles of accumulation.. Nearly two-thirds of the participants asserted that atmospheric GHGs [greenhouse gases] can stabilize even though emissions continuously exceed removal — analogous to arguing a bathtub continuously filled faster than it drains will never overflow. Most believe that stopping the growth of emissions stops the growth of GHG concentrations. **The erroneous belief that stabilizing emissions would quickly stabilize the climate**

supports wait-and-see policies but violates basic laws of physics.

Training in science does not prevent these errors. Three-fifths of the participants have degrees in science, technology, engineering, or mathematics (STEM); most others were trained in economics. Over 30% hold a prior graduate degree, 70% of these in STEM. These individuals are demographically similar to influential leaders in business, government, and the media, though with more STEM training than most.

The way to remove CO_2 quickly is to pump it, but this is a project too large to undertake with today's manufacturing infrastructure. However, as I note in the *Edge* essay,

> If we were good at making things, we could make efficient devices able to collect, compress, and store carbon dioxide from the atmosphere, and we could make solar arrays large enough to generate enough power to do this on a scale that matters. A solar array area, that if aggregated, would fit in a corner of Texas, could generate 3 terawatts. In the course of 10 years, 3 terawatts would provide enough energy remove all the excess carbon the human race has added to the atmosphere since the Industrial Revolution began. So far as carbon emissions are concerned, this would fix the problem.

Read more on his blog or his *Edge* essay.

March 28, 2010

If you like Bogart movies, see *Heat Lightning*. It's not a Bogart movie, but it's a kind of precursor to *The Petrified Forest*, with a distinctive charm all its own. It's set in a remote gas station 26 miles from Baker, California — somewhere with lots of Joshua trees. Aline MacMahon is the star. The preview may seem corny but the movie is not. It's old-fashioned, but I've gotten to really like a certain kind of old movie, and this is one.

I watched *Heat Lightning* last night, and also *The Big Heat*, a real classic film noir by Fritz Lang. You see, Turner Classic Movies was doing a special day of movies with "heat" in the title.

As if this weren't enough, I recently finished reading Raymond Chandler's first novel, *The Big Sleep*. As you may know, the the great Bogart-Bacall movie based on this novel was almost impossible to follow, since they cut a lot of crucial connecting scenes and also a long conversation between Marlowe and the Los Angeles District Attorney where the facts are explained. They've recently released a version that restores these scenes. But I haven't made up my mind whether this enhances or diminishes its curious charm! The film critic Bosley Crowther complained about the movie when it came out in 1946:

> The Big Sleep is one of those pictures in which so many cryptic things occur amid so much involved and devious plotting that the mind becomes utterly confused. And, to make it more aggravating, the brilliant detective in the case is continuously making shrewd deductions which he stubbornly keeps to himself. What with two interlocking mysteries and a great many characters involved, the complex of blackmail and murder soon becomes a web of utter bafflement. Unfortunately, the cunning script-writers have done little to clear it at the end.

But he also said that Bacall "still hasn't learned to act" — so what does *he* know? Personally I think the complex, baffling plot is part of what makes me willing to watch it over and over. That, and of course the incredible chemistry between Bogart and Bacall, and lots of great acting all around.

Anyway, reading the book does *not* completely dispel the mystery of the film, since the plot of the film diverges from

that of the book in several points. For example: why does Vivian Sternwood go to that car garage in Realito? That's not in the book!

I want to read more by Raymond Chandler.

March 29, 2010

Sometime this summer, starting with "week301", I'm going to drastically overhaul my column This Week's Finds. Among other things, I'm thinking of doing some interviews, perhaps by email. The idea would be to illustrate how smart people are solving problems and dreaming up cool new ideas... so younger people, or established academics who want to do something a bit more useful, can see some role models. And my hope is to pitch these interviews at a pretty high level, not the usual journalistic watered-down crud. Just as a kind of self-reminder, here's a little list of some people I might want to interview:

- Gregory Benford — geoengineering
- Stewart Brand - ecopragmatism
- Jiahao Chen — quantum chemistry
- Eric Drexler — nanotechnology
- Thomas Fischbacher - sustainability
- Dan Ghica — computer science
- Hendra Nurdin — quantum control
- Nathan Urban — climate change
- Eliezer Yudkowsky — friendly AI

It's a kind of compromise between bigshots and people who might actually want to talk to me. I won't say who is who, lest I hurt somebody's feelings. I've surely left out *tons* of obvious names, so don't feel bad if you're not on this list. I'll keep building up the list as time goes by. If you're an expert on climate change, ecology, extinction of species, solar power, nuclear power, quantum technologies, or anything cool like that, and you'd *like* me to interview you, send me an email! I can't promise anything, of course.

In compiling this list, I see that Stewart Brand has come out with a new book:

- Stewart Brand, *Whole Earth Discipline: An Ecopragmatist Manifesto*, Viking-Penguin, 2009.

Here's some of what he has to say about nuclear power:

> As for footprint, Gwyneth Cravens points out that "A nuclear plant producing 1,000 megawatts takes up a third of a square mile. A wind farm would have to cover over 200 square miles to obtain the same result, and a solar array over 50 square miles". That.s just the landscape footprint. (By the way, 1,000 megawatts equals 1 gigawatt — a billion watts; I'll use that measure most of the time here.)
>
> More interesting to me is the hazard comparison between coal waste and nuclear waste. Nuclear waste is minuscule in size — one Coke can's worth per person-lifetime of electricity if it was all nuclear, Rip Anderson likes to point out. Coal waste is massive — 68 tons of solid stuff and 77 tons of carbon dioxide per person-lifetime of strictly coal electricity. The nuclear waste goes into dry cask storage, where it is kept in a small area, locally controlled and monitored. You always know exactly what it's doing. A 1-gigawatt nuclear plant converts 20 tons of fuel a year into 20 tons of waste, which is so dense it fills just two dry-storage casks, each one a cylinder 18 feet high, 10 feet in diameter.
>
> By contrast, a 1-gigawatt coal plant burns 3 million tons of fuel a year and produces 7 million tons of CO_2, all of which immediately goes into everyone's atmosphere, where no one can control it, and no one knows what it's really up to. That's not counting the fly ash and flue gases from coal — the world's largest source of released radioactivity, full of heavy metals, including lead, arsenic, and most of the neurotoxic mercury that has so suffused the food chain that pregnant women are advised not to eat wild fish and shellfish. The

air pollution from coal burning is estimated to cause 30,000 deaths a year from lung disease in the United States, and 350,000 a year in China.

Watch this movie:

- Rip Anderson and Gwyneth Cravens, Could nuclear power save the planet?, Long Now Foundation.

For my April 2010 diary, go here.

Sometimes doing your best is not good enough. Sometimes, you must do what is required. - Winston Churchill

baez@math.removethis.ucr.andthis.edu

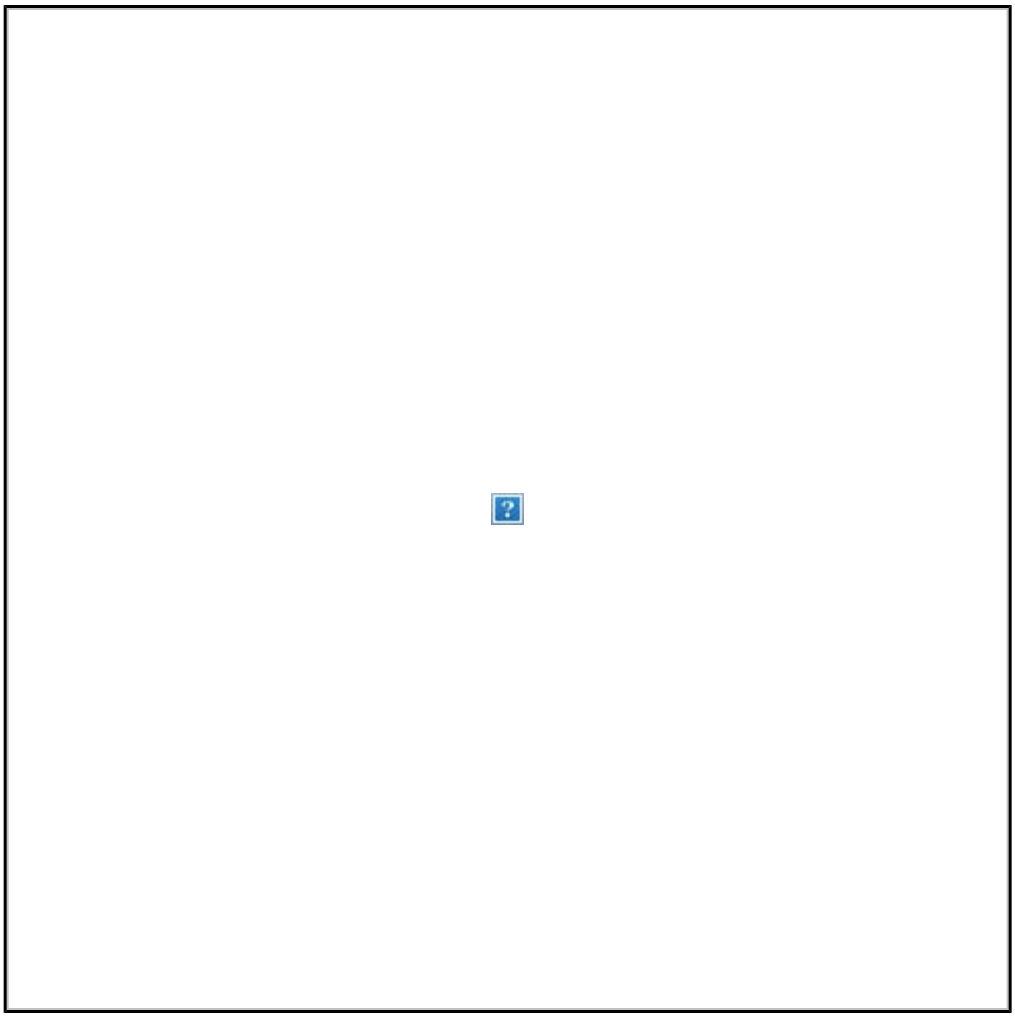
home

[For my March 2010 diary, go here.]

Diary - April 2010

John Baez

April 1, 2010



In Glendale California, police had the bright idea of dressing an officer as a giant bunny rabbit. The idea was that he would walk across a crosswalk and see if motorists would stop. If they didn't, more cops would come roaring out on motorcycles and arrest the culprit — as shown above.

One violator claimed it was no fair: he said the officer suddenly "hopped out in front of him".

I would like to see a video of that.

This is one of my favorite April Fool's jokes:

> In 1915, the Geneva Tribune reported that on April 1 a French aviator flying over a German camp dropped what appeared to be a huge bomb. The German soldiers immediately scattered in all directions, but no explosion followed. After some time, the soldiers crept back and gingerly approached the bomb. They discovered that it was actually a large football with a note tied to it that read, "April Fool!"

I often feel sorry for people who have been taken in by a joke, but in this case I don't. What makes this one especially

funny is that there was an actual war going on, but somehow still room for a joke. That's panache.

While we're yukking it up: if you haven't listened to this yet, you should:

- David Sedaris as Crumpet the Elf, National Public Radio, 1992.

I love the tone of voice when he says *"I'm going to have you fired."*

April 2, 2010

Male zebra finches have annoying songs which are highly individual. They start out babbling when they're young, and they learn a song from their father. Once they learn it, they keep that song for life. And so, now that their genome has been sequenced, we may discover some interesting things about how *people* learn to talk:

- Jon Hamilton, Songbird DNA may offer clues to human speech, *Morning Edition*, National Public Radio, April 1, 2010.

My friend Tom Leinster is a category theorist who discovered some math that turns out to be related to known ways of estimating species diversity! He passed on a quote from.

- Paul R. Ehrlich, Population biology of checkerspot butterflies and the preservation of global biodiversity, *Oikos* 63, no. 1 (1992), 6-12.

Here it is:

> ...with an effort funded to the level of the cost of two useless B-2 bombers ($1300 million), the task of more or less completing a global survey of plants could be completed. Botanists, plant collections, and botanical gardens are crucial to the future of humanity, and botanical resources need rapid expansion and deployment to accomplish the task of understanding and protecting Earth's flora. It is an indication of misplaced priorities within the scientific community that relatively unimportant exercises such as the sequencing of the human genome can take priority over the assessment and preservation of Earth's irreplaceable botanical wealth.

I don't think sequencing the human genome was "relatively unimportant". It's speciesist, but I'm not sure speciesism is wrong — and in any event I think it's unavoidable. The push to sequence the human genome as the beginning of a push towards sequencing the genomes of individual people, which is pushing down the price for gene sequencing. In 2003 it cost about $300,000,000, in 2007 it cost about $1,000,000, and in 2008 it cost less than $60,000. In February 2009 the price fell to $5000, and it must be lower by now.

Cheap genome sequencing will in turn be a key aspect of saving — or at least *recording* — genetic diversity as the current mass extinction continues. Of course, having a genotype on file is not nearly as good as having a living organism: there's a lot of information in the full organism that's not contained in the DNA, as the study of epigenetics continues to reveal. So, we can't turn a genotype back into a living creature unless there is a fairly similar creature still alive. We need to save living creatures, and classify them — and for plants, this requires "botanists, plant collections, and botanical gardens", as Ehrlich notes. It also will require seed banks! Unlike animals, many plants are quite easy to save in compressed form.

So, while I don't think sequencing the human genome was a waste of money, we *should* build fewer B-52s and spend more on botany.

April 3, 2010

In case you haven't been paying attention: our Solar System seems unusual, as solar systems go, in having the gas giants far away from the sun. If they were close, like in most solar systems, we might not be here! At least, not if "we" means life that requires a rocky planet with liquid water on its surface. Here's a fun little interview about this subject:

- Robert Krulwich, The fruitless search for solar systems like ours, *All Things Considered*, National Public Radio, April 1, 2010.

It'll be very interesting to get data on more solar systems... and you'll notice: this doesn't require sending people into space. Indeed, there's not really much of anything interesting we can do right now by sending "canned primates" into the vacuum. So it's very good news that the Obama Administation is planning to cancel the *Constellation* program — a nostalgic rerun of the Apollo program. Instead, they want to boost funding for something useful: climate research!

- Marc Kaufman, NASA plans big boost to climate research budget, *Washington Post*, April 1, 2010.

The plan is to launch as many as 10 new satellites that will measure ocean temperatures, ice coverage, ozone depletion and the central question of how much carbon dioxide is being released through human activities. This would be great!

In other news: China is planning to mine methane hydrates buried in Tibet, and use them for fuel:

- PhysOrg.com, China looks to 'combustible ice' as a fuel source.

If people decide to mine and burn the massive amounts of methane hydrates at the ocean floor — admittedly a bigger challenge than mining it in Tibet — the amount of CO_2 emission we've seen so far would look like a dainty appetizer to a gut-busting feast.

So, any move towards mine methane hydrates sounds like a dangerous idea to me. China and India both want to mine them on the ocean floor! But for the stuff in Tibet, the Chinese are taking a clever tack: they claim that global warming is bound to release this methane into the atmosphere, where it will be a much more potent greenhouse gas than CO_2 if they don't mine it and burn it! It's the first time I've heard of people saying that mining and burning hydrocarbons will help *prevent* global warming:

> Combustible ice has already been discovered in more than 100 countries, buried in both the Arctic permafrost and beneath the ocean floor. Besides China, countries including the US, Japan, and the Republic of Korea have plans to tap the natural gas hydrate buried in their territories. Last summer, US scientists on a research vessel in the Gulf of Mexico discovered pockets of highly concentrated methane hydrate estimated to contain 6,700 trillion cubic feet of gas. The DOE has estimated that the total amount of methane hydrate worldwide could be as high as 400 million trillion cubic feet, including 85.4 trillion cubic feet buried in Alaska.
>
> Because methane is a potent greenhouse gas, researchers are also concerned about the environmental effects of extracting methane hydrate. However, if handled carefully, using methane hydrate as a fuel could be safer than simply letting it melt on its own. As the earth continues to warm, methane released into the atmosphere could cause even more damage than if it were burned for fuel. On the other hand, if large amounts of methane were accidentally released during extraction, the results could further aggravate global warming. Another risk from mining the combustible ice is geological slumping.
>
> For these reasons, developing a safe technology to excavate the fuel is a priority. With these challenges in mind, China's Ministry of Land and Resources estimated last week that the country could begin using its combustible ice within 10 to 15 years, joining other countries in methane hydrate exploration.

April 4, 2010

The mysterious syndrome called "colony collapse disorder" has been killing off bees worldwide:

- US Department of Agriculture, Questions and Answers: Colony Collapse Disorder.
- Ohio State University Agricultural Research and Development Center, Colony Collapse Disorder.

Bees are responsible for pollinating 30% of American crops that depend on pollination: apples, oranges, grapes, cherries, watermelon, squash, and so on. So, this problem is a big deal.

Luckily, people are fighting back! Beekeeping is becoming really popular! It was recently even made legal in New York City!

- Ira Flatow, Bees and beekeeping, *Science Friday*, National Public Radio, April 2, 2010.
- Phang, City Bees Blogspot.

If Lisa weren't allergic to bees, and we weren't going to Singapore, I would probably start a hive myself. As it is, we've done our part by getting rid of our lawn and planting nice flowers, herbs and trees.

They like the wisteria. They really *love* basil, which keeps blooming for months. And they happily pollinate our citrus trees.

Lisa came back last night! She'd been to Shenzhen, Guangzhou, Zhengzhou, Shanghai, and San Francisco. A lazy day today...

April 5, 2010

Here's Stewart Brand's summary of the latest talk at the Long Now Institute — a talk by David Eagleman:

> Civilizations always think they're immortal, Eagleman noted, but they nearly always perish, leaving "nothing but runes and scattered genetics." It takes luck and new technology to survive. We may be particularly lucky to have Internet technology to help manage the six requirements of a durable civilization:
>
> 1. "Try not to cough on one another." More humans have died from epidemics than from all famines and wars. Disease precipitated the fall of Greece, Rome, and the civilizations of the Americas. People used to bunch up around the infected, which pushed local disease into universal plague. Now we can head that off with Net telepresence, telemedicine, and medical alert networks. All businesses should develop a work-from-home capability for their workforce.
> 2. "Don't lose things." As proved by the destruction of the Alexandria Library and of the literature of Mayans and Minoans, "knowledge is hard won but easily lost." Plumbing disappeared for a thousand years when Rome fell. Innoculation was invented in China and India 700 years before Europeans rediscovered it. These days Michaelangelo's David has been safely digitized in detail. Eagleman has direct access to all the literature he needs via PubMed, JSTOR, and Google Books. "Distribute, don't revinvent."
> 3. "Tell each other faster." Don't let natural disasters cascade. The Minoans perished for lack of the kind of tsunami alert system we now have. Countless Haitians in the recent earthquake were saved by Ushahidi.com, which aggregated cellphone field reports in real time.
> 4. "Mitigate tyranny." The USSR's collapse was made inevitable by state-controlled media and state-

mandated mistakes such as Lysenkoism, which forced a wrong theory of wheat farming on 13 time zones, and starved millions. Now crowd-sourced cellphone users can sleuth out vote tampering. We should reward companies that stand up against censorship, as Google has done in China.

5. "Get more brains involved in solving problems." Undertapping human capital endangers the future. Open courseware from colleges is making higher education universally accessible. Crowd-sourced problem solving is being advanced by sites such as PatientsLikeMe, Foldit (protein folding), and Cstart (moon exploration). Perhaps the next step is "society sourcing."
6. "Try not to run out of energy." When energy expenditure outweighs energy return, collapse ensues. Email saves trees and trucking. Online shopping is a net energy gain, with UPS optimizing delivery routes and never turning left. We need to expand the ability to hold meetings and conferences online.

But if the Net is so crucial, what happens if the Net goes down? It may have to go down a few times before we learn how to defend it properly, before we catch on that civilization depends on it for survival.

—Stewart Brand

I think it is very optimistic to think that we are "particularly lucky to have Internet technology to help manage the six requirements of a durable civilization". Previous fallen civilizations had previous technologies that were better than any technology before... do civilizations tend to last longer as the technology gets better? The examples of Egypt and Sumeria suggest perhaps the opposite.

It takes a lot of sophisticated infrastructure to keep the internet up and running. As Brand notes, it may have to go down a few times before we learn how to defend it properly.

April 8, 2010

After my classes ended at 3:30 pm, I picked up Lisa and we drove up to Fresno, where I'll give two talks tomorrow. It was a 5-hour drive: we left at 4 and got there at 9. Instead of driving into Los Angeles and up Route 5 — the quickest route, but boring — we went up Route 215 and over the Cajon Pass. Then we cut west through the desert on Route 138 to Palmdale, and then north through Lancaster to Mojave. The snow-capped San Gabriel Mountains were beautifully visible to the south for quite some time.

View Larger Map

The highway through Mojave leads through a depressing strip of gas stations and cheap restaurants. Then: eastwards up into the mountains, through Tehachapi, and then down to Bakersfield. The downward slopes are very green now, thanks to the rains — soon they will be brown, but now they're a paradise of grasslands and oak trees.

As one reaches Bakersfield and begins driving north on Route 99, the hills flatten out to an endless dull plain, smoggy and smelly: a land of agriculture, cows, and oil refineries, the highway clogged by trucks. Soon it became dark, and my mood darkened too. Passing through towns like Delano, Tulare, Visalia, I couldn't help but wonder what life was like there. What was there to do? Nothing beautiful to see, nothing interesting to do — I imagined — and anyone ambitious with the ability to leave would surely do so. If you were stuck there, you could work in a gas station or diner, eking out an existence from the constant flow of passing trucks, siphoning off a bit of the pulsing free energy of the highway, just enough to get by. I thought about how how people fill every niche, no matter how unpromising.

Photo of Bravo Farms on Highway 99, taken by Heludin-X.

Of course, I knew that someone driving through Riverside might think the same things... unaware of the crazy fun things that some people are doing in Riverside. And I knew that some of my mood came from the exhaustion of a 5-hour drive, the falling of night, the pollution, the smell of cows. Listening to Dylan's *Highway 61 Revisited* heightened my sense of the futility of human existence, but somehow soothed me as well.

Well Georgia Sam he had a bloody nose
Welfare Department they wouldn't give him no clothes
He asked poor Howard where can I go
Howard said there's only one place I know
Sam said tell me quick man I got to run
Ol' Howard just pointed with his gun
And said that way down on Highway 61.

Well Mack the finger said to Louie the King

I got forty red white and blue shoe strings
And a thousand telephones that don't ring
Do you know where I can get ride of these things
And Louie the King said let me think for a minute son
And he said yes I think it can be easily done
Just take everything down to Highway 61.

Then, finally, to Fresno. A big city, but not a romantic one. Well, to be honest: a city I don't know at all. Got our room at the hotel, had dinner at a nearby Red Lobster, and then to bed.

April 9, 2010

Lisa and I were picked up after breakfast by Carmen Caprau from the math department. She's a student of Charlie Frohman who works on Khovanov homology. I gave a talk on the virtues of the number 5.

Then Carmen handed me off to Doug Singleton, my host from the physics department. He does theoretical particle physics, and we'd gotten to know each other from talking on sci.physics.research, back in the golden age of usenet newsgroups. We talked and looked around a bit. The Cal State Fresno campus is nice: prettier than UCR's, and with a brand new library! But like us, they're suffering mightily from the financial crisis.

Then lunch, and then I gave a talk on the Physics, Topology, Logic and Computation: a Rosetta Stone. I met a bunch of people and learned a bunch of interesting stuff. For example, I mentioned graphene as a material that might someday outdo silicon chips. Todd Wilson from the computer science department told me what's the current way to make computers faster: many-core processors, which do lots of tasks in parallel. But current-day languages do not work well for parallel processing. Functional programming languages like Haskell would be better! But ordinary programmers have trouble using those languages, and many computer science departments feel it's impractical to teach them — the big job market is for languages like C++. But languages like Python are catching on, which have *some* of the advantages of purely functional languages. I like this issue because the "Rosetta Stone" gives me ways to think about programming and parallel processing. So, maybe this is an opportunity to do something practical.

Later, Tim van Beek commented on my remarks here, saying:

> Dear John,
>
> I will try to boast a little bit by commenting on your remarks about programming languages in your diary, from April 9, 2010, I'm not sure if any of this is of interest to you, but knowing it will ease the conversation with most computer scientists and software developers. 
>
> "...the big job market is for languages like C++..."
>
> For the development of large business applications the most used programming language is actually Java. Roughly, there is this line of development of programming languages:
>
> 1. C was created with the goal to design operating systems, it was very successful (most operating systems today are mostly written in C), one reason for this is that it is very easy to directly to manipulate RAM and other system resources.
>
> 2. C++ was most successful in adding "object orientation" to C and was the big player in the 1990s.
>
> 3. Java added a "virtual machine", that is a program that functions as an interface between operating system and program. This allows one to execute Java programms on different operating systems without the need to recompile them. But Java was also successful because it simplified or removed many constructs from the C++ language, that often confused developers and led to code that is very hard to understand. One part that was removed is the capability to directly access RAM that C++

inherited from C, Java does not know "pointers" anymore (pointers point to memory addresses and can be used to read and write from memory directly). Niklaus Wirth, who became famous for creating the programming language Pascal, besides other things, always stresses that the design of a language is much more about the question what you cannot do, rather than about what you can do, the evolution of Java from C++ is a good example.

Don't confuse Java and JavaScript, the latter is a scripting language used to add dynamical content to web pages. Java once had a similar functionality called applets, which is one reason why the two are often mistakenly identified. When people talk about security problems of web pages and "Java", then it's always about JavaScript.

4. Then there is the .NET-Framework from Microsoft, that contains a programming languge C# that uses many concepts of Java, this is the latest addition to the C-based family.

The latest version of Java is 7, the version 5 (also called "Tiger") added a lot of concepts for the programming of concurrent programs, it owes much to Doug Lea, the web page of his classic book is here (he wrote that before Java Tiger was created):

http://g.oswego.edu/dl/cpj/

Parallel processing is becoming increasingly important, as you already wrote, and is yet tremendously hard to do even when using Java Tiger (I'd rather try to implement any numerical algorithm you name, as long as there is one thread that does the computation in a deterministic way, than try to implement a system that has multiple threads sharing data and dependencies).

Kind regards,
Tim

Over dinner, Gerardo Munoz passed on two articles about graphene. It turns out there's pretty good evidence for the fractional quantum Hall effect in this material!

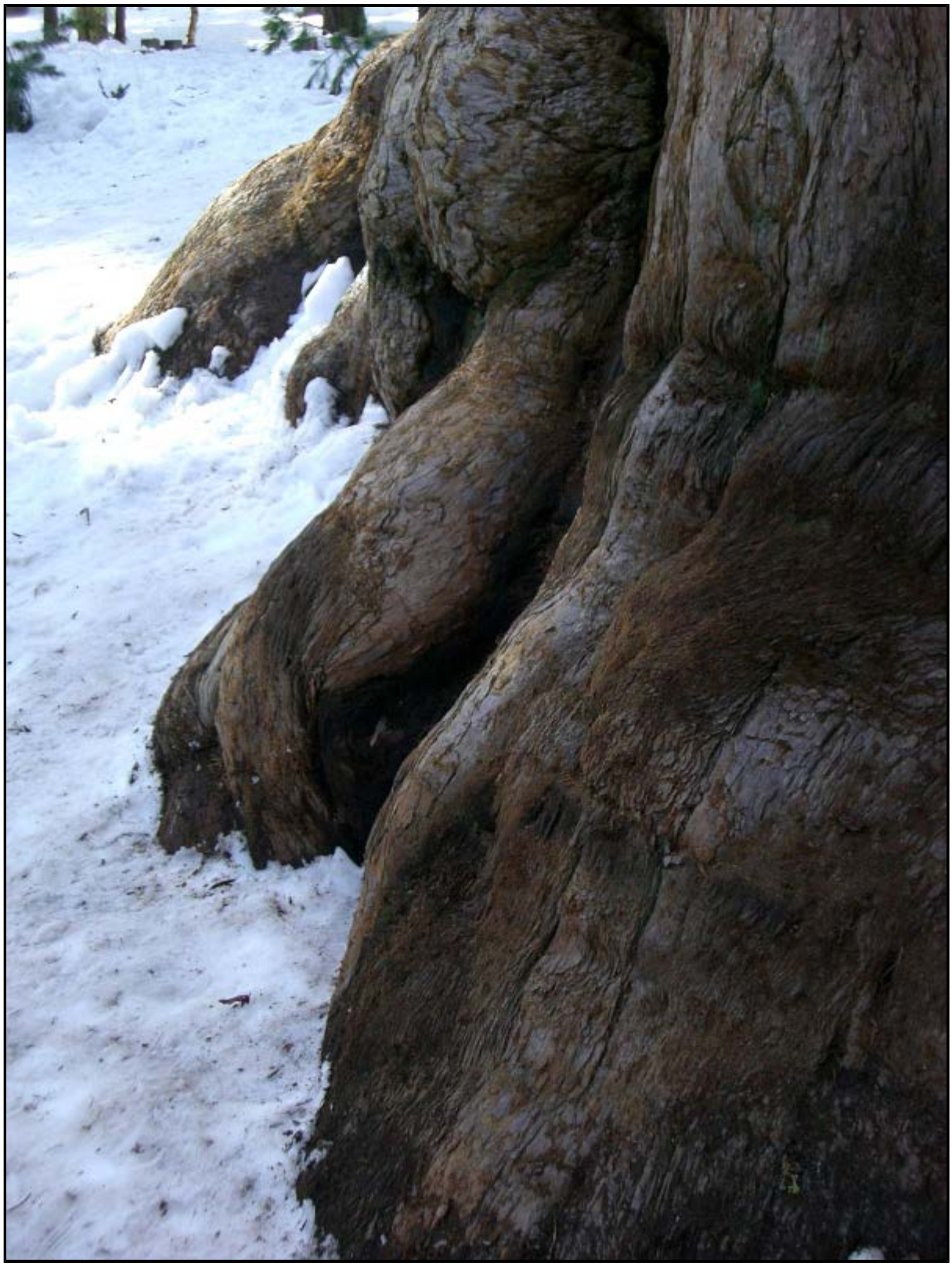
- Xu Du, Ivan Skachko, Fabian Duerr, Adina Luican and Eva Y. Andrei, Fractional quantum Hall effect and insulating phase of Dirac electrons in graphene, *Nature* **462** (12 November 2009), 192-195.

- Kirill I. Bolotin, Fereshte Ghahari, Michael D. Shulman, Horst L. Stormer, Philip Kim, Observation of the fractional quantum Hall effect in graphene, *Nature* **462** (1 November 2009), 196-199.

April 10, 2010

View Larger Map

Lisa and I drove from Fresno to Sequoia National Park. We made our way through the smaller towns near Fresno and out into the surrounding farmlands. Vineyards, then orchards as the land rose. Then we drove up into grassy hills, then up further to an elevation of 4000 feet, with steep slopes covered with wildflowers, and shockingly colorful redbuds in bloom. Entering Kings Canyon National Park we drove up and up, our elevation rising to 6000 and 7000 feet, where we met pine forests and then snow. We had lunch near the entrance of Sequoia National Park, and then we drove on... to the giant sequoias themselves. These are the world's largest trees.



These pictures, and most of those that follow, were taken by Lisa.

We went on lots of little hikes. The best was to a large grove, deeply covered with snow, with a stream running through it... and almost no other people!

As I said, the giant sequoia is the world's largest tree, measured by volume rather than height. We saw the largest one of all, the General Sherman tree. It's about 2500 years old, still magnificently thriving. With luck, it could live for another thousand years. But more likely, changes in climate will kill it long before then.

Various ancestors of the giant sequoia were widespread up to around 175 million years ago. Then the Earth began to cool and the range of these trees gradually shrank. Now in California we have the coast redwood from Oregon to Big Sur, and the giant sequoia here in the Sierra Nevada mountains. The giant sequoia likes cold weather, but not too cold. I was surprised to learn that after the latest ice age, these trees only began to grow in the Sierras only quite recently — around 4000 BC, if I remember correctly. The oldest ones have lived for a substantial fraction of this time: they're about 3500 years old!

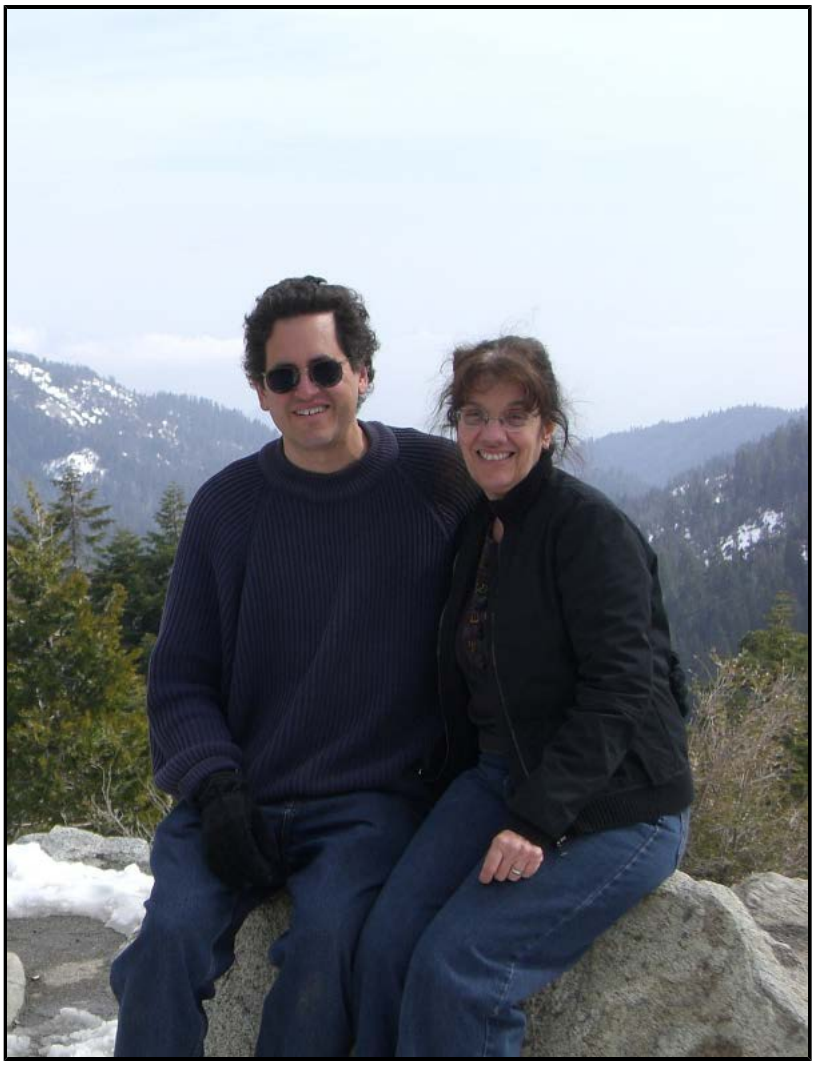
The giant sequoia, technically the *Sequoiadendron giganteum*, is the only living species in its genus. It only grows naturally here, in 68 groves on the western slopes of the Sierra Nevada mountains. Giant sequoias are also popular as an ornamental tree in many parts of the world, but I don't know if they are spreading on their own in any of these areas.

April 11, 2010

We spent last night in Sequioa National Park at the Wuksachi Lodge. It's a great lodge, rustic but elegant, nestled among pines, with a view of the mountain peaks. It was deep in snow which had built up over the impressive series of storms we've been having this winter. We had a wonderful dinner, went straight to sleep, and had some highly overpriced toast for breakfast. For $12.95 you can get a huge breakfast buffet, which would be great if you were going to spend the day hiking or skiing, but we were going to spend the day sitting on our butts, driving. Indeed, since snow was expected later today, and it would probably close down the road through the park, we decided to get going quick.

We drove south through the park, stopping occasionally to look at the mountain slopes. Near the start we saw some ominous clouds creeping over the hills.

Shortly after we took this picture, the whole view was blotted out as a wave of fog crested over a nearby slope. So, we headed on down the road. After descending further we reached more sunny weather. A friendly couple asked us to take their picture, and then returned the favor.



After a long drive down an twisting road we reached Buckeye Flats, a campground set amid beautiful redbud trees. On a big rock there called Hospital Rock we saw some petroglyphs left by the Monache Indians. Then we walked down to the Kaweah River, raging with icy water made by melting snow.

Then we drove out of the park, down to Exeter and then south along Route 65 to Porterville, where we had lunch at the Black Bear Diner — a kind of country-western joint. At this point the wind started picking up as the storm moved in. Looking out the window, I saw clouds of dust blowing through the town.

View Larger Map

We continued driving down Route 65, through orange groves and some olive groves, stuck for miles and miles behind a slow truck. Wind-blown dust filled the sky. By the time we reached Bakersfield, gusts buffeted the car, which shuddered with each blast. The wind lightened up as we proceeded to Tehachapi. We got a few drops of rain from the threatening clouds, but nothing substantial. By the time we hit Mojave we'd almost run out of gas, so we stopped at an Arco to fill up. A black guy was going from car to car asking for money. Again I thought about how people will fill any niche, eke out any sort of existence no matter how depressing. So I gave him a five dollar bill — mainly since I didn't have a one — saying "I really shouldn't do this, but...." He thanked me profusely. I finished filling up and drove off.

We took a route identical to the way we'd come up, but in reverse: down through Rosamond, and Lancaster, and Palmdale, and then east, over the Cajon Pass, down through San Bernardino and back home. I was pretty tired. It was nice being back home.

April 15, 2010

The Eyjafjallajökull volcano in Iceland is spewing out ash. It's causing flight cancellations throughout Europe... and the scary part is, it could go on for months. In fact, that's exactly what it did back in 1821.

Here's a video of the volcano taken in infrared light:

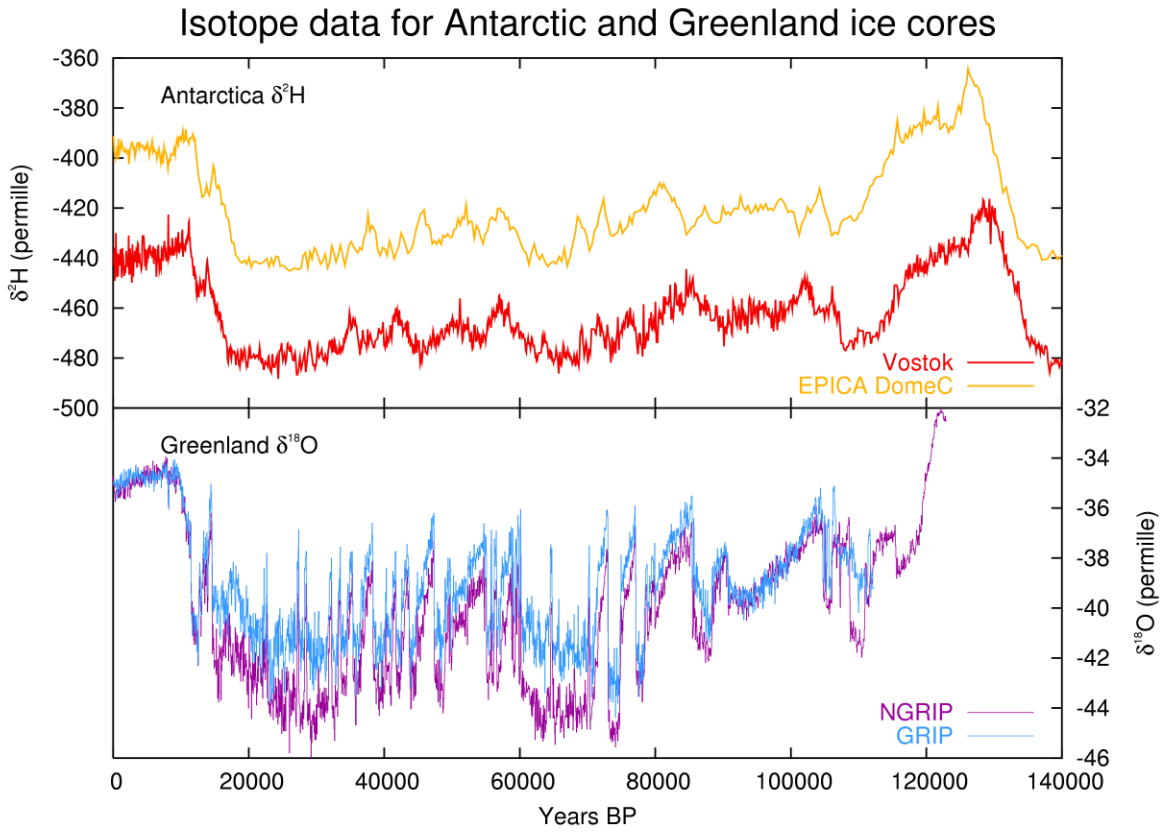
April 21, 2010

More rain! Quite amazing. The hills behind our house are covered with blooming brittlebush, in numbers we've not seen before.

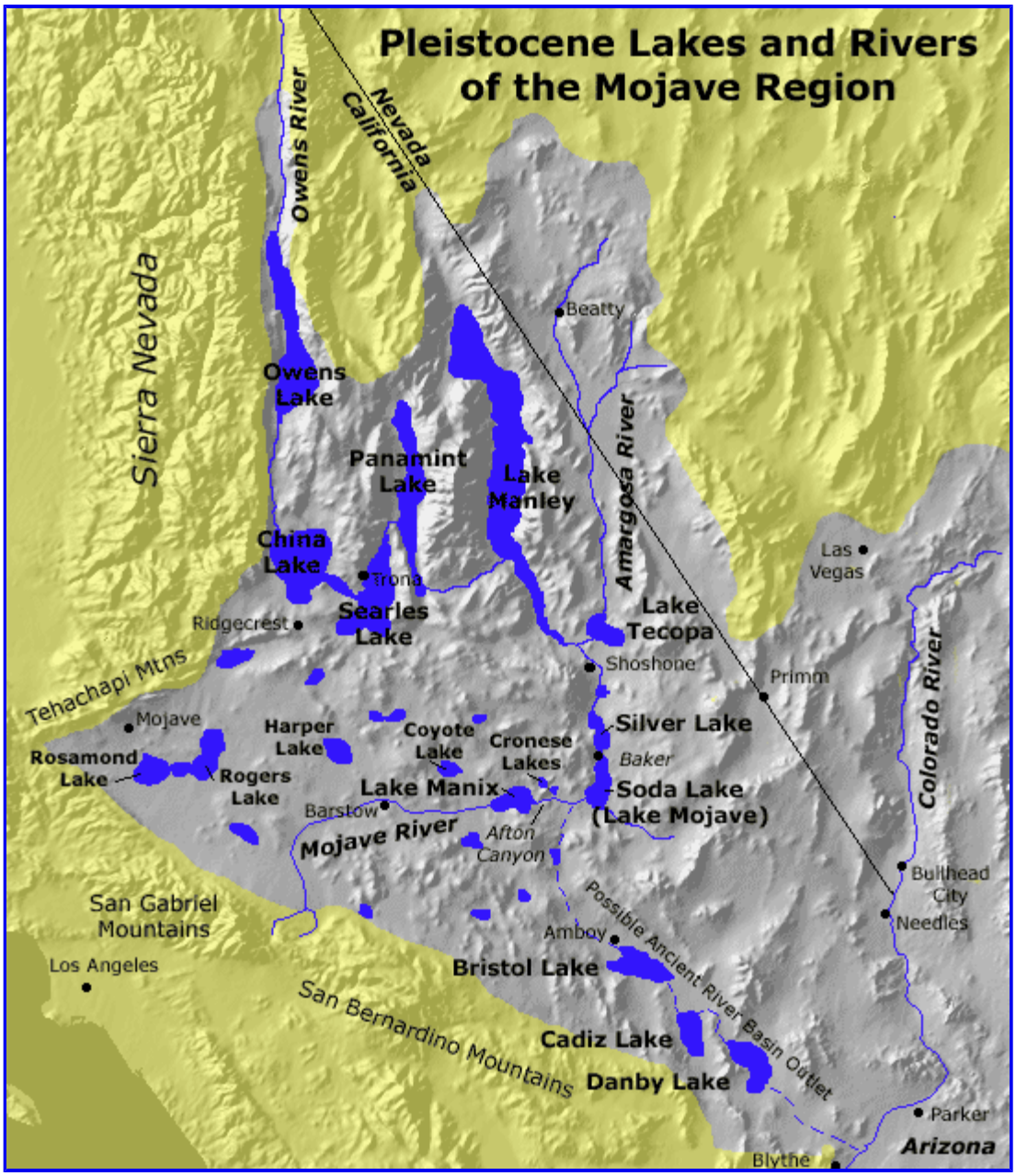
April 22, 2010

For Earth Day, Richard Minnich gave a lecture here at UCR, part of a series called Global Climate Change: Causes, Impacts, Solutions. He's a professor of geography, and his lecture was called Climate's Control of California Landscapes. He began with a long tour of California's climate during the last 65 million years or so, with great pictures of the changing flora and fauna. Unfortunately I had to leave before he reached the recent wave of large fires and the great tree die-off due to drought since 2002. Here are a few facts I learned, which filled in some holes in my understanding of climate history:

- There were big redwoods in Nevada only 12.5 million years ago; now that area is very dry, since it's in the rain shadow of the Sierra Nevadas. Why? Different wind patterns.
- The Milankovic cycles can bring a 6% change in power from sunlight in northern latitudes — enough to make glaciation come and go.
- During glacial periods we see cooling and warming events in roughly 1000-year cycles: Heinrich events and Dansgaard-Oeschger events. These seem more pronounced in the northern hemisphere, as evidenced by the flickering of the oyxgen-16 concentrations in Greenland ice cores:



- During the Pleistocene, there were lots of lakes in the Mojave region north of Riverside, which is now desert. Minnich showed us this beautiful map:



This was especially fun to see because I just recently drove over the San Bernardino Mountains, through Rosamand and the town of Mojave &mdash to the Tehachapi Mountains; see my April 8th diary entry. There are a few small lakes now, but nothing like what you see above!

For more details, try:

- Richard Minnich, California climate, paleoclimate and paleovegetation, in *Terrestrial Vegetation of California*, 3rd edition, M.G. Barbour, T. Keeler-Wolf, and A.S. Schoenherr, eds, University of California Press, 2007.

April 23, 2010

Speaking of the Mohave Desert, there's a lot of argument going on about building solar power plants in this area:

- Ina Jaffe, A renewable energy debate heats up in the Mojave, *Morning Edition*, National Public Radio, April 23, 2010.

picture by Reed Saxon / AP

April 28, 2010

Mike Stay points out this story:

- Jorge Luis Borges, Blue Tigers, *The Independent*, December 28, 1998.

A fragment:

> The ground was cracked and sandy. In one of the cracks — which by the way were not deep, and which branched into others — I caught a glimpse of a colour. Incredible, it was the same colour as the tiger of my dreams. I wish I had never laid eyes on it. I looked closely. The crevice was full of little stones, all alike, circular, just a few centimetres in diameter and very smooth. Their regularity lent them an air almost of artificiality, as though they were coins, or buttons, or counters in some game.
>
> I bent down, put my hand into the crevice, and picked out some of the stones. I felt a faint quivering. I put the handful of little stones in the right pocket of my jacket, where there were a small pair of scissors and a letter from Allahabad. Those two chance objects have their place in my story.
>
> Back in my hut, I took off my jacket. I lay down and dreamt once more of the tiger. In my dream I took a special note of its colour; it was the colour of the tiger I had dreamt of, and also of the little stones from the plateau. The late-morning sun in my face woke me. I got up. The scissors and the letter made it hard to take the discs out of the pocket; they kept getting in the way. I pulled out a handful, but felt that there were still two or three I had missed. A tickling sensation, the slightest sort of quivering, imparted a soft warmth to my palm. When I opened my hand, I saw that it held 30 or 40 discs; I'd have sworn I'd picked up no more than 10. I left them on the table and turned back to get the rest out of the pocket. I didn't need to count them to

see that they had multiplied. I pushed them together into a single pile, and tried to count them out one by one.

That simple operation turned out to be impossible. I would look fixedly at any one of them, pick it up with my thumb and index finger, yet when I had done that, when that one disc was separated from the rest, it would have become many. I checked to see that I didn't have a fever (which I did not), and then I performed the same experiment, over and over again. The obscene miracle kept happening. I felt my feet go clammy and my bowels turn to ice; my knees began to shake. I do not know how much time passed.

For my May 2010 diary, go here.

The significant problems we have cannot be solved at the same level of thinking with which we created them. - Albert Einstein

baez@math.removethis.ucr.andthis.edu

home

For my April 2010 diary, go here.

Diary - May 2010

John Baez

Oil from the BP spill covers a beach in Louisiana on Thursday May 20th
John McCusker / Times-Picayune

May 3, 2010

I went to the ESRI office in Redlands, to a meeting led by Rusty Russell, who is trying to organize a group to integrate geographic information systems software into education at the elementary and secondary school levels. One goal is to teach kids science and give them more of a sense of their local landscape by having them go around and collect data on flora and fauna... data which could then instantly appear on maps. Another goal is to actually get useful data this way. It's an interesting concept: people call it citizen science. In my idealistic dreams I can imagine kids getting really excited about science by actually doing it and seeing how it works, rather than learning science as a collection of pre-established facts.

There was a very diverse mix of people there. Maria Simani, who invited me, works at the Alpha Center at UCR, connecting UCR faculty to K-12 teachers. Rusty Russell is a botany collections manager for the Smithsonian, who has worked on mapping climate change in the San Jacinto Mountains with the help of geographic information systems (or "GIS") technology.

Some people were from ESRI, which is an leading company when it comes to GIS technology. Charles Convis leads the ESRI conservation program and knows a lot about citizen science. When I told him that I want to interview mathematicians working on environmental projects, he mentioned Abel Wohlman, a mathematician at Johns Hopkins who works on conservation planning, and Steve Kelling at Cornell Laboratory of Ornithology, who has extended John Tukey's exploratory data analysis techniques to deal with the occasional unreliability of data sets produced by citizen scientists.

Sean Lahmeyer works at the Huntington Garden Herbarium and is getting people in Pasadena to map the Arroyo Seco area. Jennifer Futterman of the Coachella Valley school district has been working on replacing their science curriculum with one that incorporates ecology. Kim McNulty runs the Career Pathways Initiative for Coachella Valley high schools.

May 10, 2010

It looks like I'll be getting another year of leave from UCR, so I can stay in Singapore for two years! Lisa already got her second year of leave approved, but I just heard my leave will be approved too.

May 17, 2010

Today is Monday, the beginning of a fun and busy fortnight.

Tomorrow at 6:30 am, Lisa and I are taking Lucky Shuttle — a Chinese-run shuttle service — to the Los Angeles airport. She's going on a long trip to Montreal, Erlangen, Glasgow, back to Montreal and then back home. I'm going first to New York and then to Oxford, returning on May 31st. In New York on Wednesday morning I'll teach Dennis Sullivan's "Intermediate Algebraic Topology" course at the CUNY Graduate Center, and then give a talk on electrical circuits at his seminar. On Thursday we'll go to Stony Brook and I'll talk about Categorification in Topology at the

topology seminar. I'll hang out for a couple more days, and on Saturday night — if the volcano permits — I'll fly to Oxford.

My flight is supposed to arrive at 10:30 am on Sunday May 23rd. I'll take the Airline (a one-hour bus ride) to Oxford and go to the Cotswold Lodge. Then from May 24th to 28th I'll attend the school on Foundational Structures in Quantum Computation and Information, run by Bob Coecke and Ross Duncan. I plan to talk to Tim Palmer over lunch on Tuesday the 24th, Thomas Fischbacher on Thursday the 27th starting at 12:00, and also Dan Ghica. On Friday afternoon, Eugenia Cheng and Alissa Crans are supposed to show up, and we'll have a big discussion on category and n-category theory with people including Bruce Bartlett, Simon Willerton and Jamie Vicary.

On Saturday I'll give a talk on Duality in Logic and Physics at the Quantum Physics and Logic workshop organized by Bob Coecke, Prakash Panangaden, and Peter Selinger. Louis Crane will give a talk there too, and John Barrett should be there as well. The workshop goes on until Sunday. And then — if the volcano permits — I'll catch a flight from Heathrow to Los Angeles at 3:45 pm on Monday May 31st.

May 21, 2010

Well, on Wednesday it turned out that Dennis Sullivan's "Intermediate Algebraic Topology" course is really just a seminar where he and his visiting speakers talk about their latest ideas. There is no "Advanced Algebraic Topology" course.

I saw a bunch of faces familiar from my last visit, and some new ones, like Aron Fischer and Kate Poirier. He'd prepared a list of questions for me which pretty much matched what I wanted to do: give a nontechnical introduction to n-categories and their applications to topology. I was momentarily afraid that my usual spiel would be too elementary for this crowd, but I tend to forget that most people are not working on n-categories and don't have an intuitive feel for them. So, I tried to give them that feel from 11 until about 1.

Then we had lunch — vegetarian sandwiches and salad were carted in. Mikhail Khovanov showed up, which was a nice surprise, and I launched into my talk about categories whose morphisms are electrical circuits. Starting from basics like Kirchhoff's laws and Ohm's law I led up to the description of circuits made of resistors in terms of chain complexes, and then their description in terms of Dirichlet forms and Lagrangian subspaces — with the last allowing us to describe wires of zero resistance, as needed for a well-behaved category. We had a coffee break and then Dennis had to leave at 4 pm. The excitement level dropped without his trademark probing questions, but the rest of the audience manfully did their best to do that job, and we went on until 6:30. We had dinner at a Persian restaurant.

On Thursday I took the train to Stony Brook with Kate and Aron. After chatting a bit with Sasha Kirillov, who is working on describing the Turaev-Viro model as an extended TQFT, and listening a bit to Dennis and Kate talk about string topology and compactifications of moduli space, I gave a one-hour slide talk on categorification in topology. Then a bunch of us had lunch, including Oleg Viro. It was nice to see him again... he used to teach at UCR.

Then we took the long train ride back, and then I more or less collapsed: first a nap, and then a long session of goofing off.

In a little while I'll take the F train down to the CUNY Graduate Center and talk to Mahmoud Zeinalian, a former student of Dennis who is working on E(n) algebras and some generalizations of Hochschild homology. Then I'll meet Khovanov at noon and take the Q train to Chinatown, for lunch. All this meeting people and zipping around on trains and subways is very unlike my life in Riverside.

May 22, 2010

I had dinner last night with Mahmoud Zeinalian, his wife Heleike, and some friends. Mahmoud pointed me to this:

- Bill Gates on energy - innovating to zero!, TED, February 2010.

One of his friends told us about this:

- RecycleBank.

This firm gets paid by cities to help you recycle your trash. They pay *you* based on how much you recycle, and the cities pay them, but apparently the cities still make money, since they spend less money disposing of trash.

By the way: yesterday Dennis Sullivan urged me to contact Mary-Lou Zeeman, a professor of mathematics at Bowdoin College who talks about how mathematicians can help tackle climate change and sustainability issues:

- Mary-Lou Zeeman, State of the Planet.

I should interview her! Let me update my list of potential interviews:

- Eliezer Yudkowsky — friendly AI. Underway.
- Tim Palmer — weather prediction. Underway.
- Chris Lee — bioinformatics. Underway.
- Gregory Benford — geoengineering
- Mary-Lou Zeeman — mathematics of sustainability
- Nathan Urban — climate change
- Stewart Brand - ecopragmatism
- Abel Wohlman - mathematics of biodiversity assessment
- Steve Kelling - tools for citizen science
- Eric Drexler — nanotechnology
- Thomas Fischbacher - sustainability
- Dan Ghica — computer science
- Jiahao Chen — quantum chemistry
- Hendra Nurdin — quantum control

May 23, 2010

Big news in synthetic biology!

- Ira Flatow interviewing Craig Venter, Booting Up A Synthetic Cell, *Science Friday*, National Public Radio, May 21, 2010.

- Craig Venter *et al*, Creation of a bacterial cell controlled by a chemically synthesized genome, *Science*, May 20, 2010.

May 24, 2010

Last night I caught a plane from New York to Heathrow. I arrived bleary-eyed this morning and, sleeping whenever possible, took a bus to Oxford and made my way to the hotel. Tomorrow morning is the start of a week-long school on Foundational Structures in Quantum Computation and Information.

May 26, 2010

I had dinner tonight with Oz and his wife Alison. We went to the Indian restaurant called Chutneys. I brought along two friends:

From left to right: Bruce Bartlett, Alison, Oz, me, and Jamie Vicary.

May 28, 2010

On Friday, after the end of the week-long school on Foundational Structures in Quantum Computation and Information and before the Quantum Physics and Logic conference started, Alissa Crans, Eugenia Cheng, Richard Garner and Simon Willerton showed up in Oxford. This called for a bit of celebration. Luckily Bob Coecke has established a tradition called the 'Quantum Whisky Club', which takes place intermittently at the Computing Lab... and that tradition provided the necessary infrastructure for a proper celebration. At 9:30 a bunch of people started started living it up. At Bob's demand, I did a little live blogging to document the event. But nothing too indiscreet.

Below from left to right you can see Eugenia Cheng's foot (if you look incredibly hard, that is), and then Alissa Crans leaning on the windowpane, and then the mysterious black silhouette of Andrei Akhvlediani, who is facing away, in front of the glare of a desk lamp. Then comes Richard Garner basking in the golden glow of light at the edge of a curtain, and then, in front of him — much easier to see! — Aleks Kissinger cheerily holding his cup high, and Philip Atzemoglou way in back, and me happily blogging away on my laptop...

...and then Bruce Bartlett, and Ray Lal behind him way in back, and Chris Heunen, Simon Willerton right up front, then Andreas Döring grinning and holding a glass, Ross Duncan, and just a tiny bit of Bertfried Fauser on the right-hand edge of the photo. Present but invisible are Nadja Kutz... and the fellow taking this picture: Jamie Vicary.

I also met Jacob Biamonte, who will be visiting the Centre for Quantum Technologies in Singapore starting this summer. Among many other things, he said:

> I mentioned some projects related to energy in Boston listed here - don't think the quantum bio stuff is mentioned here. This was work Alán Aspuru-Guzik did studying light harvesting complexes which were shown to use quantum coherence (like a search algorithm) to enhance photon consumption. The future idea they have is to use related ideas to create better solar panels. In just a few weeks, I will go to Alan's workshop on Quantum Bio.

Jacob introduced me to some other people from Oxford who will also be visiting the CQT during my stay there: notably, Dieter Jaksch (who works on ultra-cold physics such as optical lattices and Bose-Einstein condensates, and their applications to quantum information processing) and Vlatko Vedral (who works on quantum information). It was great getting some sense of who I'll be seeing when I go to Singapore next month.

May 30, 2010

On Sunday, John Barrett and Louis Crane gave talks on quantum gravity. John is trying to use 3-categories to

understand matter in 3d quantum gravity, and 4-categories to understand matter in 4d quantum gravity. The first part definitely works; the second part is speculative. I talked to both of them at lunch in the graveyard near the Computing Lab:

From left to right, facing the camera, here are Bruce Bartlett, Peter Selinger, Jamie Vicary, and Chris Heunen talking things over at that same lunch:

Facing away is Sanjeevi Krishnan.

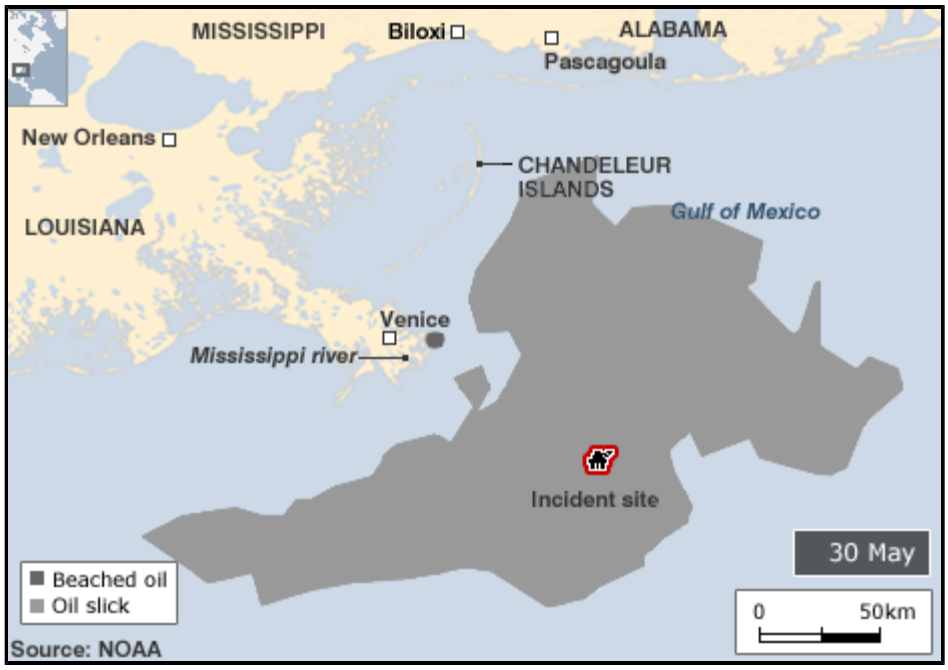
Around 5 pm, Louis gave the last talk of the workshop. He's trying to use rational homotopy theory and related ideas from model category theory to better understand state sum models of quantum gravity. Here he is, standing in front of an impressively tall blackboard containing both his notes and the pictures from John Barrett's earlier talk:

Later, John Barrett took the train home. A bunch of us had dinner... And then, late on Sunday night, my last night in Oxford, there was a smaller but more energetic meeting of the Quantum Whisky Club. Dancing!

May 31, 2010

I flew back to Los Angeles without incident.

I haven't been writing much about the BP oil spill in the Gulf of Mexico, because you could read it in the news... or books, if you're in my future. I think Obama was right: it's "enraging as it is heartbreaking".



BP initially estimated that the wellhead was leaking 1,000 barrels a day. On April 28, the National Oceanic and Atmospheric Administration estimated that the leak was likely 5,000 barrels a day. On May 27, 2010 the US government increased its official estimate to 12,000-19,000 barrels a day.

Later some scientists involved in this estimate said that these numbers were intended only as a lower bound! On June 10th Marcia McNutt, head of a group of scientists called the Flow Rate Technical Group, listed several estimates in the range of 20,000 to 40,000 barrels a day — that is, before the top of the wellhead was cut and a pipe was installed that caught some (but not all) of the oil. Different methods give different estimates.

Not many of us have a sense for "barrels", so maybe it will help to say that 20,000 to 40,000 barrels of oil is 840,000 to 1,680,000 US gallons, or 3,200,000 to 6,400,000 litres. Or maybe not. It's hard to get a sense for that much oil. Maybe some comparisons would be better.

The Exxon Valdez oil spill released a total of 250,000 barrels of oil. As of June 10th, people were saying that the current disaster was at least 4 times as big.

But in fact the Exxon Valdez was not one of the world's largest oil spills. The largest was about 40 times bigger: 10,000,000 barrels were spilled in the Gulf War oil spill. This spill was deliberately created by Saddam Hussain in 1991, apparently to prevent US Marines from landing. It reached a size of about 6800 square kilometers. Dr. Hans-Jörg Barth, a German geographer, wrote a report on the impact a decade later. He wrote:

> The study demonstrated that, in contrary to previously published reports e.g. already 1993 by UNEP, several coastal areas even in 2001 still show significant oil impact and in some places no recovery at all. The salt marshes which occur at almost 50% of the coastline show the heaviest impact compared to the other ecosystem types after 10 years. Completely recovered are the rocky shores and mangroves. Sand beaches are on the best way to complete recovery. The main reason for the delayed recovery of the salt marshes is the absence of physical energy (wave action) and the mostly anaerobic milieu of the oiled substrates. The latter is mostly caused by cyanobacteria which form impermeable mats. In other cases tar crusts are responsible. The availability of oxygen is the most important criterion for oil degradation. Where oil degrades it was obvious that benthic intertidal fauna such as crabs re-colonise the destroyed habitats long before the halophytes. The most important paths of regeneration are the tidal channels and the adjacent areas. Full recovery of the salt marshes will certainly need some more decades.

For my June 2010 diary, go here.

... and their colour is the blue that we are permitted to see only in our dreams - Jorge Luis Borges

baez@math.removethis.ucr.andthis.edu

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For my May 2010 diary, go here.

Diary - June 2010

John Baez

June 1, 2010

May 19: BP announces it's "very pleased" with the performance of the insertion tube, as oil blankets Louisiana's wetlands, fishermen are sickened, and the slick is caught by the loop current.

May 26: "As the admiral has mentioned, it's disappointing, we do have oil ashore at nine different locations in the state of Louisiana," Suttles says, before finding a silver lining. "But we still have no oil ashore in either Alabama, Mississippi, or Florida, which we're very pleased about".

May 27: "As I've mentioned before, the equipment actually has performed very well," Suttles says about the top kill effort, which replaced the failed riser insertion tube. "We are very pleased with the performance of the equipment so far".

May 28: "I've done this many, many times now and I can tell you that the battle offshore, we're winning that battle," Suttles claims. "It's the least amount of oil that I've seen offshore since my very first flight, so I'm very, very pleased with the activity of the offshore team."

May 29: "I'm very pleased to say the amount of oil on the surface of the sea continues to be reduced," Suttles bizarrely claims, as BP abandons the failed "top kill" effort.

June 5: "Over the last 24 hours we've been able to collect 6,000 barrels of oil," BP Senior Vice President Bob Fryar tells reporters in Mobile, AL, "so we're very pleased with that operation".

The quotes above are taken from Real Climate.

June 2, 2010

- Brian O'Neill, How to sue an oil company, *Washington Post*, May 16, 2010.

A quote:

> BP's public relations campaign is well underway. "This wasn't our accident," chief executive Tony Hayward told ABC's George Stephanopoulos earlier this month. Though he accepted responsibility for cleaning up the spill, Hayward emphasized that "this was a drilling rig operated by another company."
>
> Communities destroyed by oil spills have heard this kind of thing before. In 1989, Exxon executive Don Cornett told residents of Cordova, Alaska: "You have had some good luck, and you don't realize it. You have Exxon, and we do business straight. We will consider whatever it takes to keep you whole." Cornett's straight-shooting company proceeded to fight paying damages for nearly 20 years. In 2008, it succeeded -- the Supreme Court cut punitive damages from $2.5 billion to $500 million.
>
> As the spill progressed, Exxon treated the cleanup like a public relations event. At the crisis center in Valdez, company officials urged the deployment of "bright and yellow" cleanup equipment to avoid a "public relations nightmare." "I don't care so much whether [the equipment is] working or not," an Exxon executive exhorted other company executives on an audiotape our plaintiffs cited before the Supreme Court. "I don't care if it picks up two gallons a week."
>
> Even as the spill's long-term impact on beaches, herring, whales, sea otters and other wildlife became apparent, Exxon used its scientists to run a counteroffensive, claiming that the spill had no negative long-term effects on anything. This type of propaganda offensive can go on for years, and the danger is that the public and the courts will eventually buy it. State and local governments and fishermen's groups on the Gulf Coast will need reputable scientists to study the spill's effects, and must work tirelessly to get the truth out.
>
> Remember: When the spiller declares victory over the oil, it's time to raise hell.

June 3, 2010

Chris Lee writes:

> Hi John,
>
> It just occurred to me that if you haven't read Tim Flannery's book, *The Future Eaters*, I think you would find it fascinating. If you haven't read it, a quick synopsis: the many lands of Australasia have been the site of an amazing variety of experiments on what human and ecological history looks like under severe resource constraints (e.g. when the Maori wiped out all the moa). Flannery goes way beyond the surface stories of mass extinctions (e.g. Jared Diamond's book, *Collapse*) into the detailed data and dynamics of many, many examples both positive and negative. The lessons are often surprising.
>
> Cheers,
>
> – Chris

June 5, 2010

> **BP Buys 'Oil' Search Terms to Redirect Users to Official Company Website**
>
> ABC News, Emily Friedman
> June 5, 2010

Be careful where you click, especially if you're looking for news on the BP oil spill.

BP, the very company responsible for the oil spill that is already the worst in U.S. history, has purchased several phrases on search engines such as Google an d Yahoo so that the first result that shows up directs information seekers to th e company's official website.

A simple Google search of "oil spill" turns up several thousand news results, bu t the first link, highlighted at the very top of the page, is from BP. "Learn mo re about how BP is helping," the link's tagline reads.

Bill Schmitt and I went to Joshua Tree National Park today, and he took these pictures. Click on them to see bigger versions:

For an earlier round of Joshua Tree photos, taken back in 2004, go here.

June 6, 2010

The CIA has opened a new Center on Climate Change and National Security:

> Its charter is not the science of climate change, but the national security impact of phenomena such as desertification, rising sea levels, population shifts, and heightened competition for natural resources. The Center will provide support to American policymakers as they negotiate, implement, and verify international agreements on environmental issues. That is something the CIA has done for years. "Decision makers need information and analysis on the effects climate change can have on security. The CIA is well positioned to deliver that intelligence," said Director Leon Panetta.

June 8, 2010

If you believe that we need to stop global warming by cutting carbon dioxide emissions fast enough to level off at, say, 450 parts per million of CO_2 in the atmosphere, you should be aware of the *enormity* of the task confronting us. You've got to watch this talk:

- Saul Griffith, Climate change recalculated, talk at the *Long Now Foundation*, January 16, 2009.

Stewart Brand's summary:

> Engineer Griffith said he was going to make the connection between personal actions and global climate change. To do that he's been analyzing his own life in extreme detail to figure out exactly how much energy he uses and what changes might reduce the load. In 2007, when he started, he was consuming about 18,000 watts, like most Americans.
>
> The energy budget of the average person in the world is about 2,200 watts. Some 90 percent of the carbon dioxide overload in the atmosphere was put there by the US, USSR (of old), China, Germany, Japan, and Britain. The rich countries have the most work to do.
>
> What would it take to level off the carbon dioxide in the atmosphere at 450 parts per million (ppm)? That level supposedly would keep global warming just barely manageable at an increase of 2 degrees Celsius. There still would be massive loss of species, 100 million climate refugees, and other major stresses. The carbon dioxide level right now is 385 ppm, rising fast. Before industrialization it was 296 ppm. America's leading climatologist, James Hansen, says we must lower the carbon dioxide level to 350 ppm if we want to keep the world we evolved in.
>
> The world currently runs on about 16 terawatts (trillion watts) of energy, most of it burning fossil fuels. To level off at 450 ppm of carbon dioxide, we will have to reduce the fossil fuel burning to 3 terawatts and produce all the rest with renewable energy, and we have to do it in 25 years or it's too late. Currently about half a terrawatt comes from clean hydropower and one terrawatt from clean nuclear. That leaves 11.5 terawatts to generate from new clean sources.
>
> That would mean the following. (Here I'm drawing on notes and extrapolations I've written up previously from discussion with Griffith):
>
> "Two terawatts of photovoltaic would require installing 100 square meters of 15-percent-efficient solar cells every second, second after second, for the next 25 years. (That's about 1,200 square miles of solar cells a year, times 25 equals 30,000 square miles of photovoltaic cells.) Two terawatts of solar thermal? If it's 30 percent efficient all told, we'll need 50 square meters of highly reflective mirrors every second. (Some 600 square miles a year, times 25.) Half a terawatt of biofuels? Something like one Olympic swimming pools of genetically engineered algae, installed every second. (About 15,250 square miles a year, times 25.) Two terawatts of wind? That's a 300-foot-diameter wind turbine every 5 minutes. (Install 105,000 turbines a year in good wind locations, times 25.) Two terawatts of geothermal? Build 3 100-megawatt steam turbines

> every day — 1,095 a year, times 25. Three terawatts of new nuclear? That's a 3-reactor, 3-gigawatt plant every week — 52 a year, times 25".
>
> In other words, the land area dedicated to renewable energy ("Renewistan") would occupy a space about the size of Australia to keep the carbon dioxide level at 450 ppm. To get to Hansen's goal of 350 ppm of carbon dioxide, fossil fuel burning would have to be cut to ZERO, which means another 3 terawatts would have to come from renewables, expanding the size of Renewistan further by 26 percent.
>
> Meanwhile for individuals, to stay at the world's energy budget at 16 terawatts, while many of the poorest in the world might raise their standard of living to 2,200 watts, everyone now above that level would have to drop down to it. Griffith determined that most of his energy use was coming from air travel, car travel, and the embodied energy of his stuff, along with his diet. Now he drives the speed limit (and he has passed no one in six months), seldom flies, eats meat only once a week, bikes a lot, and buys almost nothing. He's healthier, eats better, has more time with his family, and the stuff he has he cherishes.
>
> Can the world actually build Renewistan? Griffith said it's not like the Manhattan Project, it's like the whole of World War II, only with all the antagonists on the same side this time. It's damn near impossible, but it is necessary. And the world has to decide to do it.
>
> Griffith's audience was strangely exhilarated by the prospect.

If you don't believe we need to do this, you've got to make your case — clearly and logically. For example, you can argue that the effects of climate change won't be as bad as he thinks. Or, you can argue that his energy calculations are wrong.

Or, you can argue that there's *no way* we can carry out a massive transformation of the sort Griffith is describing — so we just need to adapt to a changed world.

Of course, even adaptation may take a lot of work. That's the message here:

- Bill McKibben, *Eaarth: Making a Life on a Tough New Planet*, Times Books, 2010.

From the preface:

> I'm writing these words on a gorgeous spring afternoon, perched on the bank of a brook high along the spine of the Green Mountains, a mile or so from my home in the Vermont mountain town of Ripton. The creek burbles along, the picture of a placid mountain stream, but a few feet away there's a scene of real violence a deep gash through the woods where a flood last summer ripped away many cubic feet of tree and rock and soil and drove it downstream through the center of the village. Before the afternoon was out, the only paved road into town had been demolished by the rushing water, a string of bridges lay in ruins, and the governor was trying to reach the area by helicopter.
>
> Twenty years ago, in 1989, I wrote the first book for a general audience about global warming, which in those days we called the "greenhouse effect." That book, *The End of Nature*, was mainly a philosophical argument. It was too early to see the practical effects of climate change but not too early to *feel* them; in the most widely excerpted passage of the book, I described walking down a different river, near my then-home sixty miles away, in New York's Adirondack Mountains. Merely knowing that we'd begun to alter the climate meant that the water flowing in that creek had a different, lesser meaning. "Instead of a world where rain had an independent and mysterious existence, the rain had become a subset of human activity," I wrote. "The rain bore a brand; it was a steer, not a deer."
>
> Now, that sadness has turned into a sharper-edged fear. Walking along this river today, you don't need to imagine a damned thing the evidence of destruction is all too obvious. Much more quickly than we would have guessed in the late 1980s, global warming has dramatically altered, among many other things, hydrological cycles. One of the key facts of the twenty- first century turns out to be that warm air holds

more water vapor than cold: in arid areas this means increased evaporation and hence drought. And once that water is in the atmosphere, it will come down, which in moist areas like Vermont means increased deluge and flood. Total rainfall across our continent is up 7 percent,[1] and that huge change is accelerating. Worse, more and more of it comes in downpours.[2] Not gentle rain but damaging gully washers: across the planet, flood damage is increasing by 5 percent a year.[3] Data show dramatic increases 20 percent or more in the most extreme weather events across the eastern United States, the kind of storms that drop many inches of rain in a single day.[4] Vermont saw three flood emergencies in the 1960s, two in the 1970s, three in the 1980s and ten in the 1990s and ten so far in the first decade of the new century.

In our Vermont town, in the summer of 2008, we had what may have been the two largest rainstorms in our history about six weeks apart. The second and worse storm, on the morning of August 6, dropped at least six inches of rain in three hours up on the steep slopes of the mountains. Those forests are mostly intact, with only light logging to disturb them but that was far too much water for the woods to absorb. One of my neighbors, Amy Sheldon, is a river researcher, and she was walking through the mountains with me one recent day, imagining the floods on that August morning. "You would have seen streams changing violently like that," she said, snapping her fingers. "A matter of minutes." A year later the signs persisted: streambeds gouged down to bedrock, culverts obliterated, groves of trees laid to jackstraws.

Our town of barely more than five hundred people has been coping with the damage ever since. We passed a $400,000 bond to pay for our share of the damage to town roads and culverts. (The total cost was in the millions, most of it paid by the state and federal governments.) Now we're paying more to line the creek with a seven-hundred-foot-long wall of huge boulders riprap, it's called where it passes through the center of town, a scheme that may save a few houses for a few years, but which will speed up the water and cause even more erosion downstream. There's a complicated equation for how wide a stream will be, given its grade and geology; Sheldon showed it to me as we reclined on rocks by the riverbank. It mathematically defines streams as we have known them, sets an upper limit to their size. You could use it to plan for the future, so you could know where to build and where to let well enough alone. But none of that planning works if it suddenly rains harder and faster than it has ever rained before, and that's exactly what's now happening. It's raining harder and evaporating faster; seas are rising and ice is melting, melting far more quickly than we once expected. The first point of this book is simple: global warming is no longer a philosophical threat, no longer a future threat, *no longer a threat at all*. It's our reality. We've changed the planet, changed it in large and fundamental ways. And these changes are far, far more evident in the toughest parts of the globe, where climate change is already wrecking thousands of lives daily. In July 2009, Oxfam released an epic report, "Suffering the Science," which concluded that even if we now adapted "the smartest possible curbs" on carbon emissions, "the prospects are very bleak for hundreds of millions of people, most of them among the world's poorest."[5]

And so this book will be, by necessity, less philosophical than its predecessor. We need now to understand the world we've created, and consider urgently how to live in it. We can't simply keep stacking boulders against the change that's coming on every front; we'll need to figure out what parts of our lives and our ideologies we must abandon so that we can protect the core of our societies and civilizations. There's nothing airy or speculative about this conversation; it's got to be uncomfortable, staccato, direct.

Which doesn't mean that the change we must make or the world on the other side will be without its comforts or beauties. Reality always comes with beauty, sometimes more than fantasy, and the end of this book will suggest where those beauties lie. But hope has to be real. It can't be a hope that the scientists will turn out to be wrong, or that President Barack Obama can somehow fix everything. Obama can help but precisely to the degree he's willing to embrace reality, to understand that we live on the world we live on, not the one we might wish for. Maturity is not the opposite of hope; it's what makes hope possible.

The need for that kind of maturity became painfully clear in the last days of 2009, as I was doing the final revisions for this book. Many people had invested great hope that the Copenhagen conference would mark a turning point in the climate change debate. If it did, it was a turning point for the worse, with the richest and

most powerful countries making it abundantly clear that they weren't going to take strong steps to address the crisis before us. They looked the poorest and most vulnerable nations straight in the eye, and then they looked away and concluded a face-saving accord with no targets or timetables. To see hope dashed is never pleasant. In the early morning hours after President Obama jetted back to Washington, a group of young protesters gathered at the metro station outside the conference hall in Copenhagen. *It's our future you decide*, they chanted.

My only real fear is that the reality described in this book, and increasingly evident in the world around us, will be for some an excuse to give up. We need just the opposite: increased engagement. Some of that engagement will be local: building the kind of communities and economies that can withstand what's coming. And some of it must be global: we must step up the fight to keep climate change from getting even more powerfully out of control, and to try to protect those people most at risk, who are almost always those who have done the least to cause the problem. I've spent much of the last two decades in that fight, most recently helping lead 350.org, a huge grassroots global effort to force dramatic action. It's true that we've lost that fight, insofar as our goal was to preserve the world we were born into. That's not the world we live on any longer, and there's no use pretending otherwise.

But damage is always relative. So far we've increased global temperatures about a degree, and it's caused the massive change chronicled in Chapter 1. That's not going to go away. But if we don't stop pouring more carbon into the atmosphere, the temperature will simply keep rising, right past the point where *any* kind of adaptation will prove impossible. I have dedicated this book to my closest colleagues in this battle, my crew at 350.org, with the pledge that we'll keep battling. We have no other choice.

June 9, 2010

Bill Schmitt pointed me to a nice short article about Saul Griffith:

- David Owen, The inventor's dilemma, *New Yorker*, May 17, 2010, pp. 42-50.

It starts out by describing Griffith's ebullient inventiveness, and concludes on a darker note:

"Right now, everyone sees climate change as a problem in the domain of scientists and engineers," Griffith told me. "But it's not enough to say that we need some nerds to invent a new energy source and some other nerds to figure out a carbon-sequestration technology — and you should be skeptical about either of those things actually happening. There are a lot of ideas out there, but nothing nearly as radical as the green-tech hype. We've been working on energy, as a society, for a few thousand years, so we've already turned over most of the stones." Such considerations help explain Griffith's focus on ways in which affluent societies can make dramatic reduction in energy use without reducing their perceived quality of life — a challenge that involves wrestling with human nature as well as physics. He once tried to determine at what point in history his ancestors would have been consuming energy at a rate that he believes would be sustainable by humanity today, and calculated that, even in 1800, Americans used energy (mostly by burning New England forests) at a rate close to double that of the average global citizen in 2010.

Realizations like that one are partly responsible for the note of pessimism that enters his voice when he talks about these issues — a change from his M.I.T. days. He said, "In the past, friends have told me, 'You're like the manic-depressive without the depressive — you're always just happy and manic.' So they're all a little worried about me at the moment, because when I talk about these things, I sound a little less than optimistic."

Shortly after we first met, Griffith told me, "I know very few environmentalists whose heads aren't firmly up their ass. They are bold-facedly hypocritical, and I don't think the environmentalism movement as we've known it is tenable or will survive. Al Gore has done a huge amount to help this cause, but he is the No. 1 environmental hypocrite. His house alone uses more energy than an average person uses in all aspects of life, and he flies prodigiously. I don't think we can buy the argument anymore that you get special

> dispensation just because what you're doing is worthwhile." Griffith includes himself in his condemnation. "Right now, the main thing I'm working on is trying to invent my way out of my own hypocrisy."

I wish I could do the same.

Tim van Beek sent me information about a massive solar project — a tiny taste of what Griffith thinks is needed.

> Hi John,
>
> Maybe you've already heard of "Desertec". This is a long term project with the goal to build solar power plants in northern Africa:
>
> - Wikipedia, Desertec.
>
> A central aspect of Desertec not mentioned by Wikipedia are "solar heat plants". They don't use photovoltaic techniques, but simply focus the sunlight on water to heat it directly.
>
> The founding father of Desertec is Gerhard Knies, who was a particle physicist at DESY in Hamburg.
>
> CNN made a short biography about him back in 2007.
>
> Kind regards,
> Tim

June 10, 2010

Alex Hoffnung passed his thesis defense today!

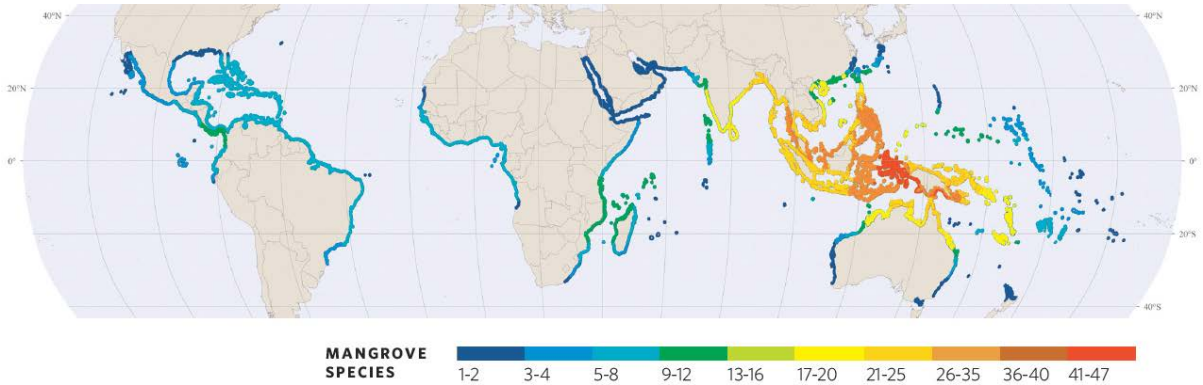
I had to update my May 31st entry on the flow rate of BP's oil spill in the Gulf of Mexico. Today Marcia McNutt, head of a group of scientists called the Flow Rate Technical Group, listed several estimates in the range of 20,000 to 40,000 barrels a day — that is, before the top of the wellhead was cut and a pipe was installed that has been catching some, but not all, of the oil. On Wednesday this pipe siphoned 15,800 barrels of oil to the surface.

June 12, 2010

It's my birthday. Lisa showed up around 3 pm, back from her travels, and quite tired.

On June 21st the moving company will take a bunch of our stuff. We leave for Singapore on July 9th. There's a lot of work to do before then!

In Singapore I'll be in a part of world that's heaven for mangrove forests. I want to check some out!



- Brendan Borrell, The mystery of mangroves, *Nature Conservancy Magazine*, Summer 2010.

And check this out:

- Joni Praded, Reinventing the zoo: it's no longer enough to put endangered species on display and call it conservation - little chat with Betsy Dresser, ecologist, *E: The Environmental Magazine*, March-April, 2002.

June 15, 2010

photo by Dave Martin - AP

At what rate is crude oil pouring into the Gulf of Mexico? The latest government estimate is even higher than before: now it's 35,000-60,000 barrels per day. That's the equivalent of one Exxon Valdez every four days. Meanwhile, a lightning strike caused a fire on the ship that was siphoning off the oil, reducing the amount collected to 5,000 barrels today.

Meanwhile, the National Oceanic and Atmospheric Administration announced that this year's January-May period was the warmest on record, with records going back to 1880.

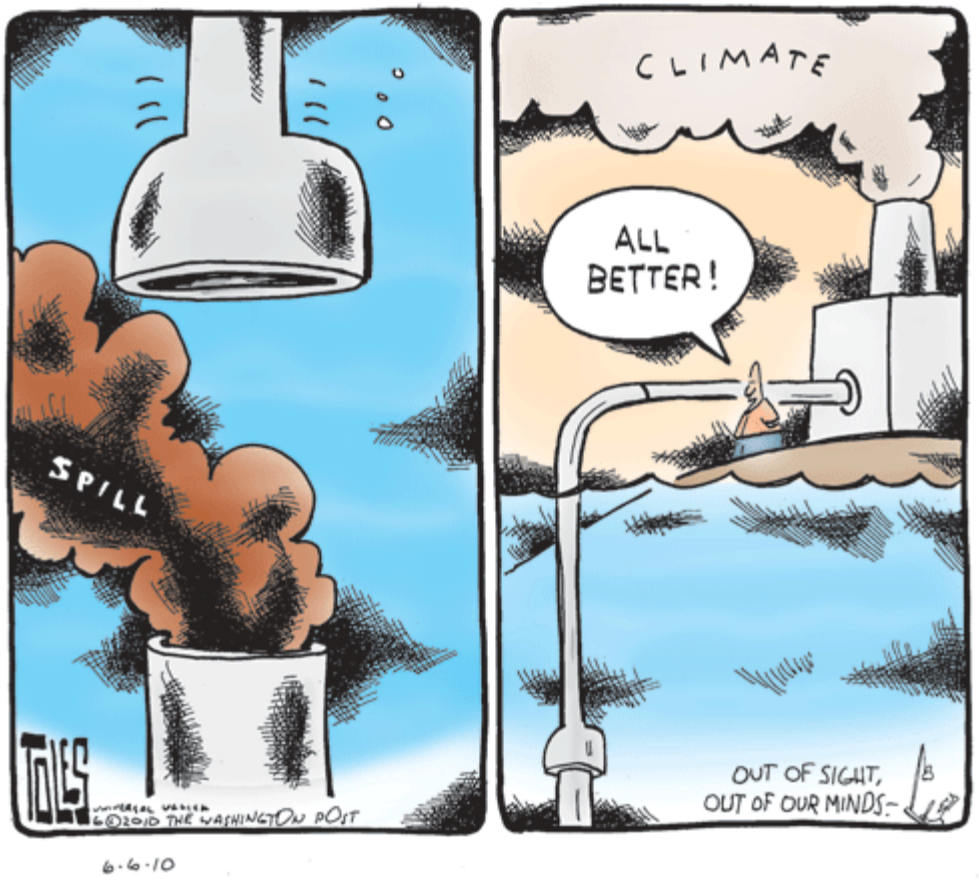
And tonight, Obama gave a speech from the Oval Office. Let's see if any of these noble words translate into action:

> One of the lessons we've learned from this spill is that we need better regulations, better safety standards, and better enforcement when it comes to offshore drilling. But a larger lesson is that no matter how much we improve our regulation of the industry, drilling for oil these days entails greater risk. After all, oil is a finite resource. We consume more than 20% of the world's oil, but have less than 2% of the world's oil reserves. And that's part of the reason oil companies are drilling a mile beneath the surface of the ocean - because we're running out of places to drill on land and in shallow water.

For decades, we have known the days of cheap and easily accessible oil were numbered. For decades, we have talked and talked about the need to end America's century-long addiction to fossil fuels. And for decades, we have failed to act with the sense of urgency that this challenge requires. Time and again, the path forward has been blocked - not only by oil industry lobbyists, but also by a lack of political courage and candor.

The consequences of our inaction are now in plain sight. Countries like China are investing in clean energy jobs and industries that should be here in America. Each day, we send nearly $1 billion of our wealth to foreign countries for their oil. And today, as we look to the Gulf, we see an entire way of life being threatened by a menacing cloud of black crude.

We cannot consign our children to this future. The tragedy unfolding on our coast is the most painful and powerful reminder yet that the time to embrace a clean energy future is now. Now is the moment for this generation to embark on a national mission to unleash American innovation and seize control of our own destiny.



June 16, 2010

I told Alex Hoffnung that he can't graduate until he watches *Casablanca*. He watched it the night before his thesis defense, but we're going to watch it again tonight with two more of my students, John Huerta and Chris Rogers.

This spring, Britain came out with a report:

- House of Commons, Science and Technology Committee, The Regulation of Geoengineering, April 18, 2010.

This included a discussion of the so-called "Oxford Principles" recommended by Steve Rayner (University of Oxford), Catherine Redgwell (University College London), Julian Savulescu (University of Oxford), Nick Pidgeon (Cardiff

University) and Tim Kruger (Oxford Geoengineering Institute). These principles were:

- **Principle 1: Geoengineering to be regulated as a public good.**

  While the involvement of the private sector in the delivery of a geoengineering technique should not be prohibited, and may indeed be encouraged to ensure that deployment of a suitable technique can be effected in a timely and efficient manner, regulation of such techniques should be undertaken in the public interest by the appropriate bodies at the state and/or international levels.

- **Principle 2: Public participation in geoengineering decision-making.**

  Wherever possible, those conducting geoengineering research should be required to notify, consult, and ideally obtain the prior informed consent of, those affected by the research activities. The identity of affected parties will be dependent on the specific technique which is being researched - for example, a technique which captures carbon dioxide from the air and geologically sequesters it within the territory of a single state will likely require consultation and agreement only at the national or local level, while a technique which involves changing the albedo of the planet by injecting aerosols into the stratosphere will likely require global agreement.

- **Principle 3: Disclosure of geoengineering research and open publication of results.**

  There should be complete disclosure of research plans and open publication of results in order to facilitate better understanding of the risks and to reassure the public as to the integrity of the process. It is essential that the results of all research, including negative results, be made publicly available.

- **Principle 4: Independent assessment of impacts.**

  An assessment of the impacts of geoengineering research should be conducted by a body independent of those undertaking the research; where techniques are likely to have transboundary impact, such assessment should be carried out through the appropriate regional and/or international bodies. Assessments should address both the environmental and socio-economic impacts of research, including mitigating the risks of lock-in to particular technologies or vested interests.

- **Principle 5: Governance before deployment.**

  Any decisions with respect to deployment should only be taken with robust governance structures already in place, using existing rules and institutions wherever possible.

Also, between March 22nd and 26th, there was a meeting at Asilomar (on the Monterey peninsula in California) to discuss geoengineering. My friend Gregory Benford went there, and I would like to interview him about that someday.

June 17, 2010

I read an interesting article about Esther Duflo, a scientist who helped found J-PAL, the Abdul Latif Jameel Poverty Action Lab at MIT:

- Ian Parker, The poverty lab, *New Yorker*, May 17, 2010, pp. 79-89.

She has really pushed the use of scientifically designed experiments involving randomized control trians to study the effects of social policies designed to help poor people. Don't just guess what's good: try things and study what happens! The *New Yorker* article quotes her as saying: randomization "takes the guesswork, the wizardry, the technical prowess, the intuition, out of finding whether something makes a difference." She's discovered a lot of interesting things by running these experiments. J-PAL teaches people how to run them, and you can even take an *online* course on how to run them:

- Abdul Latif Jameel Poverty Action Lab Executive Training: Evaluating Social Programs.

Cool stuff! To get the big ideas, look at her slides:

- Esther Duflo, Creative experimentation, aid and development policy, NYU Conference, February 6, 2009.

Lisa and I are choosing what stuff we want to have shipped to Singapore on Tuesday. This is a chance for a major house-cleaning! I couldn't help scanning some old photos...

Here is Lisa back in the days when taught at Bard College, probably somewhere about 1990-1994. We were hiking in the Catskills. I remember us climbing up a narrow rock passageway called the Lemon Squeezer. She looks so bright-eyed and happy! This makes me really sad about how we were stuck on opposite sides of the country for ten years. All that youth we had, wasted apart.

Here is one of my sister Alex and me in the woods near our parents' house, examining a garden she'd planted:

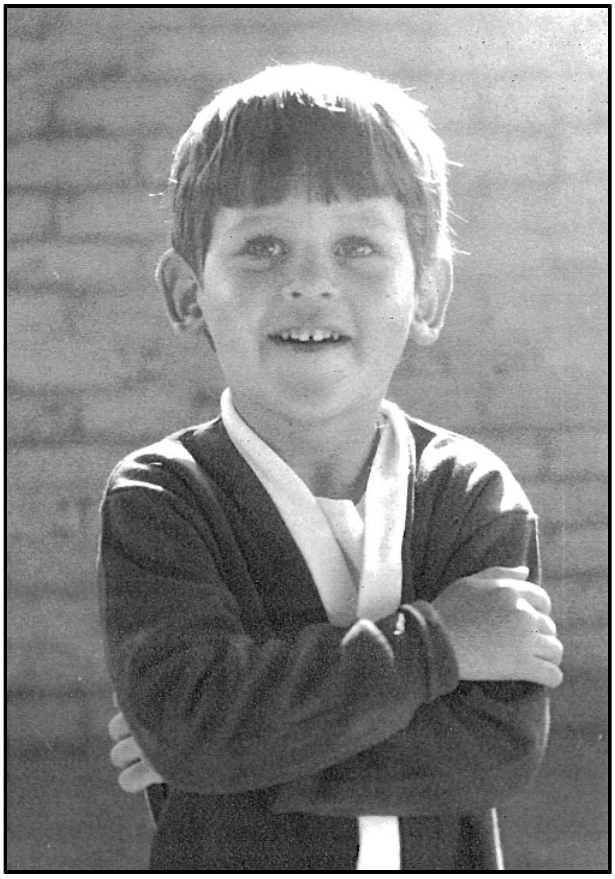
Here are Lisa and I at my parents' house around Christmas 1996:

Here's my mother Phyllis along with my aunt Joan Baez Sr. (mother of the famous singer), and her husband Albert Baez. This was taken in November 1997 at my uncle's house. My uncle and aunt were living separately at the time, and had been for decades. But this was one his big birthday parties, his 85th birthday in fact, so everyone was there:

Here's one of my mother's sister, Marylin Goudzwaard, who lives in Pasadena, along with my father Peter. This was taken in Monterey in November 1997, so they must have taken a trip down there before or after my uncle's birthday party. They are looking at pictures just like I am now:

And on a different note... here are some of Kirill Krasnov, Fotini Markopoulou and me. These were taken when I spent a few months at Penn State. This is back when we were first beginning to understand "spin foams".

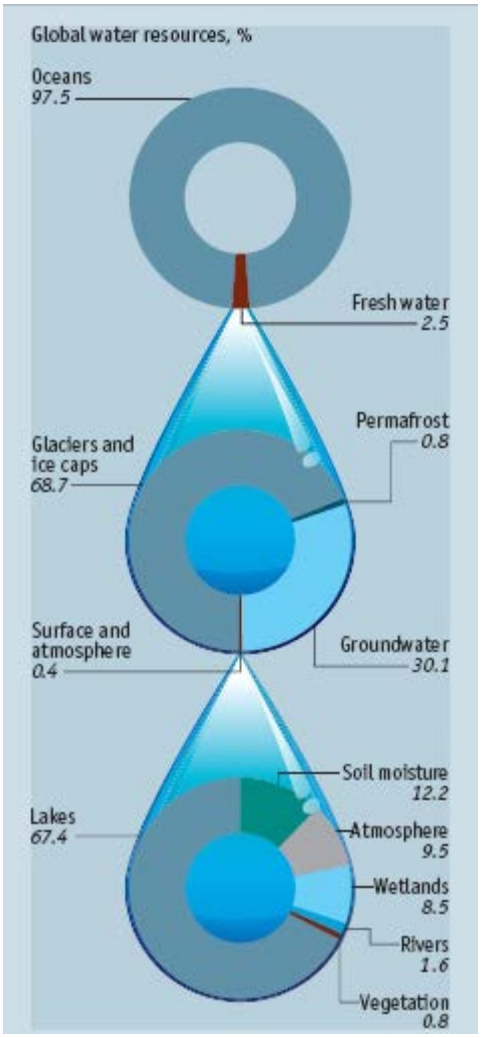
And here's one of me taken in 1964, when I was three years old:



June 18, 2010

While there's lots of water on the planet, the supplies of drinkable fresh water are getting severely strained. Want to know the big picture? Read this:

- For want of a drink: special report on water, *Economist*, May 22nd, 2010.



Only 2.5% of water on this planet is fresh water. Of that 2.5%, only 0.4% is on the surface or atmosphere.

When Bill Schmitt visited, we went to Tio's Tacos, which is teeming with strange sculptures, the creation of a feverishly inventive mind. Bill took these photos:

June 18, 2010

Scientists have recently discovered anaerobic animals called lorciferans — actual multicelled *animals*, not just single-celled organisms — that have adapted to deep ocean conditions by losing all their mitochondria and symbiotically acquiring new organelles that do the same energy-producing job without oxygen!

A lorciferan - photo by Roberto Danovaro

- Roberto Danovaro, Antonio Dell'Anno, Antonio Pusceddu, Cristina Gambi, Iben Heiner and Reinhardt Møbjerg Kristensen, The first metazoa living in permanently anoxic conditions, *BMC Biology* 2010, 8:30.

Let me quote the abstract. The most exciting part is the phrase "the lack of mitochondria, and a large number of hydrogenosome-like organelles associated with endosymbiotic prokaryotes". Until now, it was thought that all members of the animal kingdom had organelles called mitochondria in their cells. Mitochondria generate a chemical called ATP through a process of oxidation. This ATP is what powers our cells. But some single-celled organisms called prokaryotes work differently: they live in places where there's no air, and they use hydrogenosomes instead of mitochondria to produce ATP through a chemical reaction that uses hydrogen instead of oxygen. The new discovery: some of these hydrogenosomes have apparently been absorbed into the cells of tiny animals called loriciferans... the end result of a process of symbiosis. And now these animals have hydrogenosomes instead of mitochondria!

Background

Several unicellular organisms (prokaryotes and protozoa) can live under permanently anoxic conditions. Although a few metazoans can survive temporarily in the absence of oxygen, it is believed that multi-cellular organisms cannot spend their entire life cycle without free oxygen. Deep seas include some of the most extreme ecosystems on Earth, such as the deep hypersaline anoxic basins of the Mediterranean Sea. These are permanently anoxic systems inhabited by a huge and partly unexplored microbial biodiversity.

Results

During the last ten years three oceanographic expeditions were conducted to search for the presence of living fauna in the sediments of the deep anoxic hypersaline L'Atalante basin (Mediterranean Sea). We report here that the sediments of the L'Atalante basin are inhabited by three species of the animal phylum *Loricifera* (*Spinoloricus* nov. sp., *Rugiloricus* nov. sp. and *Pliciloricus* nov. sp.) new to science. Using radioactive tracers, biochemical analyses, quantitative X-ray microanalysis and infrared spectroscopy, scanning and transmission electron microscopy observations on ultra-sections, we provide evidence that these organisms are metabolically active and show specific adaptations to the extreme conditions of the deep basin, such as the lack of mitochondria, and a large number of hydrogenosome-like organelles, associated with endosymbiotic prokaryotes.

Conclusions

This is the first evidence of a metazoan life cycle that is spent entirely in permanently anoxic sediments. Our findings allow us also to conclude that these metazoans live under anoxic conditions through an obligate anaerobic metabolism that is similar to that demonstrated so far only for unicellular eukaryotes. The discovery of these life forms opens new perspectives for the study of metazoan life in habitats lacking molecular oxygen.

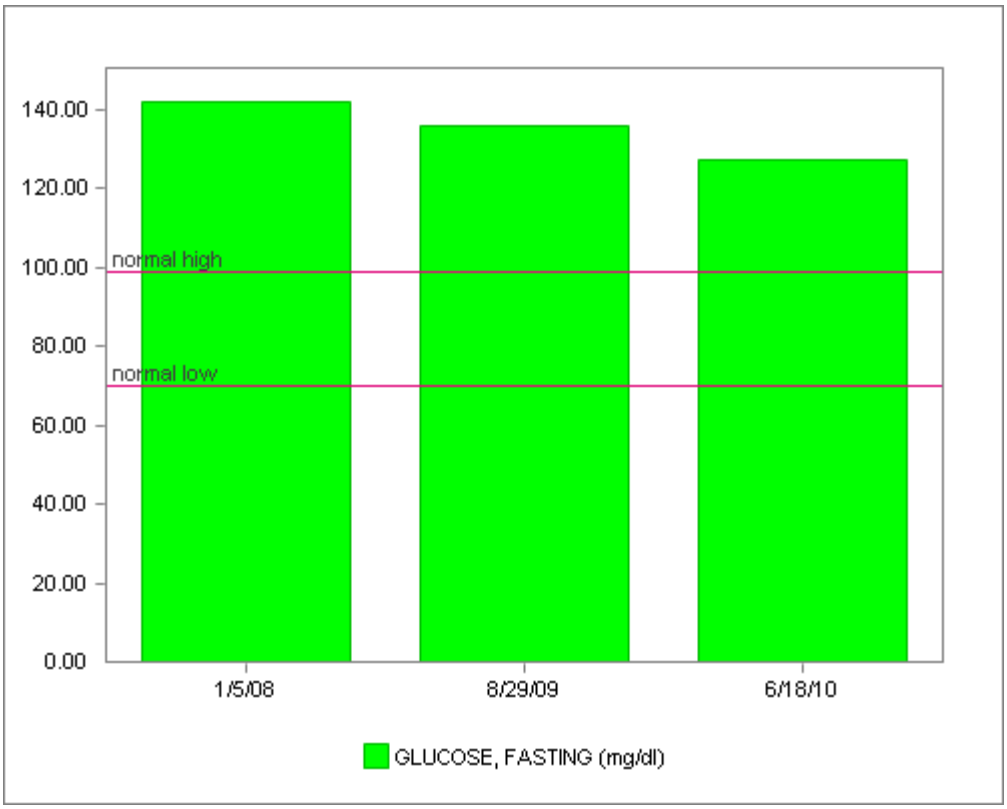
June 19, 2010

I read a cool article about sandfish: lizards native to North Africa that can literally swim through sand! People keep them as pets, which is not surprising, because they're incredibly cute:

- Henry Fountain, A Saharan lizard is a sand swimmer, *New York Times*, July 16, 2009.
- Werner Baumgartner, Florian Fidler, Agnes Weth, Martin Habbecke, Peter Jakob, Christoph Butenweg and Wolfgang Böhme, Investigating the locomotion of the sandfish in desert sand using NMR-imaging, *PLos ONE* **3**(10): e3309.
- Wikipedia, *Scincus scincus*.

The Wikipedia article has a movie of a sandfish jumping out of someone's hand and quickly diving into the sand and swimming away. How do they do it? People are busy studying that question — check out this video.

On a different note, I took some lab tests yesterday. They encourage me to hope that a better diet and more exercise can help me beat my pre-diabetic condition. I've been trying to eat better and work out more, and it seems to be helping:



In response to the above remark, Andrew Hay pointed out that a *low-carbohydrate diet* is more important than exercise. Lorenz Borsche already mentioned that the last time I talked about this subject, back on October 11th, 2009. Lorenz mentioned Gary Taubes' book *Good Calories, Bad Calories*, and Andrew pointed me to Toban Wiebe's extensive notes on this book.

So yes, I'm trying to cut back on carbohydrates — thanks, folks, and keep pressuring me to do it, because I'm finding it a tough addiction to break. For some reason I repeatedly get into moods where I'm feeling self-indulgent and want some sugar or alcohol. When I force myself to stop, I almost feel the need to invent some new sins to make up for denying myself these. It's a real nuisance. But I've also heard from reputable sources that body fat plays a role in adult onset diabetes. To fight that, exercise also seems to help. Maybe not — Gary Taubes might disagree — but anyway, exercise is good for plenty of other things too. I like it, but I don't always make time for it. In fact, maybe this should be my new self-indulgence!

June 20, 2010

Charles Grellois noticed my new interest in technology and sent me an email recommending that I study the work of Jacques Ellul and his friend Bernard Charbonneau (the latter apparently not much translated into English). In 1964 Ellul wrote a book called *The Technological Society*. Here's a summary from the Wikipedia article on him:

> What many consider to be Ellul's most important work, *The Technological Society* (1964) was originally titled: *La Technique: L'enjeu du siècle* (which literally translates to "The Stake of the Century"). In it, Ellul set forth seven characteristics of modern technology.
>
> The characteristics of technique which serve to make efficiency a necessity are rationality, artificiality, automatism of technical choice, self-augmentation, monism, universalism, and autonomy. The rationality of technique enforces logical and mechanical organization through division of labor, the setting of production standard, etc. And it creates an artificial system which "eliminates or subordinates the natural world."
>
> Regarding technology, instead of it being subservient to humanity, "human beings have to adapt to it, and accept total change." As an example, Ellul offered the diminished value of the humanities to a technological society. As people begin to question the value of learning ancient languages and history, they question those things which, on the surface, do little to advance their financial and technical state. According to Ellul, this misplaced emphasis is one of the problems with modern education.
>
> This, according to Ellul, produces a situation where an incredible stress is placed on information in our schools. The focus in those schools is to prepare young people to enter the world of information, able to handle computers, but knowing only the reasoning, the language, the combinations, and the connections between computers. This movement is invading the whole intellectual domain and also that of conscience.
>
> Ellul's commitment to scrutinize technological development is expressed as such:
>
> > [W]hat is at issue here is evaluating the danger of what might happen to our humanity in the present half-century, and distinguishing between what we want to keep and what we are ready to lose, between what we can welcome as legitimate human development and what we should reject with our last ounce of strength as dehumanization. I cannot think that choices of this kind are unimportant.

Since my wife Lisa studies classical Chinese and Greek thought, I am often made aware of how little government support there is for her activities compared to what I do. Somehow our government considers even the most rarefied mathematics more important than studying the history of how people think. This is odd, given how many of our problems involve people's thinking, world views, and implicit assumptions. But I've heard that a lot of recent work in the humanities — loosely speaking, *postmodernism* — shows little interest in a systematic study of these issues, the sort of study that could actually do the world some good.

Ellul's ideas, or at least this tiny taste of them, again makes me wonder how much I should "bracket off" questions of philosophy, politics and ethics in the new series of This Week's Finds, focusing on science and technology. Bracketing them off could make it impossible to make progress on some really important problems. On the other hand, getting involved in them seems like a bit like diving into quicksand.

June 21, 2010

The moving van is about to come and take a bunch of our stuff to Singapore! Here's some of it sitting on our bed:

Yesterday BP siphoned off 23,290 barrels of oil leaking from the bottom of the Gulf of Mexico. It collected 14,570 barrels in the drillship Discoverer Enterprise, and it burned off 8,720 on the Q4000 oil rig, which has no way of holding the oil.

It turns out that early on, an internal BP document computed an initial worst case estimate of the oil spill was 100,000 barrels a day. This was around when they were publicly estimating 1,000 barrels a day. Need I say more?

June 23, 2010

A feel-good story:

- Victoria Gill, Experts rediscover plant presumed extinct for 60 years, BBC, June 24, 2010.

This sort of effort is not the real cure for the mass extinction underway! It's too much work, and there are too many endangered species. We need to protect entire ecosystems. But, this sort of story may help fire people up.

June 25, 2010

My pals Chris and Menakshee are visiting! They recommend these books:

- Tim Flannery, *The Eternal Frontier: An Ecological History of North America and Its Peoples* , Atlantic Monthly Frontier, 2001.

Tim Flannery, *The Future Eaters*, Grove Press, 2002.

June 28, 2010

Alissa Crans and Tom Leinster used Skype to call me from Croatia, where they're vacationing.

June 30, 2010

Lisa went on another trip to Erlangen yesterday; she'll return on July 5th and we'll take off for Singapore on the 9th. I'm using the week of solitude to move stuff out of my office at UC Riverside, since they'll be needing the room while I'm gone. It's a rare chance to sort through old files and throw out stuff that's no longer necessary. All the more so since I'm changing career directions, and various old preprints — I have a 5-foot-tall filing cabinet full of them — which once seemed to hold the keys to the mysteries of the universe now seem like pointless relics, worth tossing. Mainly it's the printouts of papers from the arXiv that seem unnecessary. Actual reprints, some signed by their authors, have more nostalgic value. A letter from Mac Lane, a letter from Witten — strange to think of those days before email! Lots of papers by my PhD advisor, Irving Segal. And notes that I took in courses... What to keep, what to dispose of?

For so long I'd been trying to learn all of pure mathematics (or at least everything *interesting*) that turning to a different

goal — "saving the planet", as I modestly put it — makes me feel a bit like a cartoon character who had charged off a cliff, merrily unsuspecting until he looked down. *What was I doing? Why so much math?* Sure, it's beautiful, at least when you understand it. But why does it command such passionate energy to overcome all obstacles?

I'd actually taken a break from it until a few days ago. I was really trying to get up to speed on some environmental, technological, economic and political issues: trying to find the right places to chop the Gordian knot. Pure math seemed like a decadent waste of time, a hobby suitable for immortals basking in some intellectual Elysian fields, not us rats trapped on a failing planet. But then Todd Trimble figured out a beautiful way to fix and prove my conjecture about Schur functors. So, we wrote it up as an article on the *n*Lab. And it was great fun for a few days, and it even points towards a bigger, better conjecture about the structure of Schur functors.

But right now, throwing out all these old math papers, I'm a somewhat different mood.

I just found a manuscript that had been sent to me by Rodger Cunningham of Sue Bennett College, Kentucky... a chapter book he was writing on the magician John Dee. And I just happened to open it to this page, which may answer the italicized question above:

> In Plato's characterization of geometry as having to do with the knowledge of the eternal, not of the temporal, we find an escape from time — not only the time of generation and death, but also from the time of historical development. The early Egyptian praxis of *geometria*, earth-measuring, had indeed been in the cause of permanence over change — the permanence of human title to the earth over the changes imposed on it by the watery flow of nature. In this praxis there was indeed a germ of mathematics as an escape from mutability. But at this stage, [...] praxis was still intimately connected with the earth [...]. With the deliberate disconnection of this art from the earth came its transformation [...].
>
> In short, the only practical benefit of mathematics in which Dee is really interested is in the beneft to the mathematician himself.

For my July 2010 diary, go here.

We do not inherit the land from our ancestors, we borrow it from our children. - Native American Proverb

baez@math.removethis.ucr.andthis.edu

home

[For my June 2010 diary, go here.]

Diary - July 2010

John Baez

The older I become the more I realize that
I have to work very hard to reproduce what I seek: the instantaneous.
The influence of the atmosphere on things
and the light scattered throughout. — Monet

July 1, 2010

I got approval for a second year's leave from UCR! So, I'll be staying in Singapore for two years — long enough, I hope, to feel like I'm living there.

I had dinner with James Dolan last night, and he gave me a puzzle in homological algebra. Then he helped me move 4 boxes of books out of my office.

This morning, pal Geoffrey Dixon sent me an email saying I should look up Peter Borschberg, a historian at the National University of Singapore. I also want to look up Walter Blackstock at the Systems Biology Division of the Institute of Molecular & Cell Biology, which is part of Biopolis, a big research center in Singapore, shown below. He does biological mass spectrometry, and like me he's fascinated by the Silk Road. He emailed me a while back after reading this diary...

July 2, 2010

Dinner with Jim at the Old Spaghetti factory last night. He told me some ideas on doctrines.

Thomas Fischbacher pointed me to this cool paper on "ecological engineering" and "living machines":

- John Todd and Beth Josephson, The design of living technologies for waste treatment, *Ecological Engineering*, **6** (1996) 109-136.

A tantalizing quote:

> Kauffman (1993) and Kinsinger et al. (1991) argue that complex ecological systems with diverse enzymatic pathways and complex surfaces for the exchanges of gases and nutrients, such as are found in the micro-anatomy of plants, will enable the ecological engineer to design technologies with the potential of several orders of magnitude greater efficiency than contemporary mechanical and chemical technologies. If they are correct, it is an opportunity for ecologists and engineers to collaborate in a significant enterprise. It may be possible to reduce pollution and its negative impact on the environment to a small fraction of existing levels (Todd and Todd, 1995).

Tonight I finished another round of editing a paper on the octonions that John Huerta and I are writing for *Scientific American*.

July 3, 2010

St. Margaret and Mary School, Detroit
photo by Yves Marchand and Romain Meffre

In my June 30th 2009 entry I wrote about the decline of Michigan cities that lived on automobile production, especially Detroit and Flint. As my friend Sharon Newman-Gomez pointed out, there's a great documentary on this. Watch it!

- Julien Temple, Requiem for Detroit.

July 4, 2010

From the first Treaty of Tripoli, which was signed by the United States and Tripoli in 1797 as part of an attempt to end the kidnapping of Americans by the Barbary pirates:

> Article 11. As the Government of the United States of America is not, in any sense, founded on the Christian religion,—as it has in itself no character of enmity against the laws, religion, or tranquility, of Mussulmen,—and as the said States never entered into any war or act of hostility against any Mahometan nation, it is declared by the parties that no pretext arising from religious opinions shall ever produce an interruption of the harmony existing between the two countries.

Interesting! By the way, the treaty didn't succeed: Tripoli and the other Barbary States, Algiers and Tunis, continued their practice of piracy, and the United States later launched the the First Barbary War in 1801, and the Second Barbary War in 1815.

July 5, 2010

The thing I worry most about is the weather in Singapore. Here's the average weather. Low and high temperatures in Celsius, percent humidity in the am and pm, millimeters of rain, and days where it rains more than .25 millimeters:

	low	high	am	pm	mm	days
Jan	23	30	82	78	252	17
Feb	23	31	77	71	173	11
March	24	31	76	70	193	14
April	24	31	77	74	188	15
May	24	32	79	73	173	15
June	24	31	79	73	173	13
July	24	31	79	72	170	13
Aug	24	31	78	72	196	14
Sept	24	31	79	72	178	14
Oct	23	31	78	72	208	16
Nov	23	31	79	75	254	18
Dec	23	31	82	78	257	19

It's remarkably constant! The BBC, where I got this information from, lists the discomfort from heat and humidity as "high" every month except May, when it moves up to "extreme". But I don't remember being terribly uncomfortable the two times I was in Singapore. 32 degrees is 90 Fahrenheit (sorry, that's still more familiar to me), and indeed that's unpleasant when the humidity is over 70 percent. But I think I've been in enough hut and humid places — a summer in Hong Kong, a summer in Shanghai " that Singapore doesn't really stand out in my annals of discomfort. I remember Shanghai crushing me like a sledgehammer when I first went there, but somehow I got used to it.

And I keep reminding myself: millions of people live in Singapore; they don't all flee screaming. Everything is air conditioned indoors now... but in fact, they lived there even before air conditioning was invented.

Right now it's noon here, 3 am in Singapore. The temperature there is 82 degrees Fahrenheit and the humidity is 89%. It's supposed to rain.

Lisa is supposed to come back from Germany today; I'm not sure when.

July 6, 2010

Here's an article by a team of scientists who tried to estimate "boundaries for a healthy planet":

- Johan Rockstrom *et al*, Planetary boundaries: exploring the safe operating space for humanity, *Ecology and Society* **14** (2009), 32.
- David Biello, Setting Boundaries: 10 Guidelines to Save Earth, *Scientific American*, September 23, 2009.

From the original online version of the *Scientific American* article:

Earth System	Threshold Measure	Boundary	Current Level	Preindustrial
Climate Change	CO2 Concentration	350 ppm	387 ppm	280 ppm
Biodiversity Loss	Extinction Rate	10 pm	>100 pm*	0.1-one pm
Nitrogen Cycle	N2 Tonnage	35 mmt**	121 mmt	0
Phosphorous Cycle	Level in Ocean	11 mmt	8.5-9.5 mmt	.1 mmt
Ozone Layer	O3 Concentration	276 DU#	283 DU	290 DU
Ocean Acidification	Aragonite^^ Levels	2.75	2.90	3.44
Freshwater Usage	Consumption	4,000 km3^	2,600 km3	415 km3
Land Use Change	Cropland Conversion	15 km3	11.7 km3	Low

*pm=per million
**mmt=millions of metric tons
#DU=dobson unit
^km3=cubic kilometers

^^Aragonite is a form of calcium carbonate. Measurement is in global mean saturation state.

They mention that while climate change gets a lot of attention, biodiversity loss is the most out of whack measured sheerly by the ratio of the current estimated rate to the supposedly safe "boundary level". Then comes the nitrogen cycle. Ocean acidification is also above the boundary level.

Of course everything about this stuff is tricky, but it's important. We've got to think about it!

July 7, 2010

Lisa and I went to a nice farewell dinner thrown by Judy and David Kronenfeld last night. Al and Betsy Fix were there, and some other folks too.

Walter Blackstock pointed out an interesting special issue of the *Kyoto Journal*: issue **74**, which is about the Silk Road.

July 9, 2010

Today is the big day: we're going to the airport at 9 pm tonight, and we'll catch a plane for Singapore (via Hong Kong) at 1 am. Now: last-minute packing and house cleanup.

Another farewell dinner last night, thrown by Gene and Barbara Anderson. Shannon Lynch and Akif Eskalen came too. Shannon and Akif are friends of ours, but they also happen to live right behind the house Gene and Barbara moved into when they returned to Riverside! So we had the pleasure of introducing them to each other.

My student John Huerta pointed out this talk:

> **Oberwolfach Vorlesung by Prof. Rupert Klein**
>
> The annual Oberwolfach Vorlesung is a public lecture of about one hour taking place at the MFO after the general meeting of the Gesellschaft fuer mathematische Forschung e.V. (The GMF is the running society of the MFO; please note that its general meeting is NOT public.)
>
> We are pleased to announce the next Oberwolfach Vorlesung:
>
> > Prof. Rupert Klein (Berlin)
> > "Mathematical Challenges from Climate Research"
> > Saturday, October 2nd, 2010
> > at 5:30 pm in the institute's large lecture hall
>
> For organisational and capacity reasons, we kindly ask you to register by letter or email to admin@mfo.de. Please note that we cannot offer board and lodging for this event at the MFO. Instead, we recommend the nearby hotels to the interested participants.

I'd like to find out what Klein says!

July 10, 2010

I started my new blog, Azimuth.

July 11, 2010

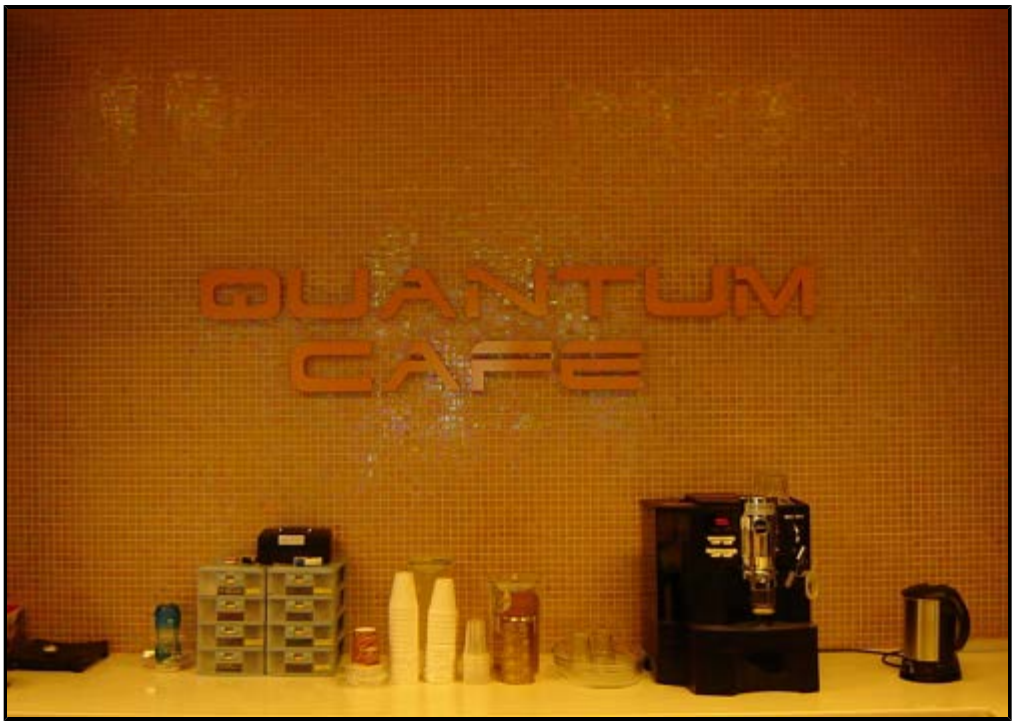
A wonderfully smooth though tiresomely long trip took us to Singapore and to NUS where we picked up the keys to an apartment in Block A of Kent Vale, a faculty housing area near the northwest corner of the NUS campus. This is a temporary apartment... we'll get a permanent one when our stuff shows up in a couple of weeks. It's very spacious and

nice, and it's on the 12th floor. The view is big but not particularly picturesque, since they're doing lots of construction on campus:

Here's Lisa trying to get the wireless to work:

Lisa and I spent today getting set up at our offices. The campus of the National University of Singapore is a bit Escher-esque, since it has a lot of densely packed buildings on steep hills, connected by lots of stairs and walkways, but separated by little gardens with lush jungle vegetation, and there are lots of tricky situations where the 1st floor of one building becomes the 4th floor of another just by walking down the hall. There are four or five bus lines on campus, and I had to quickly learn about those to get to a cafeteria to have some breakfast, then go to the Centre for Quantum Technologies and get set up there, then pick up Lisa and then come back to Kent Vale to pick up an extra set of apartment keys.

At the CQT I chose a slightly depressing windowless office on the 4th floor over a sumptuous one with windows on the 6th floor because there was nobody else on the 6th floor (yet), and I want to talk to people. Right after I made this decision I started regretting it. Since there was nothing to do in my office (I'd forgotten to bring my laptop), I went down the 3rd floor and hung out in the CQT's lounge. This is called the Quantum Cafe! — nice competition to the Black Hole Bistro at the Perimeter Institute. More importantly, you can make your own espresso — a real treat in an Asian context, where good coffee can be hard to come by.



I met Mile Gu, who told me about his paper "More really is different", which proves the uncomputability of the expectation values of some natural observables in the ground state of a lattice spin system with periodic Hamiltonian. I find it rather amazing that these are uncomputable, so I'll have to talk to him more and understand the physics of this better. Then I met Artur Ekert, the director of the CQT, who invited me here in the first place. I'm going to talk more to him tomorrow. And then I met Kuldip Singh, the administrative director (who turned out to have an old interest in quantum gravity), and Valerio Scarani, who works on quantum information and quantum cryptography. Kuldip Singh volunteered that an office with windows might open up on the 4th floor.

Later, a colleague of Lisa's got the wireless working in our apartment, and told us that that the best place to shop should be a short walk through a park to West Coast Plaza, where there's an upscale grocery store called Cold Storage, so named because it descends from an old Singapore company that sold ice. Crossing the road will take us to a "wet market" — that is, a more traditional Chinese market — called West Coast Market Square.

July 12, 2010

Walking through the park last night the air felt nice — almost cool, though humid as ever. The West Coast Plaza has a Starbucks, a Coffee Bean, a Quiznos sub shop — all just like home! That was somehow disappointing. But there was also a bunch of Chinese restaurants including a Formosan one that sells *xiao long bao*, and a toast shop — a Singaporean specialty whose charms I have not yet discovered.

It turns out that Cold Storage sells a diverse array of standard western foods, but at alarmingly high prices — enough to make me hope I'd overestimated the value of a Singapore dollar. I gritted my teeth and shelled out $5.00 for a kilo of oatmeal. As you can probably tell, I'm a real skinflint when it comes to buying staples like this. I'm not sure why; maybe because my parents grew up in the Depression and they ingrained this habit in me. I normally pay US $2.99 for a 30-ounce container of "Country Choice" steel cut oats, which are nice because they are just *oats* with a minimum of precooking and other messing around. We pay the food industry to predigest our foods for us.

(Turns out that a Singapore dollar equals 0.72 US dollars now. I was guessing 0.80, so I'm 8% less alarmed now.)

As if trying to live up to its name, Cold Storage is also air-conditioned to a ridiculous extent — enough so that upon leaving, the outdoors felt oppressively hot. That pissed me off. How can I adapt to a tropical climate and avoid wasting energy if stores catering to non-natives keep blasting me with arctic air?

Then we crossed the road via an overpass common here and went to the West Coast Market Square. The wet market was closed, since they tend to close around 5 or 6 pm, but the hawker centre was still going strong, with about half the little booths selling food still open. Lisa got Heinan chicken (steamed chicken with dark soy sauce and a chili condiment) and vegetables with satay sauce and "floss". After near-terminal indecision brought on by hunger, I got chicken curry from a claypot shop " something like this. Turned out they were almost out of chicken, since it was late — so the guy charged me $2.50 instead of $5. After dinner Lisa had a sour plum juice and I had lime juice. Then we walked around, looking at small shops selling a diversity of cheap practical things, very Chinese in style. We saw a 7-11 with lots of incense for sale, sitting in bundles outside. I've heard that 7-11's are taking over, here. We started feeling hot and tired, so we walked back home and went to bed.

Overall it was quite a nice first day in our new life. It will be nice to go to that hawker centre often enough to try all the dishes! In choosing a lime juice, I yet again missed an opportunity to try my first bandung:

or Milo dinosaur:

I'm not sure I'd actually like these things, but it seems important to try them while I'm here — just as in the United States you're not a full member of the culture if you haven't tried all sorts of absurd foods.

Greg Egan said he was not shocked by the results in "More really is different". He said it basically just showed you can mimic a Turing machine with an Ising model, and then — unsurprisingly — the Halting Problem would still be undecidable. Somehow this popped my consciousness into a state where the result indeed seemed obvious instead of "rather amazing", as I mentioned yesterday. Here's what I'd been thinking: you can usually compute ground state expectation values of observables for a lattice system by imposing a spatial cutoff, computing the ground state expectation values, and then removing the cutoff. With the cutoff they should be computable for any computable Hamiltonian, so the uncomputability can only arise in taking the limit. Somehow this seemed hard to achieve.

But now I see that it's easy to achieve. You can set up the Hamiltonian so that its ground state mimics the running of a universal cellular automaton. Then computing ground state expectation values to a given accuracy may require making the cutoff arbitrarily large — or more precisely, uncomputably large.

Here's a fun question, then. The ground state corresponds to thermal equilibrium at T = 0. Suppose we consider expectation values not at T = 0, but at nonzero temperature. Are these still uncomputable? I'm hoping they'll be computable: namely, that thermal fluctuations will ruin the functioning of the universal computer. I have a philosophy that reasonable physics problems have computable answers. The T = 0 idealization would count as "unreasonable" if the results are destroyed by increasing the temperature just a little bit.

July 15, 2010

Combining land and ocean temperatures worldwide, this June was the warmest June on record in 131 years. Similarly, this May was the warmest May on record. This April was the warmest April on record, and this March was the warmest March on record.

Do you hear about this on the news? I haven't.

There have been a lot of floods this year. Are floods getting worse? Opinions vary. It seems people agree that flood damage keeps increasing. But some say it's mostly due to more people living near the coasts:

- Amanda Ripley, Why disasters are getting worse, *Time*, Sept. 3, 2008.

while others say that, at least in the Northeast U.S., heavy rainfalls are increasing:

- Doyle Rice, Is U.S. flooding getting worse?, *Science Fair*, May 6, 2010.

while the Southwest seems to be suffering from more droughts.

July 16, 2010

Some useful advice from Walter Blackstock, which I reproduce here for anyone who visits Singapore:

> Hi John,
> Welcome to the air-conditioned Nation!
>
> Recommend Kinokuniya for books, Sim Lim Square or Funan Mall at City Hall for electronics, Buddha Tooth Temple in Chinatown as an example of a working inner city temple. Cold Storage varies with location: Jelita is high-end for ex-pats, Takashimaya on Orchard has Japanese food, Holland Village is basic and crowded. Brewerkz by the river does a decent pint — prices vary with time. Their Wine Garage is nearby, but you will be shocked at the price of wine in Singapore.

July 22, 2010

A taste of an America nostalgic for times long gone:

- Wade Goodwin, Western swing gets Texas town scootin' again, *Morning Edition*, NPR, July 21, 2010.

July 23, 2010

July 24, 2010

photo by Ariana Lindquist for NPR

The sea goddess Mazu is back!

In truth she was never gone... Lisa says she's very popular in Taiwan, and we've visited temples to Tin Hau, a similar figure, in Macau and Hong Kong. According to this article, she has 160 million followers and 4,000 temples in mainland China, and now the government there is encouraging her worship:

- Louisa Lim, China's leaders harness folk religion for their aims, *All Things Considered*, NPR, July 21, 2010.

While the title focuses on how China's leaders are using Mazu, lets not forget that Mazu — or, let us say, her followers — is also using them.

But let us not forget that in China one can easily pay reverence to one god or goddess without denying others, so that the 160 milllion followers of Mazu may also be Buddhists, and regularly visit Taoist temples as well.

Here in Singapore, we've seen the usual signs of Chinese religion: there's a Taoist temple near the wet market at West Coast Market Square, and the market itself has an altar where they burn incense. Across the street there's a Christian church that does services in English, Filipino and Mandarin.

On a more mundane note: Lisa and I had a really great lunch today! It was Teochew cuisine, from the city of Chaoshan, a region of China in the north-easternmost part of the Guangdong province. It was braised duck on yam rice. It came with a bowl of anise-flavored chicken broth and some nice condiments on the side: half a hard-boiled egg, some peanuts, and some cucumber slices. The flavors were intriguing, especially with the help of a dollp of shacha sauce. It cost all of 3 Singapore dollars.

You can get it from a little booth in the outermost row of booths in West Coast Market Square, here, which specializes in Teochew food. (Lisa calls it "Chaozhou" food, but it's often written Teochew, and that's what you'll see on this booth.)

July 30, 2010

Some blue sky at 7:20 am today, but now it's pouring rain.

Here's the kind of thing I love about Singapore: in the national news today in the *Straits Times*, the big headline story yells:

Girl, 14, Allegedly Kicks Her Teacher

That is what you'd hope for in a civilized country. In Los Angeles such a minor incident would never be reported.

Meanwhile, up in China, here's what they think about Sarah Palin:

Being out of the American sphere of infleuence, I hadn't noticed that Palin likes the word "refudiate" until I saw this video!

For my August 2010 diary, go here.

Be the change you wish to see in the World - Mahatma Gandhi

baez@math.removethis.ucr.andthis.edu

home

For my July 2010 diary, go here.

Diary - August 2010

John Baez

August 5, 2010

Today we moved into our permanent apartment here in Kent Vale, the faculty housing complex across Clementi Road from the National University of Singapore. Above you see a sunset view of the harbor from our living room window, processed a bit to look like an oil painting.

Maybe I should do a series of photos like this illustrating different light conditions, a bit like Monet's paintings of the Rouen Cathedral.

August 11, 2010

I posted "week300", the last issue of This Week's Finds in Mathematical Physics. It made me kind of sad. But it's full of cool stuff, including two papers I'll need to finish sometime, one with James Dolan and one with Todd Trimble.

August 15, 2010

Lisa's colleague Grace Fong came to a conference and stayed in the guest house at NUS. On Sunday we all went to the botanical garden. One of the first things that struck me were the banyan trees. Here is a *Ficus kurzii*, or Burmese banyan:

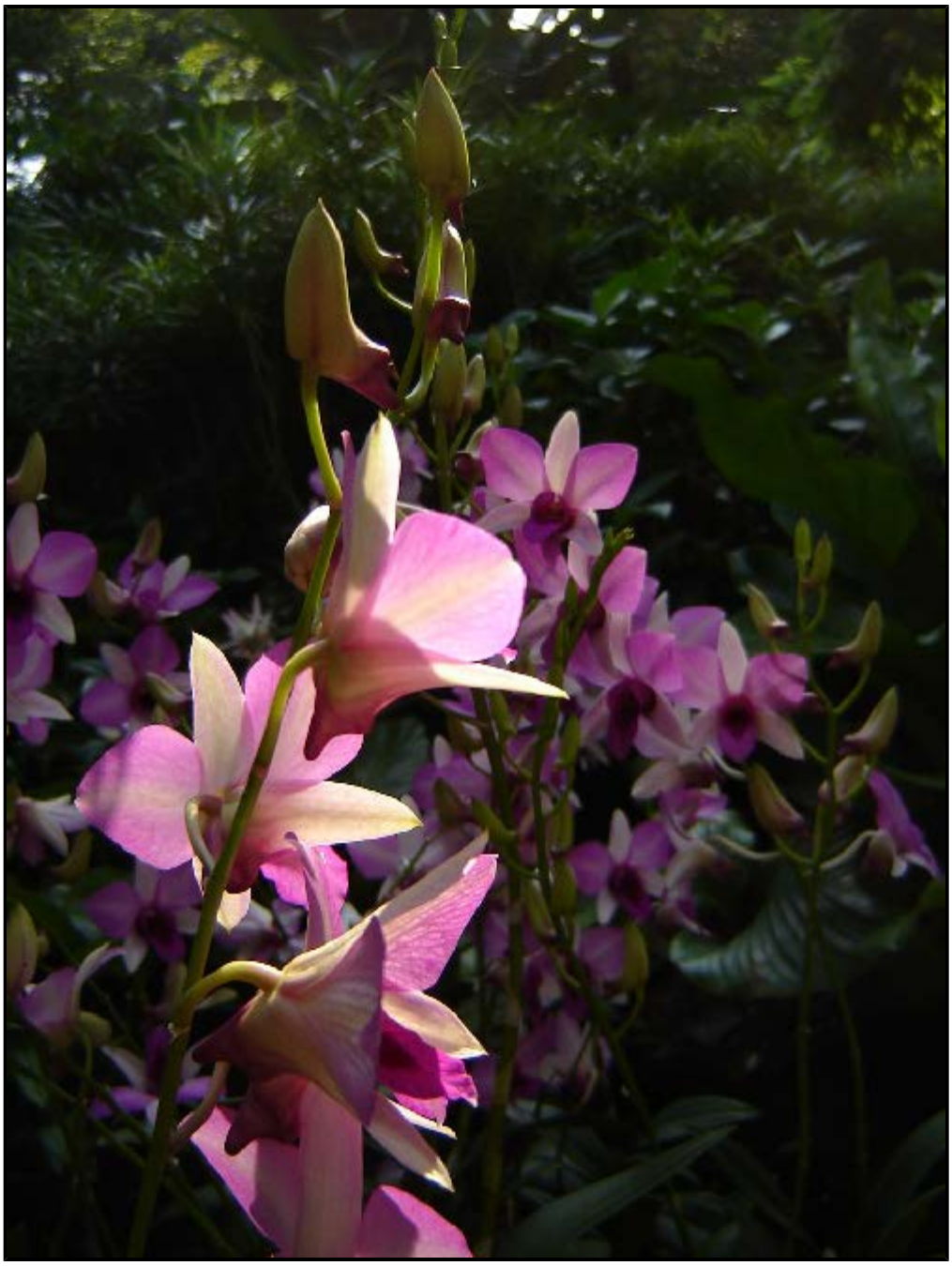
Lots of interesting leaves:

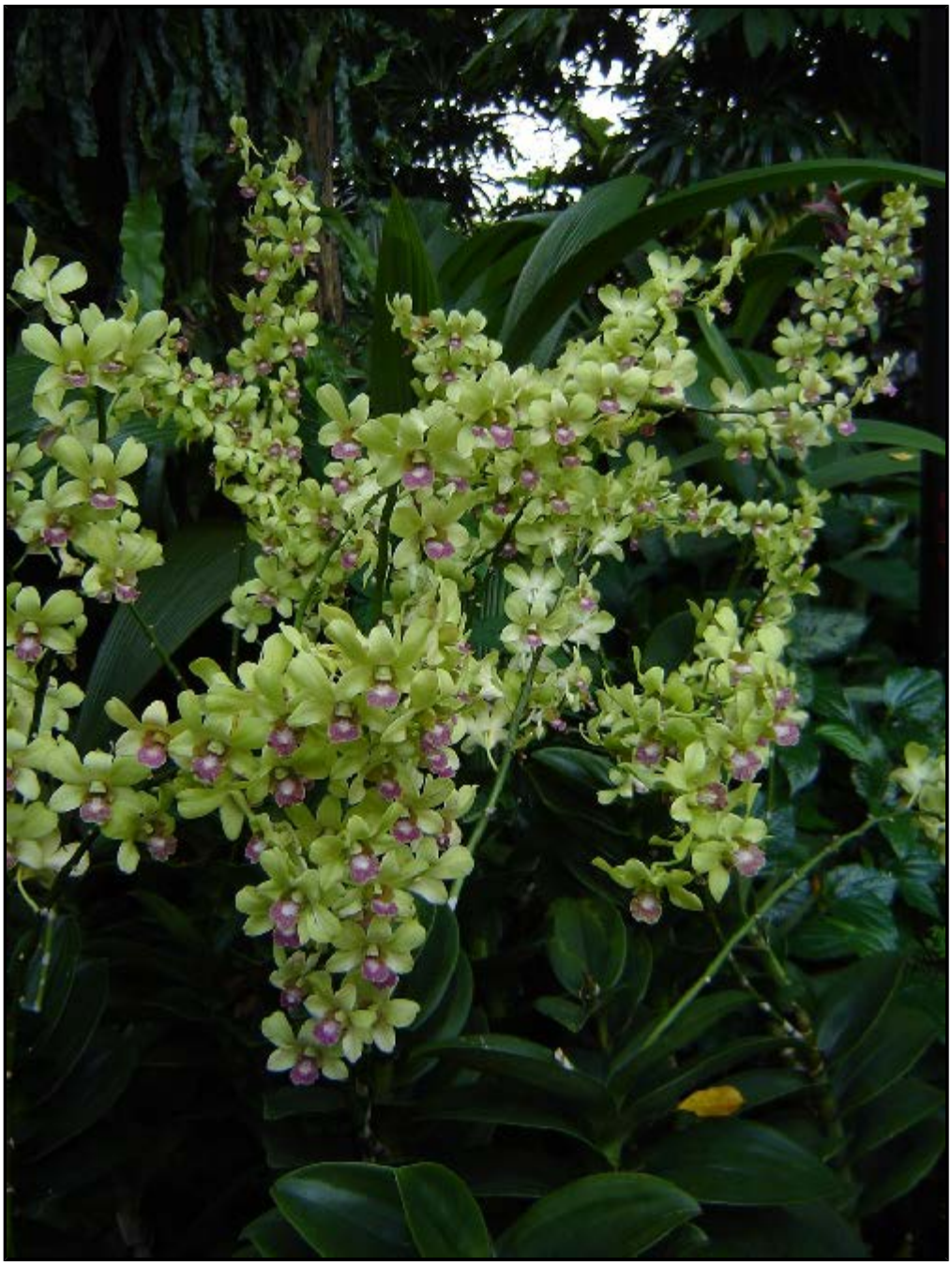
Some interesting flowers:

Busy taking pictures, I fell behind Lisa and Grace as we walked through a patch of jungle:

Lisa took lots of pictures too:

Eventually we reached the orchid garden:





It was hot and steamy throughout the botanical garden... until we reached the "Cool Room", a glassed-in garden that was kept at a lower temperature and regularly sprayed with chilly fog. It was full of carnivorous plants, like pitcher plants:

... and sundews and Venus flytraps:

Leaving the garden, we saw some huge trees:

I believe the tree in the last two photos is a kapok tree, *Ceiba pentandra*, that was planted in 1933.

August 18, 2010

I decided it's time to start a kind of seminar or research group focused on diagrammatic methods for studying open systems — the kind of stuff I began discussing back in week292 - week297. So, I talked to Jake Biamonte and Dieter Jaksch and Stephen R. Clark, all folks from Oxford who regularly visit the CQT.

Jake is already into the general idea of using category theory to clarify and unify diagrammatic methods, not just for quantum systems but also things like electrical circuits. On the other hand, Dieter and Stephen are using diagrammatic methods for more specific practical purposes: for example, describing "tensor states" of quantum systems like the Hubbard model, which can be nicely simulated using optical lattices. I'm less familiar with this stuff, but it sounds cool, so I want to study it. Dieter recommended these papers:

- T. H. Johnson, S. R. Clark, D. Jaksch, Dynamical simulation of classical stochastic systems using matrix product states — the first part, for a general overview.
- S.R. Clark and D. Jaksch, Dynamics of the superfluid to Mott insulator transition in one dimension — using numerical methods to simulate the superfluid/Mott insulator phase transition in the Hubbard model, as simulated by an optical lattice!
- S.R. Clark and D. Jaksch, The cold atom Hubbard toolbox — an introduction to the Hubbard model. — a nice overview of the Hubbard model.
- Jamie Smith and Michele Mosca, Algorithms for quantum computers, Section 5. Tensor networks and their applications.

August 23, 2010

As China surpasses Japan to become the world's second largest economy, they're starting to flex their military muscle:

- Tom Gjelten, China's economic rise enables military growth, *Weekend Edition Sunday*, NPR, August 22, 2010.

A quote:

> The new Pentagon report, "Military and Security Developments Involving the People's Republic of China," suggests China wants to establish itself as a dominant regional power before claiming a larger global role. The Chinese military, according to the Pentagon, is pursuing "anti access and area denial strategies" in its corner of the world with respect to potential rivals like Japan, South Korea and the United States. In part, this means being prepared to keep U.S. and other foreign military forces as far from Chinese waters as possible.
>
> "One of the missions that have been given to the Chinese Navy and the Chinese air force has been to extend China's defensive perimeter out to sea, eastward," says [David] Finkelstein, now at the Center for Naval Analyses. "So they're developing operational capabilities that can make it difficult for forces outside the region to operate with impunity inside China's coastal strategic areas."
>
> New Chinese submarines, according to the Pentagon report, are being equipped with missiles capable of destroying aircraft carriers operating anywhere in the Western Pacific. At the same time, China is locking up oil supplies and other resources needed to fuel its economic growth, looking especially to nearby countries like Iran and Afghanistan.
>
> "They do intend to become very dominant in the region," says Cornell's Prasad, formerly the top China specialist at the International Monetary Fund. "They see economic, political and military issues as all intertwined in terms of trying to obtain their longer-term objectives."
>
> International law normally recognizes a country's territorial domain only over seawaters within 12 miles of its shores, but China is claiming dominion out to 300 miles. Other Asian countries, with U.S. support, are now pushing back, as was evidenced at a meeting last month of the Association of Southeast Asian Nations in Hanoi. But China has not retreated, with Chinese leaders even asserting their domination of the Yellow Sea, between China and the Korean Peninsula.

"Beijing's statements about their sovereignty in the Yellow Sea as well as their sovereignty in the southern part of the China Sea reflect a new, even more expanded view [of their sovereignty claims]," says James Mulvenon of the Defense Group consultancy. He notes that the United States has repeatedly challenged China's claims, most recently in the speech given by Secretary of State Hillary Clinton at the ASEAN meeting in Hanoi.

"We have been very clear in the last three or four months to say that we reject that [Chinese] definition of sovereignty and that we are going to deliberately reassert our ability to operate freely in those areas," Mulvenon says.

Such statements, in the face of Chinese claims, suggest that if there is to be a U.S.-China military conflict in the coming years, it most likely would be a naval confrontation in some part of the China Sea.

China, meanwhile, is also boosting its military presence in distant corners of the globe. The Pentagon report highlighted the role of the Chinese navy in anti-piracy operations off the coast of Somalia and China's direction last year of a military medical exercise in the African nation of Gabon. Such relatively minor moves serve at least to bolster China's international image as a military player.

"They're going to be out there showing the flag in the Horn of Africa, Indian Ocean and other places," Finkelstein says. "We're going to have to get used to that."

It would be a mistake to conclude China will rule the world anytime soon. It still has huge internal challenges to deal with, including widespread rural poverty and an unbalanced economy that depends far too much on other countries continuing to buy Chinese goods. Twenty years ago, many commentators were predicting the next global superpower would be Japan, the very country that has now slipped to No. 3 in the economic rankings.

But China's military and economic development over the past decade has been dramatic, and at this point it seems destined to be a dominant 21st century player.

August 27, 2010

Today I posted "week301", the first issue of the new series of This Week's Finds. It took me forever to get the tone right, and decide what to include. A far cry from "week1", which I just spat out thoughtlessly. I guess I'm getting old, taking myself too seriously. But anyway, it's fun to be starting a new project.

August 30, 2010

I recently heard how the Koch brothers are funding a wide variety of groups who are trying to block action on climate change. Never heard of the Koch brothers? They run the 2nd largest privately held company in the US, with revenues of almost $100 billion. They do a lot of oil refining. And they contribute lots of money to climate change denial groups: organizations whose goal is to prevent action on global warming. According to Greenpeace, "From 2005 to 2008, ExxonMobil spent $8.9 million while the Koch Industries-controlled foundations contributed $24.9 million in funding to organizations of the "climate denial machine"."

I think it's good to find out who is in the pay of these foundations, so we can improve our understanding of who is honestly seeking the truth and who is arguing for commercial interests.

- Greenpeace, Koch industries: secretly funding the climate denial machine.
- Jane Meyer, Covert operations, *New Yorker*, August 30, 2010.
- Conor Friedersdorf, The Koch brothers profiled, *The Daily Dish*, August 30, 2010.

From the executive summary of the Greenpeace report:

For years, both openly and behind the scenes, ExxonMobil dominated the voice of climate science denial in the national global warming dialogue. However, after a decade of reputation-damaging public disclosures, as well as pressure from scientific organizations, shareholders and senators, ExxonMobil implemented a new public relations strategy under a new CEO, and has begun to moderate its public statements on climate change. ExxonMobil's website declares: "We have discontinued contributions to several public policy research groups whose position on climate change diverted attention from the important discussion on how the world will secure the energy required for economic growth in an environmentally responsible manner".

In spite of publishing this statement and reducing funding to a number of prominent climate denial organizations over the past few years, ExxonMobil continues to support dozens of organizations who are part of the climate denial movement with millions of dollars in annual funding. ExxonMobil has responded to public scrutiny by slightly reducing their support of climate denial, and Koch Industries is outpacing ExxonMobil's funding activities while drawing very little public attention. As ExxonMobil's silent partner in funding the climate-denial machine, Koch Industries often uses similar and sometimes more aggressive tactics.

Kansas-based Koch Industries is a conglomerate dominated by petroleum and chemical interests with approximately $100 billion in annual sales, operations in nearly 60 countries and 70,000 employees. Most of Koch's operations are invisible to the public, with the exception of a handful of retail brands such as Brawny® paper towels and Dixie® cups, produced by its subsidiary Georgia-Pacific Corporation. Koch Industries has been ranked as the first- or second-largest privately-held company in the United States in recent years, currently ranked second behind Cargill corporation.

Two brothers, Charles and David Koch, each own 42 percent of the company. Part of Koch Industries. influence is channeled through three foundations, also controlled by the two brothers. This report documents roughly 40 climate denial and opposition organizations receiving Koch foundation grants in recent years, including:

- More than $5 million to Americans for Prosperity Foundation (AFP) for its nationwide "Hot Air Tour" campaign to spreading misinformation about climate science and opposing clean energy and climate legislation.

- More than $1 million to the Heritage Foundation, a mainstay of misinformation on climate and environmental policy issues.

- Over $1 million to the Cato Institute [founded by one of the Koch brothers], which disputes the scientific evidence behind global warming, questions the rationale for taking climate action, and has been heavily involved in spinning the recent ClimateGate story.

- $800,000 to the Manhattan Institute, which has hosted Bjorn Lomborg twice in the last two years. Lomborg is a prominent media spokesperson who challenges and attacks policy measures to address climate change.

- $365,000 to Foundation for Research on Economics and the Environment (FREE) which advocates against taking action on climate change because warming is "inevitable" and expensive to address.

- $360,000 to Pacific Research Institute for Public Policy (PRI) which supported and funded An Inconvenient Truth... or Convenient Fiction, a film attacking the science of global warming and intended as a rebuttal to former Vice-President Al Gore's documentary. PRI also threatened to sue the US Government for listing the polar bear as an endangered species.

- $325,000 to the Tax Foundation, which issued a misleading study on the costs of proposed climate legislation.

This is only part of the picture, because the full scope of direct contributions to organizations is not

disclosed by individual Koch family members, executives, or from the company itself. Contributions through Koch's political action committee (PAC) are a matter of public record. Since the beginning of the 2006 election cycle, Koch's PAC spent more on contributions to federal candidates than any other oil-and-gas sector PAC. For that period, Koch Industries and its executives spent $2.51 million compared to next three biggest contributors: Exxon ($1.71 million), Valero ($1.68 million), and Chevron ($1.22 million).

August 31, 2010

Check out some color photos taken by Sergei Mikhailovich Prokudin-Gorskii from 1909 to 1912, long before modern-day color photography was invented:

- Alan Taylor, Russia in color, a century ago, *The Big Picture*, August 20, 2010.

His trick: take three black and white photographs through red, green and blue filters.

For my September 2010 diary, go here.

Be the change you wish to see in the world - Mahatma Gandhi

baez@math.removethis.ucr.andthis.edu

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For my August 2010 diary, go here.

Diary - September 2010

John Baez

September 1, 2010

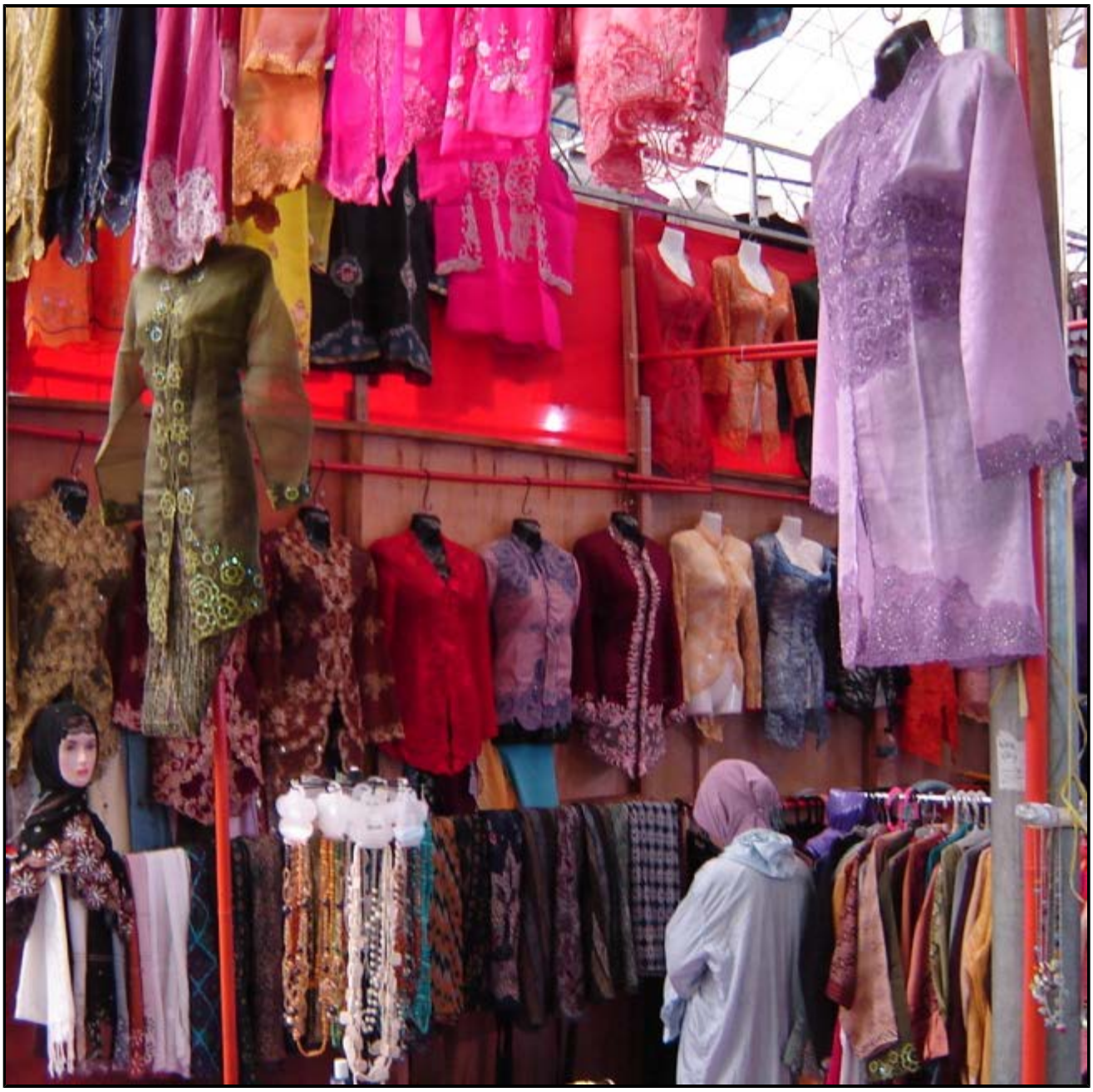
The view outside our window on a foggy morning.

September 5, 2010

Shortly before the end of Ramadan, Lisa and I went to Paya Lebar, a heavily Malay area in eastern Singapore. First we went to a little Chinese temple east of the Singapore Post Centre:

Nothing all that impressive-looking, quite ordinary as temples around here go, but Lisa was interested to see that it was called a "unified" temple, apparently referring to the combination of Taoist and Buddhist aspects. This combination, again, is not unusual, but the explicit designation "unified" was new to her.

Then we went south a bit to a large tented shopping area that's only open during Ramadan. It was packed with stuff to buy.



September 15, 2010

photo by John Goodrich

At one point, there were only 30 Siberian tigers, also known as Amur tigers, left in the wild. Now there are several hundred. Most of them live in the birch forests of eastern Russia, with a few in China and North Korea. Their range is far smaller than it once was. They used to live in many places, including Iraq and Kazakhstan. In their western range they were called the "Caspian tiger". Many were killed by the Russian army in early 20th century.

There's a reason the Russians killed off these tigers. They're fierce!

Yesterday I heard the story of a poacher who made the mistake of shooting a Siberian tiger and wounding it but not killing it:

- The true story of a man-eating tiger's 'vengeance', *Morning Edition*, NPR, September 14, 2010.

Give it a listen! Some good lines:

> "Imagine a creature that has the agility and appetite of the cat and the mass of an industrial refrigerator."

and:

> How high can an Siberian tiger jump?
>
> "As high as it needs to."

Hint: don't tease one if the fence between you and it is only 3.8 meters high. (For you Americans, that's twelve and a half feet.)

The full story is in this book:

- John Vaillant, *The Tiger: A True Story of Vengeance and Survival*, Knopf, New York, 2010.

You can see an excerpt on the NPR website.

The irony, fully brought out in the book, is that this fierce, deadly creature now needs our protection to survive — because we're even *more* fierce and deadly. We're the biggest kids on the block: it's time to start acting like grownups.

From the book:

> One of the many negative effects of perestroika and the reopening of the border between Russia and China has been a surge in tiger poaching. As the economy disintegrated and unemployment spread throughout the 1990s, professional poachers, businessmen, and ordinary citizens alike began taking advantage of the forest's wealth in all its forms. The tigers, because they are so rare and so valuable, have been particularly hard hit: their organs, blood, and bone are much sought after for use in traditional Chinese medicine. Some believe the tiger's whiskers will make them bulletproof and that its powdered bones will soothe their aches and pains. Others believe its penis will make them virile, and there are many . from Tokyo to Moscow . who will pay thousands of dollars for a tiger's skin.
>
> Between 1992 and 1994, approximately one hundred tigers . roughly one quarter of the country's wild population . were killed. Most of them ended up in China. With financial assistance (and pressure) from international conservation agencies, the territorial government created Inspection Tiger in the hope of restoring some semblance of law and order to the forests of Primorye. Armed with guns, cameras, and broad police powers, these teams were charged with intercepting poachers and resolving a steadily increasing number of conflicts between tigers and human beings.
>
> In many ways, Inspection Tiger's mandate resembles that of detectives on a narcotics detail, and so does the risk: the money is big, and the players are often desperate and dangerous individuals. Tigers are similar to drugs in that they are sold by the gram and the kilo, and their value increases according to the refinement of both product and seller. But there are some key differences: tigers can weigh six hundred pounds; they have been hunting large prey, including humans, for two million years; and they have a memory. For these reasons, tigers can be as dangerous to the people trying to protect them as they are to those who would profit from them.

Some good news: in 1986, the Chinese government established a Siberian tiger breeding base at Heilongjiang Northeast Tiger Forest Park. According to the current breeding rate of tigers at the park, the worldwide number of Siberian tigers will break through 1,000 sometime this year!

Even better: Iranian and Russian ecologists are planning a joint project to return Caspian tigers to the wild in Central Asia. They want to do the same for an even more endangered species, the Asiatic cheetah, but some scientists think this is a risky move, since there is no captive breeding population of the Asiatic cheetah.

September 20, 2010

Lisa and I took a trip to Bali — it's a short 2½-hour flight from Singapore. We reached Denpasar airport around 8:40 pm, and took a cab to the Casa Ganesha hotel in the southern part of Ubud, which is the "cultural capital" of Bali. Actually what people call Ubud is a collection of villages, and our hotel was in the village of Pengosakan. It rained on the way there, and indeed it rained intermittently and often heavily throughout our stay. By the time we got back all our clothes and books were moist. On the other hand, it was much less hot than I'd feared it would be. Being in Singapore for a couple months has toughened me up when it comes to tropical weather.

The hotel had a beautiful little courtyard with a fish pond and a statue of Ganesha, the Hindu elephant god, of whom the Balinese seem especially fond. After getting settled in we took a short walk in the wet darkness, just to get a preliminary feel for the place. We went north on Jalan Raya Pengosakan to its intersection with Monkey Forest Road.

The landscape was more gritty and urban than I'd imagined in my romantic fantasies. When choosing a hotel and noting that the Casa Ganesha was a bit south of the main town, I envisioned having to walk to town along a twisting muddy trail next to rice paddies. Instead we walked beside a road lined with shops, restaurants, and the omnipresent spa and massage places that define the Ubud tourist trade. We even saw a Circle K store — something like this (not my photo):

This was a depressingly reminiscent of America, and all that one might hope to leave behind in Bali — but on the other hand, we saw a man setting an offering on little altar in a completely matter-of-fact way, so we knew were someplace new and strange.

The sidewalk, as we later realized, was typical of Ubud: large red concrete slabs, mostly level but sometimes rising or declining at a steep angle, sometimes frighteningly wobbly, punctuated by drains and occaisional gaping holes into dark mysterious depths. Especially on a rainy night, with streetlights infrequent, negotiating such a sidewalk can be a substantial cognitive challenge.

I say all this in part so you don't look at the beautiful pictures to come and get fooled into thinking Bali is an unspoiled oriental paradise. If you think that you could be disappointed, and perhaps even miss its real beauty. I remember going to China the first time — Beijing, to be precise — and being shocked for days at how *grimy* and *dirty* it was. None of the tourist brochures prepared me for that! Bali is far more pretty, and the Balinese are esthetic as the Chinese are practical — but most of the people in Bali are dirt poor, so you'll still see plenty of run-down buildings, corrugated steel roofs, chickens pecking around, mangy dogs, grimy and tired-looking women carrying large buckets of black mud on their heads, and so on.

I think a lot of what people see when they travel is a reflection of their own soul. I think that's the only explanation of the drastically different reviews one sees of the same hotels. This is from one review of Casa Ganesha:

> Ever stayed in a hotel and thought to yourself, "Why do I have to leave?" I was there only for several days and I was already trying to recreate the Balinese atmosphere when I returned home back to my normal life.
>
> I miss all the delicious goodies the chef conjured up in the kitchen — truly mouth watering dishes. There will definitely be special something in there for everyone and the chef is so nice he doesn't mind to adjust to your taste.
>
> The service there in general was tiptop. They were all so friendly and happy to help with anything — gave me illusions of grandeur thinking I was some kind of god, truly pleased and appreciated.
>
> The establishment was absolutely great, it all seemed custom made and had this strong traditional influence with its cultural architecture, the rooms themselves were very cosy and concise.

And this is from another:

> I stayed at this hotel largely based on the reviews of others on this site. I would agree that the staff are friendly and helpful. That's about all I can agree with. The hotel used to be old cheap apartments. A lot of money has been spent to make the gardens look nice but they must have run out of funds to do anything

with the rooms other than put in a new basic (futon style) bed. The rooms were not secure (the lock consists of a padlock handed at arrival) and let in lots of mosquitos (mosquito net was provided). The ceiling was covered in mould and there were cockroaches in the bathroom (not to mention rats in the eating area at breakfast that were also interesting). It is really just cheap backpacker accomodation (not that there's anything wrong with that — I've stayed at places like this before but the price should be about $10-$15US, not $50US!)

Its also located on a busy street some way out of town and the walk consists of walking an hour along broken pavement above sewers. You can't stay in though as (putting to one side the mosquitos) the wi-fi was no more than a crawl pace and TV consisted of BBC news as the only English station.

We tried to leave after the first night...

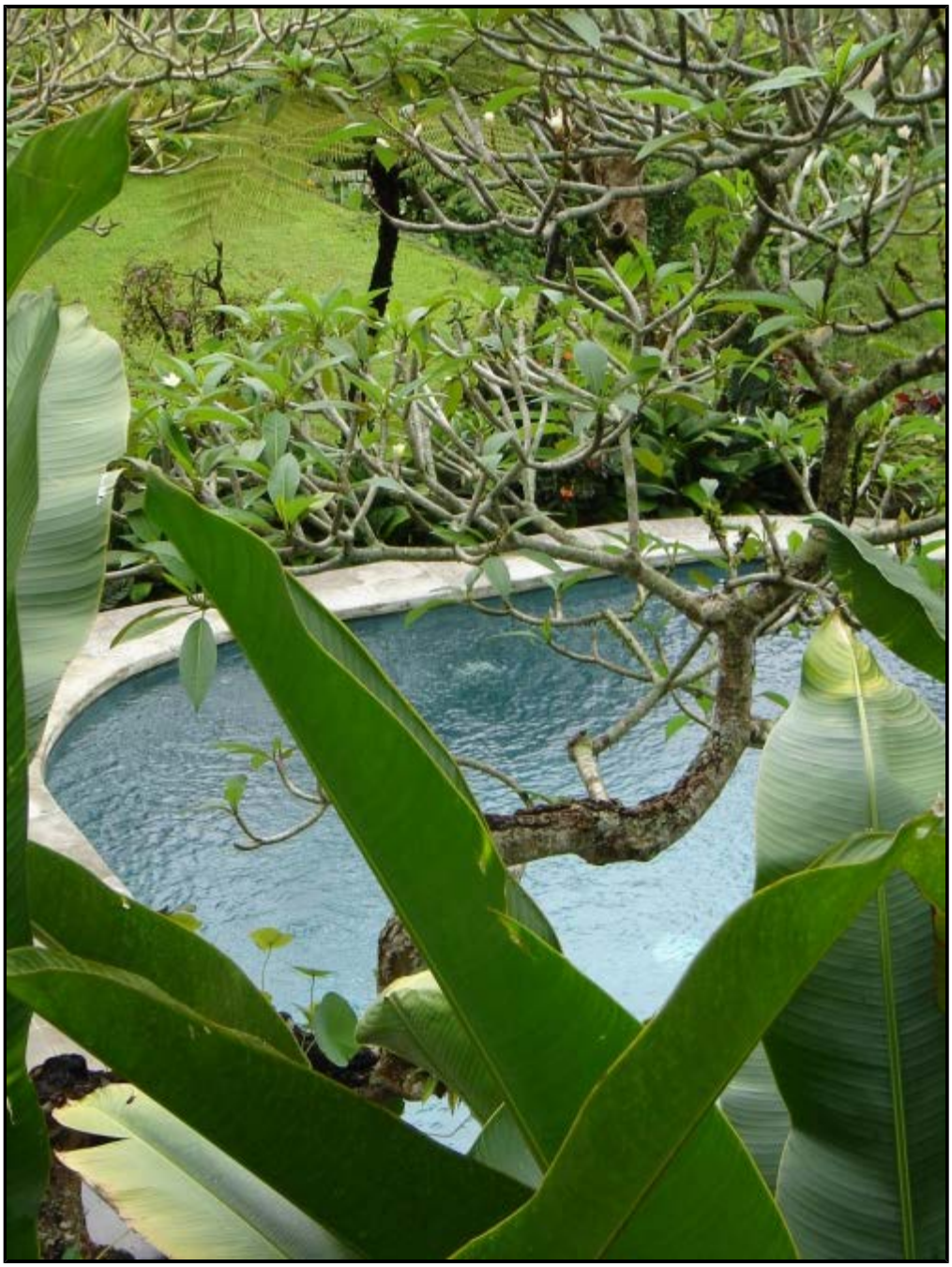
Having been there, I think both of these could easily be true — though the price was only US $40 a night, and we weren't bitten by mosquitos, and didn't see any cockroaches or rats: just the omnipresent geckos, which I find cute. Some of the complaints seem to mistake common practice in Bali for special defects of the Casa Ganesha hotel. For example: a padlock on the door may be pretty common in Bali, along with mosquito netting — we encountered them not only at this hotel but also the much fancier one we stayed in next. The broken pavement above sewers — well, as I said, that's what sidewalks in Ubud are like! On the other hand, the more positive reviewer may have let some of his general enthusiasm for Bali give his impression of the hotel a rosy hue.

September 21, 2010

We had a wonderful breakfast at the Casa Ganesha hotel: a vegetable omelette and a mixed fruit drink. We bought phone cards, walked up Jalan Raya Pengosakan again, and then up Monkey Forest Road, where I bought a cloth bag. Then we walked to the Mandala Wisata Wanara Wana, or Sacred Monkey Forest Sanctuary. We saw some monkeys near the entrance, but didn't go in.

Thoughout Ubud, and indeed much of Bali, you'll find little offerings in altars, shopfronts and the sidewalk, placed there several times a day by the local residents — usually women. They are beautiful little trays made of bamboo, containing flowers, leaves and rice. They are part of what makes Bali a magical place. Monkeys naturally treat these offerings as snacks:

We hiked a bit further up Monkey Forest Road, but soon returned to the hotel to check out. We took a taxi to the Sanyan Terrace Resort, west of Ubud in the village of Sanyan. As the *Lonely Planet* says, "Properties generally go from posh to posher as one nears the fabled Ayung Valley". The Sayan Terrace Resort is a stunningly beautiful place overlooking the jungle. Here are three views from the balcony of our room:



Famously, the Balinese have no word in their language for "art", but they decorate everything beautifully. Here is the wall near the door of our room:

The fellow who drove us to the Sayan Terrace was a would-be lawyer named Nyoman, who we later hired to drive us all over the place. He has gotten a master's degree in law, but not yet been able to find a job using this skill. Apparently no education in Indonesia is free, not even primary school — and the price rises drastically as you climb the ladder. There are fellowships, but mostly well-connected people get them. Nyoman's master's degree cost him 18 million rupiah, or approximately US$ 18,000. He didn't have this much money, so now he has debts to repay. The mean income in Indonesia is about $6 a day, but many people live on less than $1. On days when Nyoman drove us all around, we paid him 350,000 rupiah, or about $35. The Sayan Terrace Resort cost us $110 a night. Staying there was a great experience, but if we go back we will go to a cheaper place, because there are very nice ones for much less.

If you go to Ubud and want someone friendly, reliable and honest to drive you around, I recommend Nyoman. For some reason his card gives his name as Nyoman Banana. I only discovered that when he dropped us off at the airport at the end of our stay, so I didn't have a chance to ask why. Every first-born child in Bali is called Wayan, every second-born child is named Made, every third-born child is called Nyoman, and so on... it loops around after the fifth child. So, first names don't really serve to identify people. Maybe he wanted something that would stand out? Anyway, his email address is

balibanana at hotmail dot com

and his cell phone number is 081 7978 74 06.

After getting settled in, we walked into Ubud, partly on roads and partly on a footpath. Early on, I slipped on a slick wet surface and fell hard on my hand — ouch! Bloody and painful. I haven't done something like that for a long time. We walked down Monkey Forest Road and had a late lunch at a nice restaurant with a lovely garden.

September 22, 2010

A day of driving around with Nyoman. First we went to the Goa Gajah, or Elephant Cave, a temple near Bedulu. Then we went to the Pura Kebo Edan, or "crazy buffalo temple," nearby. Then we drove northeast past Tampaksiring to a really big temple, Gunung Kawi. Here we climbed a hill through terraced rice paddies, where I got my first good look at the elaborate irrigation systems of Bali:

Then we hiked down stairs through the impressive temple gate:

Then we saw the stupas carved into the hill — the reason this temple is famous:

But there are also many other things there:

Later, we drove further north to the volcano Gunung Batur and the lake Danau Batur, which we saw from afar, standing on an overlook, assailed by insistent hawkers trying to sell us trinkets. Not very pleasant, despite some nice fruit stands.

Then we drove south to Mas, a town famous for wood carving, and Nyoman took us to two shops. The first was elaborate, commercial, and unpleasant. The second was much more humble: the house of wood carver, in a traditional walled-in family compound. The place was packed with masks and statues made by carver and some of his ancestors. Trades of this sort tend to run in families. We talked with him quite a bit about woods — crocodile wood and hibiscus wood are the most common, true ebony is logged out, and even fake ebony is expensive. He was not shy of admitting

that he stains hibiscus wood with Kiwi brand shoe polish to make it darker.

At one point, he cheerfully mentioned that he had cremated his mother not too long ago. This was not the only time someone told us something like this during our short stay in Bali. Later we learned that a cremation ceremony can easily cost 20 million rupiah, or about US$ 20,000: an enormous amount of money in these parts, where many people live on $3 a day or less. If someone's relatives can't afford a cremation ceremony, they'll be buried in the hopes that someday, when times are better, their remains can be dug up and receive a proper cremation. We saw some of these graves later on.

After lengthy discussions we bought a Buddha made of hibiscus wood, as above — the tough part was finding the one with the best expression. We also bought a barong. In Bali, Barong is the king of the spirits, benign though sometimes mischievous. It's depicted in five different ways in different regions, and you see the lion form all around Ubud. There are stone barong statues — amid dozens of other types of statues — throughout Ubud. In the popular dance drama where Barong fights the demon queen Rangda, the barong costume looks like this (not my picture):

You can see some wooden barongs on the wall of the wood carver's shop here:

The prices were quite reasonable after some bargaining. (If you don't bargain hard in Bali, you'll be taken for a sucker and pay prices that may seem reasonable by tourist standards, but are easily ten times the base rate. This may seem

annoying — but you need to remember that the people are poor, and would need to be saints to resist soaking up money from people who act like they have more than they know what to do with.)

Alas, I didn't learn this wood carver's name, but he's a nice guy, and I urge you to visit his shop if you visit Ubud. It's called Ary Pura, it's in Mas, and if you want to visit, you can phone at (0361) 975195.

Afterwards we drove back to Ubud, Nyoman dropped us off, and we had dinner at the same place as yesterday.

September 23, 2010

We walked into Ubud again, by the same route. There's a nice stretch of jungle where the road is too steep for cars. In Bali you'll see statues even in places like this, often covered with moss:


After getting into town, we turned right on Jalan Raya Ubud and went down Jalan Bisma, a quiet street where we had lunch at a cafe and art gallery called Adi's. We then explored the rice paddies near the south end of Jilin Bisma, then went back to Ubud Street. After picking up some money at an ATM we walked down Jalan Hanoman looking for the Kejak dance that was supposed to occur that night at 7:30. We were accosted by many people trying to sell us tickets but had trouble finding the performance venue. Finally we found it, with an hour and a half to spare.

Lisa went further down to Monkey Forest Road to buy some stuff, I wound up hanging out at a cafe, waiting for Lisa to call; the cell phone service didn't work, but Lisa found me in the cafe, across from dance venue: the Taman Sari temple on Jalan Hanoman in the village of Pedangtagal. Then we went to a performance consisting of three dances. Each one would take a page to describe well, but I don't have time!

All three were done on a dim-lit stage. The first was the Kecak dance: a portion of the Ramayana, acted out in dance with a chorus of 50 men providing the music. The remaining two were traditional "sanghyang", or trance dances. First, a Sanghyang Dedari dance: two girls walking forwards and backwards with eyes shut waving their heads back and forth. Three times they fell down and three times they were "revived" by two woman. Then, a Sanghyang Jaran dance, also called a "fire dance". They lit a pile of coconut shells, poured on some alcohol to hasten the flames, then brought in a young man on a kind of toy horse. He rode around it in circles until the fire had burnt down a bit, and then ran through the burning shells, kicking them out of his way... a bit like firewalking, but not quite as demanding, I think. It was still fascinating, since the man was supposed to be in a trance — and even if this was a watered-down touristic version of

some traditional ritual, it seemed to hark back to something more potent.

After the dance the fellow sat down and recovered. It was hard to take good photos in the dark, but this one captures some of the mood:

Afterwards we went to the Bebek Bengil, also known as the Dirty Duck Diner. Despite its name, it's an elegant establishment: a deep garden with tables set both under the the open air and in thatched-roof structures, typical of the nicer Balinese restaurants. At night it's lit by many torches, and of course they play gamelan music. Lisa had their signature dish, the crispy duck, which was quite good. I forget what I had, but whatever it was, it went well with the ubiquitous Bintang beer. Beer is a lot cheaper in Indonesia than Singapore, so I let myself indulge a bit during my stay in Bali, despite my pre-diabetic condition. Yeah, stupid, I know.

September 24, 2010

We were planning to walk down to the river in the morning, but wound up talking with Made Dadug, a young tour guide who tends to hang out at the Sayan Terrace Resort. We decided it would be better to go on a guided tour with him another day. And we were right.

At 1 pm we went on another day trip with Nyoman. We stopped at a temple en route to the village of Sukawati. We bought dishes in the crafts market at Sukawati, with Lisa managing to bargain them down wonderfully. We then walked around the back streets, which were full of the walled-in compounds that Balinese like. An extended family of 20 or so will live in one of these, and it will have a bunch of small houses and its own little temple:

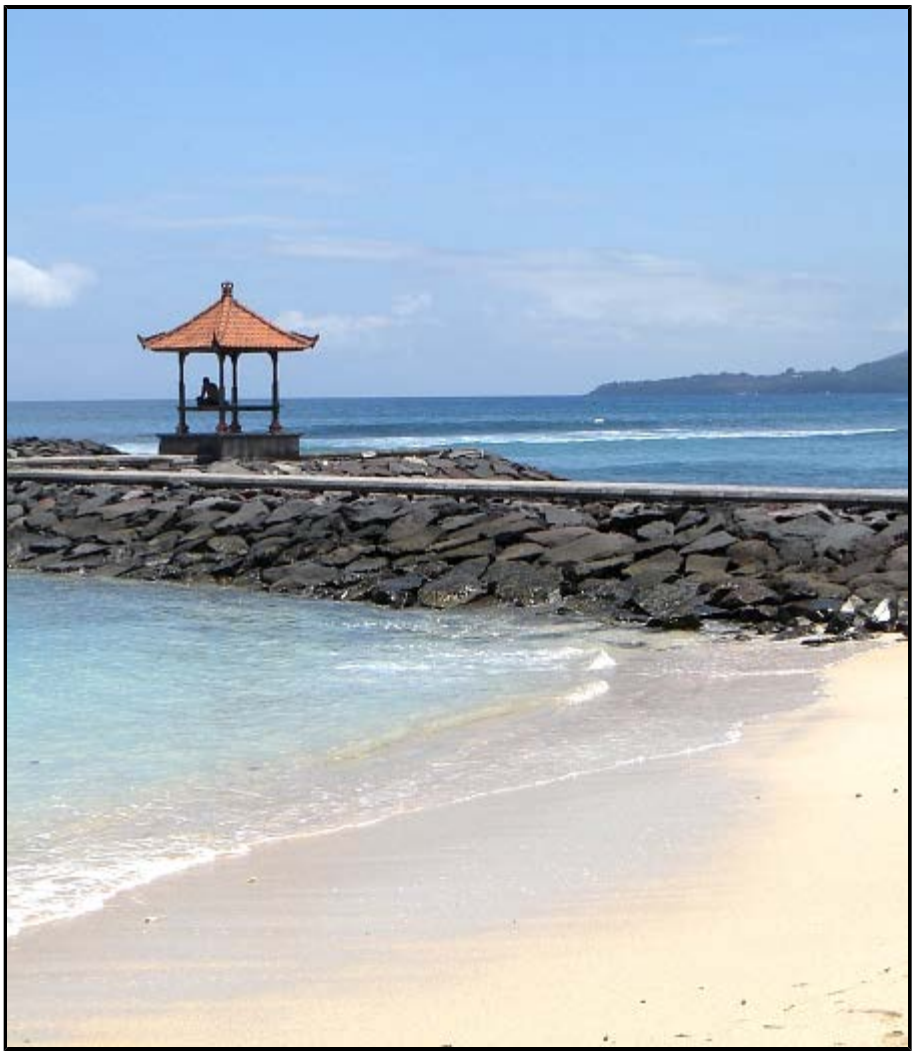
On the way back, we passed a tiny wood carver's shop where we bought a statue of Saraswati, the goddess of learning. In the process we spoke quite a bit with the young woman in the shop, whose father had done the carving. She usually worked as a kindergarten teacher in the big city, Denpasar, a 45 minute drive away. Here is her mother in the shop:

Walking on, we bought some wooden wind chimes on the main street, prompted by the wind chimes at our hotel, which play a nice Balinese sléndro scale. Then Nyoman drove us to a fancy woodcarver who had expensive carvings in crocodile wood and hibiscus wood, including some Saraswatis. He scoffed when we mentioned the little shop in Mas. We liked some of his stuff, but wound up not buying any.

Then Nyoman drove us back to Ubud and dropped us off near the Lotus Cafe — but we went to the Legong and Barong dances put on by the Panca Artha Troupe down the street at the Ubud Wantilan. Afterwards we ate dinner at the Cafe Padang — nice spicy food, but bad for the lower digestive tract next morning! Or maybe it was the bottled water? That's the only thing I had a lot of that Lisa avoided: she'd heard that some of the obscure brands here aren't very safe, and maybe she was right.

September 25, 2010

Another day trip with Nyoman. First we stopped by the the old beach town of Candidasa — our first and only beach experience so far in Bali. It was beautiful, and it brought on fantasies of spending a lot more time at the beach — especially since bungalows are lot cheaper in these out-of-fashion, out-of-the-way towns than in stylish upmarket Ubud!



Then we drove north to to visit Tanganan, where our Bali trip really reached its peak. We had timed our visit to catch a famous ceremony that the residents of this village perform every full moon. In fact every village has scads of ceremonies, scheduled according to the rather complex Balinese calender. There are full moon ceremonies, new moon ceremonies, the special day of thanks for the gift of livestock, the the special day of thanks for the gift of art, the special day of thanks for the gift of knowledge, the special day for meditation to enhance balance in the world, the special day of thanks for the gift of metal, the Balinese New Year (and the day before that, called Tawur Agung Kesanga), the special day of thanks for the gift of fruit-bearing plants, the day of praying for the victory of dharma over adharma, the day when ancestral holy spirits and deities ascend back to eternity, the Buddha's birthday, the special day of thanks for the gift of livestock, and probably others I don't know about. Nyoman said he's rather tired of so many ceremonies: for one thing, they eat up a lot of time and money. But of course we'd never seen one, so it was a real treat.

We didn't know what was going on, so we played it by ear. We saw a big procession going down the main road, so we put on sarongs and followed it.

At first we were rather cautious and kept a respectful distance. But then we noticed a white guy taking lots of photographs, along with his wife and children, and nobody seemed to mind them — in fact the villagers seemed pretty interested in their younger child, in a baby carriage — so after a while we relaxed a bit. This village is famous for a gamelan tuned according to some unusually archaic system — and sure enough, a bunch of guys in purple were playing it while leading the procession! At a gateway they turned off the road and headed towards a temple:

They went into the temple, sat down under a roofed-over structure, and continued playing. Random-looking groups of people gradually filtered into the temple courtyard. They sat or stood, talking to each other and listening to the music. Men generally stayed with men, women with women, boys with boys and girls with girls. Many women came carrying offerings of fruit, which they put on several altars. Many girls wore yellow outfits and handmade bamboo headdresses — we knew they were going to do a ceremonial dance.

After watching the proceedings for a while, we asked someone if it was okay to go in, and he said it would be fine if we gave a donation. We gave it to a guy sitting at a little table, and he asked us to write our name, address and the amount of our donation in a book. Later he read out the names and amounts for everyone who gave donations — and it wasn't just a few confused tourists like us, it was a long list of names.

After about 45 minutes, the girls did a dance:

And then, before the boys did their dance, it started to rain quite heavily. Both Lisa and I had foolishly forgot to bring our umbrellas. She found cover and watched the dance, but I left the temple and went under a roofed-in area that was packed with villagers also fleeing from the rain. I spent quite a while there, wishing I could talk to them.

After a while the rain slacked of and Lisa joined me. As the ceremony ended, women brought the offerings back out of the temple, stacked on their heads:

Then the gamelan players left the temple and slowly marched back the road they'd come from, still playing. Other villagers carried banners:

That was a great experience.

After a look at some shops, we then drove to see herons gather at dusk in the village of Petulu. Then, back to Ubud. Nyoman suggested that we have dinner at Cafe Wayan, so that's what we did. They first gave us a bad table, but then we got a nice table way in back, in the typical Balinese garden. Lisa was chilled from being wet, but when we got back to the hotel I took a quick dip in the pool!

September 26, 2010

In the afternoon we took a taxi to the Mandala Wisata Wanara Wana, or Sacred Monkey Forest Sanctuary. It was fun watching the monkeys. The big males were quite aggressive.

We saw two temples there, one being the Pura Dalem Agung Padangtegal, or Padangtegal Great Temple of Death.

There were monkeys roaming around the temple, and a bunch in the cemetery. Funeral ceremonies are expensive. People who cannot afford a proper Hindu funeral are buried until their relatives can get the money.

After a small snack that turned out to be a bit too large, we did a forced march through the rain up the length of Hanuman Road to the same ATM on Jilin Raya Ubud. We then had a nice light dinner at Coco Bistro, across from the Ubud Wantilan. We could hear the gamelan music for yet another dance performance, and also see it in shadow form on the wall of the hall.

September 27, 2010

This afternoon we flew home to Singapore. But in the morning, we went on a marvelous 3-hour walk with a young guide, Made Dadug, whom we'd met on our previous failed attempt to walk down to the river. We started from our hotel (the Sayan Terrace Resort), walked down to the river, upstream to a dam, and then back through miles of terraced rice fields. I wrote about this in week303, and I don't have the energy for a thorough report here, even though that writeup just scratched the surface. For example, I didn't talk about the sacred banyan trees that slowly "walk" by lowering aerial roots to the ground, which then grow into new trees as the old ones die. Nor did I talk about how our guide, Made Dagung, invited us to his home for snacks! It was great getting to see inside one of the family compounds that Balinese traditionally live in.

Another image that stuck with me is a local lad sitting in a small open-air hut amid the rice fields, working on a laptop, using a wireless internet connection provided by a big fancy hotel up the hill. People who work at the hotel tell the ever-changing password to their friends.

For my October 2010 diary, go here.

Hesperiidae
Papilionidae
Hyblaeoidae
Epiplemidae
Notodontidae
Nemeobiidae
Eupterotidae
Callidulidae

Dioptidae
Lymantriidae
Noctuidae
Endromidae
Oxytenidae
Lycaenidae
Argyresthiidae
Ctenuchidae

Nepticulidae
Hieroxestidae
Symmocidae
Blastobasidae
Heliozelidae
Limacodidae
Agonoxenidae
Compsoctenidae

Neopseustidae
Incurvariidae
Oecophoridae
Stenomidae
Thyrididae
Heliodinidae
Glyphipterigidae
Dudgeoneidae - Elizabeth Fraser, *Melonella*

baez@math.removethis.ucr.andthis.edu

home

For my September 2010 diary, go here.

Diary - October 2010

John Baez

October 1, 2010

The view outside our apartment window, a bit after sunset.

October 16, 2010

I spent most of the day working on the Azimuth Project and writing letters of recommendation for two of my students who are graduating this year, John Huerta and Chris Rogers. John is studying categorified groups that describe symmetries in superstring theory and M-theory — more precisely, "Lie 2-supergroups" and "Lie 3-supergroups". Chris is studying a a categorified version of a standard procedure for quantizing classical mechanics problems, called "geometric quantization". Again, the categorification naturally gives a way to take ideas developed for point particles and bump them up to strings or higher-dimensional membranes. It's funny that we got so heavily into string theory, since I don't believe in this this as a theory of physics — not yet, anyway, not unless someone comes up with a really good idea or two. But the math of this theory is beautiful, and it connects very naturally to categorification, which was an interest of mine for a long time.

Right now I don't feel particularly interested in categorification anymore. I'm more excited about energy technology, trying to figure out what we should do to slow and maybe someday even stop global warming. I went into town to have dinner with Walter Blackstock and talk about this. As I left the apartment I noticed it was really hazy today in Singapore — like a really polluted day in downtown LA back in the 1980s. Walter told me it's due to forest fires in nearby

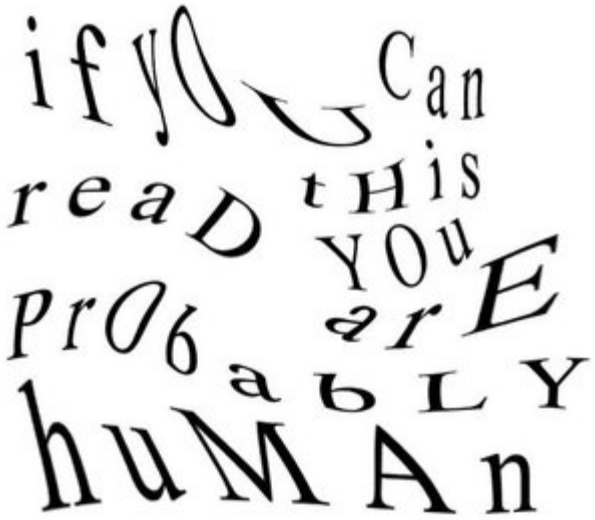
Sumatra: 80 hotspots were detected in the Riau Province in Sumatra. Farmers set these fires to clear land, and maybe they get out of control — I don't know, but in some previous years massive fires in Sumatra made the air very bad here.

Ironically, Walter gave me a book on how Singapore has been cleaning up its act since 1968:

- Tan Yong Soon, Lee Tung Jean and Karen Tan, *Clean, Green and Blue: Singapore's Journey Towards Environmental and Water Sustainability*, Utopia Press, 2009.

Walter and I had dinner at a place called Brussels Sprouts, downtown by the river. Good Belgian beer and mussels, friendly but intermittent service.

October 17, 2010



You know "CAPTCHAs", those annoying little things where you have to read some warped letters and type them in to prove your human — a device used to prevent spam? Well, spammers are hiring people at low wages to crack thousands of them:

- Spammers use the human touch to avoid CAPTCHA, *Weekend Edition Sunday*, National Public Radio, October 17, 2010.

- Marti Motoyama, Kirill Levchenko, Chris Kanich, Damon McCoy, Geoffrey M. Voelker and Stefan Savage, Re: CAPTCHAs — Understanding CAPTCHA-solving from an economic context, Proceedings of the USENIX Security Symposium, Washington, D.C., August 2010.

Front-end companies like DeCaptcher make a plugin that solves CAPTCHAs. The way this plugin works is by sending the CAPTCHAs to another company, like PixProfit, that hires people in places like Russia and Southeast Asia to solve them. These folks work all day for rock-bottom wages, comparable to those in the lowest paid textile mills. It's basically a kind of white-collar sweatshop operation. I find it pretty depressing to imagine working a job like this, doing a repetitive task that seems utterly useless. Make a hundred shirts and at least you've done something. But help a hundred spam attacks...

When I told Mike Stay about this, he said this wasn't anything new. He pointed me to this old blog entry:

- Hackers, Solving CAPTCHAs for cash, April 27, 2007.

It's about a guy in Romania who set up a team of 5 guys who worked 12 hours a day to solve CAPTCHAs at a price of $9-$15 per thousand. But read the comments to this blog entry! You'll see people from India, Bangladesh and elsewhere

offering to do the same job for less! For example:

> I am from bangladesh. In bangladesh there is lot of jobless computer known people. We wanna do captcha job. Please guide us on this regards. Please reply.
>
> Have a nice a day.
>
> Thanks
>
> Robin
> abdul815@gmail.com
> +8801713228990
> Dhaka, Bangladesh

If you read a bunch of these comments you won't be at all surprised that the going price for solving CAPTCHAs keeps going down. From the paper cited above:

> While the market for CAPTCHA-solving services has expanded, the wages of workers solving CAPTCHAs have been declining. A cursory examination of historical advertisements on getafreelancer.com shows that, in 2007, CAPTCHA solving routinely commanded wages as high as $10/1,000, but by mid-2008 a typical offer had sunk to $1.5/1,000, $1/1,000 by mid-2009, and today $0.75/1,000 is common, with some workers earning as little as $0.5/1,000.

Your firm can charge more money if you can guarantee that you'll solve the CAPTCHAs quickly:

> For example, suppose that a customer wants to create 1,000 accounts on an Internet service, and the Internet service requires that CAPTCHAs be solved within 30 seconds. When using a CAPTCHA solver, the customer will have to pay to have at least 1,000 CAPTCHAs solved, and likely more due to solutions with response times longer than the 30-second threshold (recall that customers do not have to pay for incorrect solutions). From this perspective, the solver with the best value may not be the one with the cheapest price.

The question of whether CAPTCHAs remain useful as an anti-spam tool is fundamentally an economic calculation:

> Put simply, a CAPTCHA reduces an attacker's expected profit by the cost of solving the CAPTCHA. If the attacker's revenue cannot cover this cost, CAPTCHAs as a defense mechanism have succeeded. Indeed, for many sites (e.g., low PageRank blogs), CAPTCHAs alone may be sufficient to dissuade abuse. For higher-value sites, CAPTCHAs place a utilization constraint on otherwise "free" resources, below which it makes no sense to target them. Taking e-mail spam as an example, let us suppose that each newly registered Web mail account can send some number of spam messages before being shut down. The marginal revenue per message is given by the average revenue per sale divided by the expected number of messages needed to generate a single sale. For pharmaceutical spam, Kanich *et al.* estimate the marginal revenue per message to be roughly $0.00001; at $1 per 1,000 CAPTCHAs, a new Web mail account starts to break even only after about 100 messages sent.
>
> Thus, CAPTCHAs naturally limit site access to those attackers whose business models are efficient enough to be profitable in spite of these costs, and act as a drag on profit for all actors.

October 18, 2010

As I get deeper into the Azimuth Project I may be moving away from a science-based approach towards an engineering-based approach. In science you try to understand the universe; in engineering you try to do something about it.

I've always done science, so that's what I know, not engineering. I'm used to starting with a situation and trying to understand it. It doesn't come naturally to me to say "hmm, how can I make a gizmo that does this?" But it turns out that now, I'm not really motivated by wanting to *understand* the Earth's climate, although it's a fascinating subject. I'm

motivated by wanting to *do something about it*. (Of course you have to understand things to know how to do anything: engineering relies on science. The converse is true too. So they're not really separable. But still, one can be motivated more by one than the other.)

Climate science is tricky. The Earth's atmosphere, ocean and biosphere form a very complex system. The struggle to understand this system has led people to develop the most complicated scientific simulations ever done. It's hard to know if you're getting it right — and almost impossible to convince a skeptic that you're not doing something wrong, or deliberately cooking your results.

Climate engineering may actually be easier. In science you're naturally pulled into studying subtle effects; in engineering you can try to set things up so those effects don't matter much! You can *build in robustness*. In other words, you can make the relevant aspects of the system's behavior insensitive to parameters whose values are uncertain. Then it's more likely to do what you want, even if your understanding is a bit off.

Note: by "climate engineering" I don't mainly mean big scary geo-engineering products. I'm just distinguishing science from engineering. So I mean things like reducing carbon emissions by increasing efficiency, moving away from fossil fuels, and the like. I also mean a whole host of adaptation measures that could allow us to better survive global warming.

Some of these things are good to do regardless of the details of your views on global warming. Focusing on those is a way of building in robustness.

Here's a great example. You can get people to improve energy efficiency and move away from fossil fuels even if they don't believe in global warming, because there are *other reasons* to do these things:

- Leslie Kaufman, In Kansas, climate skeptics embrace cleaner energy, *New York Times*, October 18, 2010.

It's about Nancy Jackson, chairwoman of the Climate and Energy Project:

> The energy experiment started as a kitchen-table challenge three years ago.
>
> Over dinner, Wes Jackson, the president of the Land Institute, which promotes environmentally sustainable agriculture, complained to Ms. Jackson, his daughter-in-law, that even though many local farmers would suffer from climate change, few believed that it was happening or were willing to take steps to avoid it.
>
> Why did the conversation have to be about climate change? Ms. Jackson countered. If the goal was to persuade people to reduce their use of fossil fuels, why not identify issues that motivated them instead of getting stuck on something that did not?
>
> Only 48 percent of people in the Midwest agree with the statement that there is "solid evidence that the average temperature on earth has been getting warmer," a poll conducted in the fall of 2009 by the Pew Research Center for the People and the Press showed — far fewer than in other regions of the country.
>
> The Jacksons already knew firsthand that such skepticism was not just broad, but also deep. Like opposition to abortion or affirmations of religious faith, they felt, it was becoming a cultural marker that helped some Kansans define themselves.
>
> Nevertheless, Ms. Jackson felt so strongly that this opposition could be overcome that she left a job as development director at the University of Kansas in Lawrence to start the Climate and Energy Project with a one-time grant from the Land Institute. (The project is now independent.)
>
> At the outset she commissioned focus groups of independents and Republicans around Wichita and Kansas City to get a sense of where they stood. Many participants suggested that global warming could be explained mostly by natural earth cycles, and a vocal minority even asserted that it was a cynical hoax perpetrated by climate scientists who were greedy for grants.

> Yet Ms. Jackson found plenty of openings. Many lamented the nation's dependence on foreign oil. Some articulated an amorphous desire, often based in religious values, to protect the earth. Some even spoke of changes in the natural world — birds arriving weeks earlier in the spring than they had before — leading her to wonder whether, deep down, they might suspect that climate change was afoot.
>
> Ms. Jackson settled on a three-pronged strategy. Invoking the notion of thrift, she set out to persuade towns to compete with one another to become more energy-efficient. She worked with civic leaders to embrace green jobs as a way of shoring up or rescuing their communities. And she spoke with local ministers about "creation care," the obligation of Christians to act as stewards of the world that God gave them, even creating a sermon bank with talking points they could download.
>
> Relatively little was said about climate.
>
> "I don't recall us being recruited under a climate change label at all," said Stacy Huff, an executive for the Coronado Area Council of the Boy Scouts of America, which was enlisted to help the project. Mr. Huff describes himself as "somewhat skeptical" about global warming.
>
> Mr. Huff said the project workers emphasized conservation for future generations when they recruited his group. The message resonated, and the scouts went door to door in low-income neighborhoods to deliver and install weatherization kits.
>
> "It is in our DNA to leave a place better than we found it," he said.
>
> Elliot Lahn, a community development planner for Merriam, a city that reduced its energy use by 5 percent, said that when public meetings were held on the six-town competition to save energy, some residents offered their view that global warming was a hoax.
>
> But they were very eager to hear about saving money, Mr. Lahn said. "That's what really motivated them".
>
> Jerry Clasen, a grain farmer in Reno County, south of Salina, said he largely discounted global warming. "I believe we are going through a cycle and it is not a big deal," he said. But his ears pricked up when project workers came to town to talk about harnessing wind power. "There is no sense in our dependency on foreign oil," he said, "especially since we have got this resource here".

I think it's ultimately counterproductive to *trick* people into fighting global warming when that's not what they want to do. Condescension is also deadly. People will notice it, and it'll backfire. Instead of saying "you're a hick who doesn't believe in global warming, so I'll get you to fight it without noticing you're doing that", it's better to say right up front: "we may disagree about global warming, but I think we can agree that a wind farm here would be good." By focusing on areas of *agreement* rather than *disagreement* — avoiding the climate change "wars" — it may be possible to make a lot more progress.

And focusing on areas of agreement is a form of "building in robustness".

October 31, 2010

"Transition Towns", also known as the Transition Network or Transition Movement, is a movement that tries to prepare communities for the challenges of global warming and peak oil using the principles of permaculture. The term "transition town" was coined by Louise Rooney and Catherine Dunne. The movement began in Kinsale, Ireland and then spread to Totnes, England in 2005 and 2006 thanks to the help of Rob Hopkins and Naresh Giangrande. By now there are 321 "transition initiatives" in Europe, mainly in England (see map), as well as 8 in North America and 3 in Australia.

- Transition Towns, Wikipedia.
- Transition Network website.

New Economics Foundation, *The Great Transition: A Tale of How it Turned Out Right*, October 19th, 2009.

Quoting from the last:

> *Put bluntly, the dilemma of growth has us caught between the desire to maintain economic stability and the need to reduce resource use and emissions. This dilemma arises because environmental impacts 'scale with' economic output; the more economic output there is, the greater the environmental impact — all other things being equal.*
>
> Tim Jackson, *Prosperity without growth*.

Of course, as Tim Jackson points out in his recent report for the Sustainable Development Commission, all things are not equal. While there is now widespread acceptance of the severity of our environmental position, there is a presumption that growth can be decoupled from environmental impact through more efficient use of resources and through the dematerialisation of economies.

As Jackon argues and as **nef**'s own climate research has shown, there is absolutely no evidence to support this " quite the opposite in fact: the scale of output continues to outstrip efficiency gains and no economies have dematerialised to any meaningful extent or show any signs of doing so. The reasons for this have long been well understood, though largely ignored. The environmental economist Herman Daly put it like this: "The notion that we can save the 'growth forever' paradigm by dematerialising the economy, or 'decoupling' it from resources, or substituting information for resources, is fantasy. We can surely eat lower down the food chain, but we cannot eat recipes..."

It looks increasingly inescapable that we need to stop the growth in output and consumption and even to put this process into reverse . at least until an environmentally sustainable level is reached, taking full account of all potential efficiency gains and renewable energy uses.

The problem is that our economies are entirely geared towards maximising growth. Whilst this may not always succeed, there have been no attempts to deliberately engineer a 'steady-state economy' of the kind that would be needed after the Great Transition.

The Canadian economist Peter Victor is one of the only members of the profession to have devoted any time to this subject — which in itself is astonishing. Victor constructed a macroeconomic model of the Canadian economy, where standard macro variables (e.g., savings, investment, output, consumption, public expenditure) combine to produce outputs (e.g., poverty, employment, debt, GDP per capita, $C0_2$ emissions, etc.), with the relationships based on empirical data from the Canadian economy.

Victor then proceeds to develop a number of scenarios by altering the variables associated with growth — such as investment, for example — and looks at the impact on key variables. The first scenario shows why everyone is terrified of even talking about no longer targeting growth: GDP per capita remains flat and CO_2 emissions fall, but unemployment, debt and poverty escalate alarmingly.

The second scenario is more encouraging, however. As we do in the Great Transition report, Victor assumes an introduction of measures such as shorter working weeks, more publicly funded investment on infrastructure and the provision of high-quality public goods. Here, CO_2 emissions also fall, but so, too, do unemployment, poverty and debt.

This is an important first step, but no more than that. What Victor has done is to adapt standard macroeconomic models, but it is clear that a new modelling approach is needed. Standard models take no account of the use of finite resources and environmental constraints, and are blind to social outcomes in terms of equity and, of course, human well-being.

To make a reality of the sort of society and economy envisaged in this report, such a model is not a luxury

but an essential foundation.

Macroeconomic models are open-ended by nature, with growth being the primary output of interest. Inputs feed in, interact with each other, achieve balance (or equilibrium) and outcomes result. We need to reverse this. That is, to start with the hard outcomes we need: environmental sustainability; equitable social and economic justice; and high levels of human well-being. We then propose to link these to relevant economic determinants within the model (aggregate output, income distribution and working hours, respectively, for example) and to "reverse engineer" what this would imply for the levels and types of differing inputs.

Solving the problem of economic externalities and the production of a working, full-scale and robust model of the 'new economy' are huge tasks. While we clearly could not do these alone at **nef**, we will continue to contribute what we can to overcoming these major challenges.

For my November 2010 diary, go here.

The rising hills, the slopes,
of statistics
lie before us.
the steep climb
of everything, going up,
up, as we all
go down. - Gary Snyder

baez@math.removethis.ucr.andthis.edu

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[For my October 2010 diary, go here.]

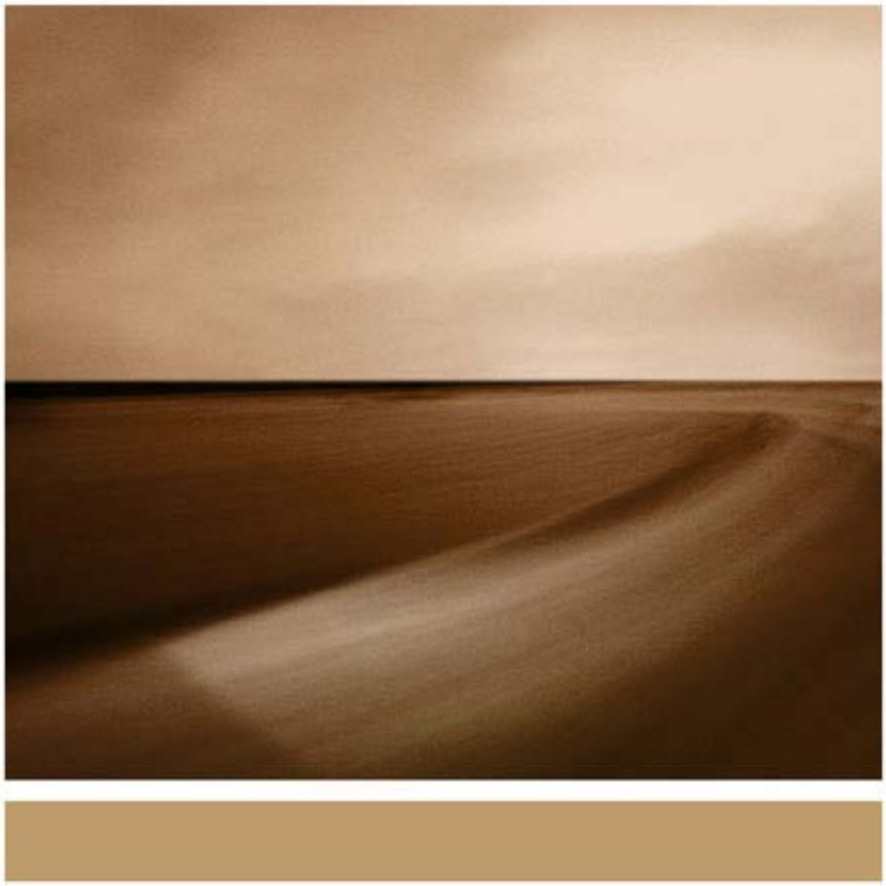
Diary - November 2010

John Baez

November 1, 2010

A view from our apartment at night. The flame at left comes from a refinery burning off waste hydrocarbons. The usual three chimneys are visible only thanks to some dim red lights.

November 3, 2010



Brian Eno has new album out: *Small Craft on a Milk Sea*. You can hear three tunes from it on his webpage. At least you can now; this may change. My favorite of these three is "Emerald and Stone", and indeed this could be my favorite of all the tunes on this album.

Also: check out the joke interview with Eno on Wired.com. I have to tell you it's a joke, because if you don't know that, you may get disgusted after the first minute and quit listening, like I did the first time.

(Can you see who Dick Flash really is?)

November 15, 2010

A nice improvisation by Brian Eno, Jon Hopkins and Leo Abrahams: Written, Forgotten, Remembered.

November 16, 2010

Last night Lisa and I went to Sia Huat, a really good kitchenware and kitchen appliance store at 9 Temple Street in Chinatown here in Singapore. We took the subway to the Chinatown stop and emerged at Pagoda Street, then walked down to South Bridge Road, went one block south and turned back up Temple Street. I can't believe I hadn't seen this area before! Pagoda Street is really picturesque in a touristic sort of way, lined by lots of small shops and restaurants, with red lanterns hanging all over. There's no pagoda there... the street is named after an impressive Hindu temple whose main entrance is on South Bridge Road, the Sri Marianman Temple. If you're in the vicinity, go and take a look inside!

We bought a bamboo steamer, a metal apparatus for supporting something in a wok, a pair of scissors, and a bunch of glasses. Then we looked for a restaurant. We found a shop that sold Szechuan opera masks, and we bought three, which now decorate our dining room. We asked the shop owner for a good local restaurant, and they told us to try Yum Cha. We went there, but it turned out to specialize in dim sum, not optimal for dinner. So, we looked around a bit more and

found a Hunan/Singaporean place called Tang's Restaurant on 53 Temple Street. It's new, so they didn't have many customers, but it was great! Try the pork cooked with coffee... very unusual, very tasty. Also pork with sliced sour long beans, and a bitter melon omelette. Yum!

November 24, 2010

Nurd Kamal mosque, Norilsk

Anatoly Karlin runs a number of very entertaining blogs with a very strong Russian intellectual flavor. He seems like the sort of guy who would completely dominate a conversation with his wit and unorthodox theories, and become utterly unbearable after 2 or 3 fascinating hours. Luckily, with a blog you can take a break whenever you want!

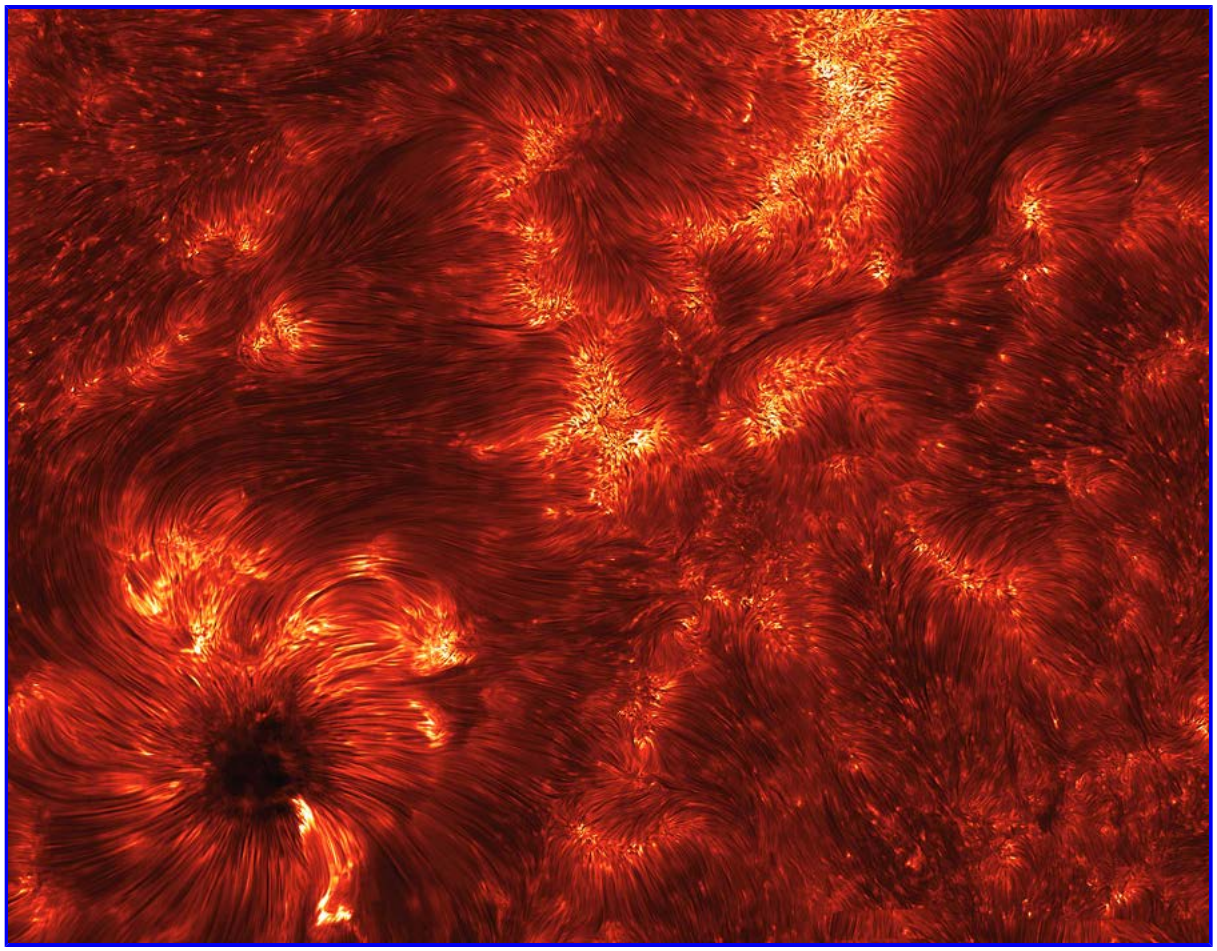
I recommend these articles:

- China, the last superpower.
- Ecotechnic dictatorship is our last hope of averting collapse.
- Introduction — why Arctic Progress?

November 25, 2010

Amazing machines, pointed out by Graham Jones:

November 26, 2010



For my December 2010 diary, go here.

All is clouded by desire, Arjuna — as fire by smoke, as a mirror by dust. - Krishna, in the *Bhagavad-Gita*

baez@math.removethis.ucr.andthis.edu

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For my November 2010 diary, go here.

Diary - December 2010

John Baez

December 1, 2010

If you stare hard you can see the usual three chimneys. This photo was taken when Singapore was shrouded in haze from dozens of fires in Sumatra. For about a week, the air quality was really bad.

December 8, 2010

It's interesting to see what Julian Assange, the head of Wikileaks, thinks he's doing:

- Zunguzungu, Julian Assange and the Computer Conspiracy; "To destroy this invisible government"

For a thorough listing of the new Wikileaks revelations, including some that you don't tend to see on American media, try:

- WikiLeaks embassy cables: the key points at a glance, *The Guardian*.

December 3, 2010

Lisa and I went downtown and had dinner in Clarke Quay. Sitting in a bar overlooking the river after dinner, we saw what appeared to be a UFO swooping and diving amid some trees across the river. We crossed a bridge and walked over to the vacant lot next to the Swissotel, and saw that in fact there were a number of these flying, glowing things. They turned out to be RC kites: radio-controlled, propeller-driven kite-like aircraft, lit up with LED lights. Some kids were

making them fly complicated maneuvers, and they jokingly dive-bombed Lisa and me as we stood there gawking, without actually hitting us. They were standing in this field:

It turns out there's a fad for RC kites in Singapore, which was started by a guy named Michael Lim. He is now about 60, but he is still flying RC kites, and we think we saw him out there in that field, flying the biggest and best one.

There's something peculiarly Singaporean about this. Most of the RC kite fliers were teenage males, and rap music was blaring out of an industrial-strength speaker system — a situation I associate with unruly youthful rebellion. But the undisputed master was this guy who looks like, and probably is, a retired businessman. This and other things, like the mix of races involved (both Chinese and Indian), quickly made the situation seem a lot less threatening that it did at first. And that's Singapore for you.

Here's video made at this location. It starts out focused on the bar Lisa and I were in, and then pans around to the woods full of RC kites:

December 9, 2010

Marko Galac posted these photographs of artworks in the rapidly transforming downtown of Shanghai.

December 11, 2010

Tonight, Saturday night, we saw LED kites outside our apartment window, like glistening insects flying in front of the chimneys that have graced the top of every diary page for the last few months. I guess we hadn't noticed these until we were sensitized by last weekend's encounter with the RC kites! But this time what we saw were actual kites, lit by LED lights and flown at night.

(It later became clear that they come out every Saturday, down at the park by the sea.)

December 12, 2010

The day before yesterday, Lisa and I watched the Nobel Peace Prize ceremony, with the head of the Nobel Committee, Thorbjorn Jagland, giving a fiery speech, and Liv Ullmann reading Liu Xiaobo's remarkable closing statement from his trial: I Have No Enemies: My Final Statement. You can watch it here, and I hope you do.

Now a friend is visiting us. She came from Beijing. She was surprised and pleased to find that in Beijing, many people were criticizing the government for their absurd reaction to Liu Xiaobo's prize. Taxi drivers. Artists at parties... not just whispering, but openly complaining. So, while the authorities can carry out their crackdown, it is not working.

December 23, 2010

Here are some interesting reflections on the Wikileaks case and cypherpunk culture:

- Bruce Sterling, The Blast Shack, December 22, 2010.

December 24, 2010

Happy Holidays! Lisa and I are taking off for Vietnam tomorrow. We'll spend seven days in Hanoi and five days in Huế, which was the imperial capital of the Nguyễn Dynasty until 1945. In Hue we'll be staying with our friends Gene and Barbara Anderson. We'll be staying in the Heritage Hotel, right across the Perfume River from the citadel and imperial palace.

View Larger Map

For my January 2011 diary, go here.

Move the needle of your radio receiver along the short-wave band. Between the foreign voices and the alien anthems crowding the invisible frequencies, there stretches a deep gulf. The gulf is filled with an enormous hissing, and sometimes with a prolonged, humming blaze, like wires stretched between the stars.... You are listening perhaps to what the Hindus call ākāśa: *the dark which has no end.* - Christopher J. Koch

baez@math.removethis.ucr.andthis.edu

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