Compression

Extended Footnotes

By Robert W. "Doc" Hall

Introduction

Although this set of footnotes is long, documenting every statement in the printed book proved impossible. A great deal of additional research is not in either the book or the extended footnotes. Original sources were preferred to secondary sources reporting about them, but some originals could not be found. One could only get as close to facts as possible. Many topics cited are fast moving, so some citations were obsolete as the book went to press. In addition, web page references are not fixed, but subject to revision, moving of servers, and deletion. URLs cite the location where a reference was last seen.

To participate in ongoing "Compression Thinking," see: http://www.compression.org

Some footnotes covering a page or more are background commentary adding depth to topics in the printed text. Readers are invited to do their own digging, looking for original sources and data. Readers familiar with environmental sustainability will notice that the book does not rely on some familiar references or touchstones. I deliberately followed no well-worn trails researching that topic and most others. You are invited to do the same.

Conclusions reached are certainly outside conventional business thought, and somewhat outside the patterns of thinking that seem to be jelling as conventional environmental thought. So please do your own thinking based on facts as best you can determine them. We need a lot of dialog on Compression. We do not need PR "stealth bomber" wars between web sites, articles, and books merely blowing opinion back and forth.

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Chapter 1: Understanding the Challenges of Compression

1 Thomas Malthus penned "An Essay on the Principle of Population" in 1798. He posited that since resource growth was linear, but population growth exponential, humans would periodically outgrow their resources, followed by collapse. Malthus did not foresee the industrial revolution letting resource use grow "exponentially" for a couple of hundred years. In 1968 Paul Erlich's *The Population Bomb* made specific short-term predictions of collapse that were discredited when they did not materialize. In 1972 the Club of Rome projection, *The Limits to Growth*, did not do that, but was accused of it. In 2008 Graham Turner, "A Comparison of *The Limits to Growth* with 30 years of Reality," found that the Club of Rome projections were not far off track. Critics can't bear to think of this. The most noted critic, the late Julian Simon, basically argued that since economic expansion had never stopped, it never would—linear projection taken to an extreme.

Nicholas Georgescu-Roegen, a pioneer in "thermoeconomics," did not make specific run-out or doomsday predictions, noting that specific projections using "crossover" models assume incorrectly that one can deterministically project the amount of recoverable resources, global carrying capacity, and resource consumption rates. However, no state is permanently stable; all nature, including human-influenced processes, is not deterministic, but can sometimes flip from one near-stable state to another. Timing of flips may be difficult to predict. Hence run-out predictions can only be roughly approximated. Georgescu-Roegen was criticized for stretching the applicability of the second law of thermodynamics postulating how human activities can tip the balance of natural processes in a direction unfavorable to survival of part of the human population. After all, both economic and climatic changes have always doomed a fraction of the global human population. Unfavorable shifts merely increase that doomed fraction, and if drastic, include all of it. (Readers can glimpse his work at: www.eoht.info/page/Nicholas+Georgescu-Roegen and read one of his papers at:http://dieoff.org/page148.htm)

The definition of Compression in this book is operational. Therefore it's arbitrary. However, without setting goals that we can fix in mind and work toward, we'll dither with half-measures while debating resource limits and climate shift points that cannot be pinpointed. Plenty of carbon economics proposals have been floated; see for example the variety identified by Climate Changes at www.economicsclimatechange.com/ Nearly all of these concentrate on modifying current financial and economic systems to drive environmentally sustainable behavior. By contrast, this book proposes setting up physical state goals as drivers; then modifying business models to attain those goals.

2 According to the U.S. Geological Survey, global iron reserves are many times current production, but ores are becoming lower in grade. For U.S. iron ore reserves see: (http://minerals.er.usgs.gov/minerals/pubs/commodity/iron_ore/feoremcs04.pdf)
Global copper: (http://minerals.er.usgs.gov/minerals/pubs/commodity/copper/240303.pdf)
Platinum group: (http://minerals.usgs.gov/minerals/pubs/commodity/platinum/550300.pdf).

That is, reserves exist for older common commodity metals, but they are harder to mine. Reserves of materials like tantalum exist, but their location and conditions under which they are taken incur protest, particularly in the Democratic Republic of the Congo. "Back page" news articles on this are not hard to find if you Google the subject.

Interestingly, statistics on uranium ore sources do not appear to be publicly available from USGS, at least not from the open list at http://minerals.usgs.gov/minerals/pubs/commodity. However, the Earth Policy Institute claims that global uranium ores have decreased in concentration from 0.28% to 0.09%, which may be a bit low; old mining lore is that the acceptable concentration is

0.7%. Uranium often concentrates in nodules, so a few nodules may be rich in U3O8, but an entire site is not. Quaterra Resources claims to have hit several holes (Braccia pipes) on an 85 square mile property near the Grand Canyon with U3O8 concentrations ranging from 0.34% to 0.63%. The site is near old uranium mines that were well worked in the 1950s. Some were on the tribal grounds of the Navaho Nation, which has banned further uranium mining on Navaho territory, described as the "Saudi Arabia of uranium," although bigger deposits are in Australia. The reasons: Many Navaho miners died in the early days of mining from inhaling dust, and now tailings from many abandoned mines present a continuing risk to the Navaho Nation (see Tom Zoellner, *Uranium*, Viking, New York, 2009, pp. 170-172; much of the book is on the sorry history of uranium mining). Since Quaterra's new finds are near the Grand Canyon, their proposal to mine there met great opposition from environmental groups and naturalists concerned about further upsetting the ecology (and beauty) of the Grand Canyon National Park. According to the Associated Press, the Obama administration was preparing to "segregate" Federal lands to block the development of all mining claims in the area ("Interior to Halt Uranium Mining," July 20, 2009).

Technology and energy required to exploiting remaining reserves of uranium and other minerals is only part of the problem of recovery. For example, according to Paul VanDevelder, "What Do We Owe the Indians?" *American History*, June 2009; 65% of the United States' known uranium reserves are on Indian land. So are 40% of its coal reserves, 20% of its sources of fresh water, and rich deposits of copper, zinc, and petroleum. Indians will resist tearing up more of their land obtaining these things. Bill Yellowtail is quoted as saying, "The battle of the 21st century will be to save this planet, and there is no doubt in my mind that this battle will be fought by native people. For us it is a spiritual duty."

Mining and refining metals uses a lot of energy. Obtaining them from less and less concentrated sources takes more energy (and cost). Avoiding or restoring ecological damage takes even more energy. People want commodities if they do not live near locations where the stuff is mined or smelted. An example is the uproar in West Virginia about "mountaintop surface mining" of coal. Normally, the most concentrated ores are found and worked first, while the industry seeks more efficient technology to mine and refine lower-grade ores. However, at some point the physics of gathering energy from more dispersed sources requires a lot of energy using any technology, and potentially leaves more environmental damage. In addition, mining and extraction often entail ugly chemistry with the potential for long term effects from emissions and effluents.

Now and then, media snippets suggest that mining can be made environmentally friendly by methods like using bacteria to concentrate metals. Bacteria are now used to promote oxidation of gold or copper ores, which concentrates gold before further processing, but a process merely made less damaging is still far from environmentally benign. For example, lactobacillus bacteria are proposed to concentrate uranium from ores, tailings, or even seawater (Takehiko Tsuruta, "Removal and Recovery of Uranium using Microorganisms from Japanese Uranium Deposits," *J. of Nuclear Science and Technology*, No. 8, 2006, pp 896-902).

3 "Hubbert's Peak" is named after the late petroleum geologist, M. King Hubbert, who first projected the peak of American oil production in 1949. He presented a formal paper in 1956 estimating that oil production would peak in the early 1970s. The actual peak occurred in 1970. (I first heard of Hubbert from Jim Donnelly, a technological forecaster at Socony-Mobil Oil Company in 1964, but never thought more about him for decades. In the 1960s peak American oil was as disputed as peak global oil today, so Socony-Mobil concluded that control of oil might shift to the Middle East. Therefore it hedged its bets by increasing drilling outside the Middle

East.) As it became apparent that finding new global petroleum reserves was not keeping up with increasing demand, attention turned to projecting "Hubbert's Peak" for global oil production.

Peak oil is not a run-out point, like draining oil from a tank. It's the point at which the pumping rate from a field reaches peak because it can't be coaxed out of it's crevices any faster, so increasing pumping rate to meet higher demand becomes infeasible. That is, oil fields cannot support increasing demand indefinitely, and without new reserves being found at a rate that matches increasing demand, eventually growth in demand cannot be met. That's peak oil.

Key papers by Hubbert can all be found at www.hubbertpeak.com

His 1949 paper in *Science* is at: www.hubbertpeak.com/Hubbert/science1949/

His 1956 projection of peak American oil, "Nuclear Energy and the Fossil Fuels," is at: www.hubbertpeak.com/Hubbert/1956/1956.pdf This paper was presented at at an American Petroleum Institute meeting in San Antonio. In it, Hubbert discussed global peak oil, peak gas, and peak coal and projected that nuclear power would take over when fossil fuels faded away.

Hubbert's Peak applies to all fossil fuels, not just petroleum. Hubbert researched them all and nicely summarized his work in testimony before Congress in 1974. His testimony can be seen at: www.energybulletin.net/node/3845. He was not understood, and was ignored. He wrote a number of papers on a post-fossil fuel economy that are referenced at the hubbertpeak.com site. However, the author's conclusions in this chapter were reached before finding that Hubbert and others had reached similar far ranging conclusions 50 years earlier, and without considering the other major challenges that have become apparent since then!

The Association for the Study of Peak Oil (ASPO www.peakoil.net) became the European pioneers projecting peak oil for the world – and regarded as industry doom seekers for doing so. The primary graphs summarizing ASPO projections are at www.peakoil.net/uhdsg/Default.htm. No one knowledgeable claims to project the timing of peak oil with great precision. Data on reserves are "flakey," often exaggerated for negotiating purposes. However, reserve estimates from Western oil companies are regarded as the most "conservative." British Petroleum's global reserve estimates are considered to be one of the more "honest" data sets. (To see BP data go to: www.bp.com/subsection.do?categoryId=9023761&contentId=7044545 and "drill down" under oil reserves.) That the United States has only 2.4% of the world's "proven reserves" is usually an eye opener for Americans. Reported finds with millions of barrels sound big, but not compared with reserves elsewhere, but every find is ballyhooed. And of course future market demand is iffy to forecast.

Energy Information Administration projections, based on different methodology from Hubbert and generally regarded as overly "rosy," projects a peak anywhere from 2021 to 2112, depending on growth in demand. The history of peak oil projections is that they usually underestimate the reserves that can be brought on line, while the "optimists" overestimate them. None of these projections consider whether pumping a lot more CO_2 in the air is advisable for environmental reasons. Now that peak oil has entered public discussion, one can easily find many books, references, and points of view from an internet search.

4 Around 3 percent is estimated by the German Chemical Industry Association, but about as much energy is used to process the feedstock as is potentially in the feedstock, so total usage is closer to 6 percent.

5 The estimate for the first gushers is a rough guess bandied by Deffeyes, Odum, and others. See Kenneth S. Deffeyes, Hubbert's Peak, Princeton University Press, Princeton, NJ. (His Chapter 5 explains as much about oil drilling and recovery as those outside the industry care to know.) Also see Howard T. Odum, *Environmental Accounting, Emergy and Decision Making*, John Wiley, New York, 1996. The estimate for the Canadian Tar sands was made personally from press articles about it. That a third of the BTUs expected from the oil are burnt in the natural gas used to make it flow is acknowledged, but much more energy is used moving sand, and so on. No source found claims a clear grasp of the energy return from working either oil sand or heavy oil deposits, as in Venezuela.

Both the Alberta and Venezuela deposits are "making money" when oil is above $60 a barrel, but heavy oil also has significant contaminants to remove, so refining it takes more energy. Reserves in both Alberta and Venezuela are substantial, but no credible source found projected energy return ratio curves into the future for either one. Instead, managers seem to rely on conventional accounting, which is misleading. If cheap energy is used to extract expensive energy, they make money from poor thermodynamic yields. Energy yields close to 1 make projecting fossil fuel reserves dicey. (Forty years ago, I reviewed prospects for Colorado Oil Shale (Green River) and concluded that more energy would be used to work the shale than would be extracted from it. Methods have undoubtedly improved since then, but the basic physics of having to use energy to concentrate dispersed energy do not change.) Neglect of energy yields not only leads to fruitless debate between Pollyannas and pessimists on energy reserves, it fosters speculative ventures chasing mirages.

6 Many small-to-medium sized reserves may be added in the future, but according to Deffeyes, the only prospect of a size close to Saudi's Ghawar (their biggest field) is in the South China Sea; it's been known for decades, but not explored because at least six countries have conflicting claims there (p. 9). Smaller finds shift the date of peak oil production very little. However, as was the case with Hubbert's original projection for the US, global production is likely to tail off more slowly than the present status of reserves suggest. First to deplete are the low-sulfur, "light crudes," prized for being easy to refine. According to ASPO, unworked reserves are more likely to be "heavy crudes" requiring more refining, therefore less energy efficient.

According to Matthew Simmons (*Twilight in the Desert*, John Wiley & Sons, Hoboken, NJ, 2005), the Saudi fields are already at or near peak, and their reserves have probably been overstated. Exaggerated reserve claims are a big part of ASPO's case; Aramco engineers at meetings talk about secondary recovery, in contrast to official claims of plenty. One area not subject to satellite imaging is oil under the melting polar caps. Initial claims were that as much as 400 billion barrels are in reserve there, enough to add at least a third to global reserves: Randy Boswell, "Vast Oil Potential in Arctic, New Data Says," Canwest News Service, March 20, 2008. Later estimates whacked this to 90 billion barrels (a three-year supply at a global demand level of 30 billion barrels a year). It's not a whopping addition to about 1.2 trillion barrels of global oil reserve, a 40-year supply at the current demand rate, but how difficult will it be to get this oil, and at what pumping rate?

7 A number of well-reasoned articles (and less-reasoned ones) can be found at ASPO's web site, www.peakoil.net/ Probably the best technical explanation, understandable with minimum effort by non-technical readers, is Kenneth S. Deffeyes, *Hubbert's Peak: The Impending World Oil Shortage*, Princeton University Press, Princeton, NJ, 2002. Deffeyes was a working colleague of M. King Hubbert, who died in 1989. He has his own peak oil methodology, which pegged 2004

as the peak year, but recently has agreed with the Uppsala Group consensus on more like 2008. A book that explains the implications of peak oil more extensively is Richard Heinberg, *The Party's Over: Oil, War and the Fate of Industrial Societies*, New Society Publishers, British Columbia, Canada (800-567-6772). Heinberg is a journalist and environmentalist. Possibly the best known overview article is Colin J. Campbell and Jean Laherrere, "The End of Cheap Oil," *Scientific American*, March 1998. pp. 78–83. A related theory by Duncan, that global energy use per capita is declining, could not be corroborated using global energy use data from BP Statistical Review of Energy, 2004.

8 The only known comprehensive attempt to project a global peak for natural gas is Jean Laherrere, "Future of Natural Gas Supply," paper presented at the ASPO 3rd International Workshop on Oil & Gas Depletion, Berlin, May 24–25, 2004. Laherrere is a French petroleum geologist, and his paper is huge: 112 figures and tables. He concluded that U.S. natural gas production is already near a peak, and that the global peak would be around 2030, and sooner if natural gas is drawn down faster to replace diminishing supplies of oil. Natural gas imports into the United States have been holding steady at about 15-16 percent of annual demand.

A 2007 study of "peak coal," made long after Hubbert did his projections, is *Coal: Resources and Future Production*, Energy Watch Group, EWG Paper No. 1/07. It was found at www.energywatchgroup.org/fileadmin/global/pdf/EWG_Report_Coal_10-07-2007ms.pdf. It projects a global peak in about 2025 (page 7), based on demand projections and downward restatements of coal reserves over the past few decades. They claim that the direst situation is China, which has half the reserves of the United States, but is gobbling them up at twice the production rate.

9 For example, unrest simmering in Nigeria finally bubbled onto the radar screens of oil and gas traders, and into the mainstream press in 2006: Jad Mouawad, "Violence in Nigeria Sends Oil Prices Higher," *New York Times*, Feb. 21, 2006. That situation has not improved in the past two years; production is still down. Traders still seem irrationally sanguine about supplies from Venezuela, Bolivia, Indonesia, Saudi, Iraq, Iran, Uzbekistan, or Libya. Russia obviously uses its oil and gas supplies for political leverage. In 2004 the Russian Federation made its oil and gas reserves a state secret, but one poorly kept. Exact locations are kept secret by the Russian disinformation apparatus. It is not just the location of fields that is critical, but the location of existing and proposed pipelines and sea lanes that bring supplies to the global market. Knowing these locations helps explain much of the context of current global politics, and even piracy is not a bygone geopolitical threat.

10 "Biofuels in the U.S. Transportation Sector," Energy Information Administration, DOE, Feb. 1977, at www.eia.doe.gov/oiaf/analysispaper/biomass.html. Ethanol production alone consumed 20 percent of the U.S. corn supply in 2006, when ethanol amounted to slightly over 4 percent of gasoline consumed. By recent methods, totally replacing gasoline with corn-based ethanol would consume more than the entire U.S. production of corn. Well-publicized cellulosic sources such as switchgrass can be grown on ground unsuitable for other crops, and they can be converted to fuel using enzymatic breakdown rather than heat. That makes them attractive if such native grasses are tended as a crop, according to Schmer, Vogel, Mitchell, and Perrin, "Net Energy of Cellulosic Ethanol from Switchgrass," Proceedings of the National Academy of Sciences (PNAS), Jan. 15, 2008. However, the authors used Net Energy Value, not Net Energy Yield and based estimates on preliminary findings from experimental growth of crops. Their projection that 500 percent more energy can be derived from this than is used to produce it is well above yields derived from actual

production of other biomass for alternative energy. Many other proposals have been made, from producing ethanol as a by-product of a diversified farming operation (better overall yield from the sun) to producing ethanol from kelp also used to clean up the pollution in "dead zones" at the mouths of rivers (see: www.alcoholcanbeagas.com/)

Projects to factory-farm specialized algae promise to produce fuel using only 4 to 20% of the growing area of conventionally grown corn, and claim that oil yield from algae exceeds that of the best-yielding oil seed (palm oil) by as much as twenty times, but no source found disclosed a total process energy yield. The most publicized algal effort is a venture of Craig Venter with Exxon in the San Diego area ("ExxonMobil Fuels Venter's Efforts to Run Vehicles on Algae-Based Fuel," *Science*, July 24, 2009). However, the major oil companies to not see alternative fuels as mainline processes (Jad Mouawad, "Oil Giants Loathe to Follow Obama's Green Lead," New York Times, Apr. 7, 2009) The sites http://sustaintechs.com/ and http://biofuelsdigest.com/ encapsulate all kinds of companies and approaches to alternative materials and energy sources; and www.oilgae.com/, a proponent of algal fuels, cites many references on this technology. The entrepreneurial optimism of many of these commercial ventures suggests that investors are betting on technical magic to avoid having to make many changes in business thinking or consumptive life styles, while the theme of *Compression* is that for many industries, substantial change in "business models" will be necessary, and the fall out will affect all of us.

One of the more comprehensive reviews of alternative energy – more than can be discussed in this book, but primarily addressing the UK and Europe, is David MacKay, *Sustainable Energy – Without the Hot Air*, UIT Cambridge Ltd., Cambridge, UK, 2009. It can be read on line at www.withouthotair.com/, and MacKay has a blog at http://withouthotair.blogspot.com/ It's an objective review covering ideas not prominent in normal American media, including the possibility of adsorbing uranium from the ocean (a Google search unearths several proposals for this), and DESERTEC, using direct current to pipe energy from solar collectors in the Sahara to Europe. However, MacKay ignores the American excitement about fuel from algae, which apparently has not yet excited Europeans. The debates on uranium from the ocean have begun; proponents refer to it as the salvation of nuclear energy, while detractors like David Fleming (*The Lean Guide to Nuclear Energy*, on line) estimate that the energy yield would be less than 1. One route to improving the yield of this is using bacteria or seaweed so that nature begins the concentration process, and so the search goes on.

11 Robert F. Service, "Framework Materials Grab CO_2 and Researchers' Attention," *Science*, Feb. 15, 2008. Technologies capable of absorbing CO_2 exist, but managing production of efficient absorbers, and managing this absorption process on a big scale presents, well, another big dimension to the problem.

12 Commercial PV cells are now 15–20 percent efficient converting solar energy to electricity; their energy yield is still below 1. Lab development has created cells up to 42.8 percent efficient, and 50 percent is the goal. Whether these cells can be made and installed so efficiently that they have a high lifetime energy yield is not known. See: "Consortium Achieves Record-High Solar Cell Efficiency," *Newswise*, July 24, 2007, at www.newswise.com/p/articles/view/531808. Solar absorbers that convert sunlight directly to heat have been made at better than 50 percent conversion efficiency, adequate to heat water, but marginal if the heat must be further converted to electricity.

As for the promise of nuclear fusion, for nearly six decades it has been deferred for about 30-40 years into the future. So far no fusion reaction has been sustained very long, and when it has the

energy yield is still below 1. A good review of the history of nuclear fusion is Charles Seife, *Sun in a Bottle*, Viking, New York, 2008.

13 The severe consequences of diverting food crop ground to growing fuel are already being felt, or so it is alleged; and much more in Asia and Africa than in the United States. Asian and African news have reported food shortages to the poorest of people because of high prices for wheat and rice. An example is "Manila Rice Pleas a Wake Up Call for a Hungry World," Reuters (in the *Daily Times*–Pakistan), Feb. 28, 2008. President Arroyo of the Philippines directly contacted Prime Minister Dung of Viet Nam to see if he could pledge to deliver an undisclosed quantity of rice. It was the first time in decades that a political intervention in markets was attempted to alleviate projected shortages. When hoarding and speculation spiked prices above that which the poor could pay, and above the budgets of food aid agencies, food riots broke out in a number of places. Then governments felt compelled to short-circuit markets.

Classical economic thinking is that market incentives can induce planting more rice, but grain reserves are dropping. If production capacity drops below demand, this situation will balloon into a world crisis. Little of this was ballyhooed in the mainstream American media, where the news was that higher food prices meant better times for farmers, but a crimped standard of living for low-income Americans. However, if starving people see market prices of food soaring beyond their reach, they certainly won't wait patiently for a market bust to save them. Taking a narrow home market view of the global food supply is a dangerous game of beggar-thy-neighbor.

14 Leo Horrigan, Lawrence S. Wallace, and Polly Walker, "How Sustainable Agriculture can Address the Environmental and Human Health Harms of Industrial Agriculture," *Environmental Health Perspectives*, May 2002. They noted that the average US farm uses about 3 calories of energy to grow 1 calorie of food energy, based on earlier studies by David and Martha Pimentel (*Food, Energy, and Society*, U. Of Colorado Press, 1996), but Pimentel pads energy usage figures, and these vary considerably by crop. For example, a bushel of corn contains about 381,000 BTU (Penn State Agricultural Department: http://energy.cas.psu.edu/energycontent.html) while the USDA estimated that 57,476 BTU are expended on average to grow it by industrial methods (Table 4 in www.usda.gov/oce/reports/energy/aer-814.pdf), so that is roughly a 6-fold energy yield in the field. Since processing and transport require more energy and not all grain that is grown reaches a mouth, the total fertilizer-to-mouth process for corn can have an energy yield well under six. Change the crop and transport it a long distance, like cranberries from Chile, and energy yield on the food eaten can easily be negative. That's certainly true of celery, with nearly zero calories and high water content. Feeding corn to animals cuts its yield considerably too, but how much is subject to much dispute. Measurements are coarse, ratios are hardly significant to two digits, and analyses may be biased to support a preconception, but many of them conclude that the food energy yield from the modern food system is low. More energy may be derived from a biomass if it is burnt directly for fuel, but using fuel energy to grow it cuts its overall energy yield.

The approximated data and computations bandied about to dispute the merits of ethanol illustrate the point. Discrepancies between tables from the Energy Information Administration are not easy to reconcile, but from Table 10.3 at www.eia.doe.gov/aer/renew.html, estimates that ethanol *production* in 2008 was 9.237 billion gallons. That's 6.467 billion gasoline-equivalent gallons. In 2007 (no figures for 2008) total gasoline consumption was 140.6 billion gallons (which declined slightly in 2008). So ethanol was about 4.6% of total gasoline-ethanol motor fuel consumption, not counting diesel.

According to university agricultural extension services (www.extension.org/pages/Corn_Ethanol_Production), corn yield is about 151 bushels per acre, with about 2.8 gallons of ethanol per bushel. From USDA about 86.5 million acres of corn were planted in the U.S. in 2007. Working through this, if *all* the corn crop were used for ethanol, it would amount to 18-20% of just the present gasoline usage. The same service estimates that by present methods, ethanol produced from corn has an energy yield of 1.34, which accords with the author's rough computations. If the energy inputs were reduced by enzymatic distillation of ethanol (little heat), it might go up as high as 2.0. Given the enthusiasm and subsidies for ethanol at present, some of the claims by proponents seem pretty wild, as do those of the most adamant opponents. It should be apparent to even the most ardent proponent of alternate fuels that replacing even the hydrocarbons that the U.S. imports with alternatives (wind, solar, high-energy crops) is daunting to say the least.

15 Space prevents giving this subject the attention it deserves. The world grows enough food at present, but not enough where people want to eat it. The world's "official" source of global food information is probably the Food and Agriculture Organization of the United Nations (FAO). The statistics are kept at http://faostat.fao.org/ According to the latest 2008 FAO update, the most urgent problem (and controversy) is that grain price volatility makes it very difficult for regions short in both food and money to buy enough grain to stave off disaster. This was a big issue in 2008 and may not have abated. Food shortages are interlocked with all the challenges of Compression. Besides FAO, groups like Worldwatch have long maintained global statistics on the environment and all types of food: www.worldwatch.org. (Statistics summarized at "Vital Signs," www.worldwatch.org/taxonomy/term/39.)

16 One of the more comprehensive critiques of hydrogen as a fuel is Joseph J. Romm, *The Hype About Hydrogen*, Island Press, Washington DC, 2004. The author's personal observation is that technicians with long experience dealing with hydrogen production, handling, and use generally come to respect its shortcomings, as well as its great potential. Craig Venter's Institute for Biological Energy Alternatives (famed for sequencing the human genome) is experimenting with bacteria to generate hydrogen. Biological researchers are working on low energy routes to generate hydrogen directly from solar energy (artificial photosynthesis). A truly novel breakthrough is necessary to commercialize hydrogen on a large scale and with a high energy yield.

17 Jared Diamond, *Collapse*, Viking, New York, 2005. Many of Diamond's cases of collapse are islands or settlements, not as imperial in size and scope as the Roman Empire, but he cites the rise and fall of the Maya and the Anasazi as following a pattern of imperial rise and fall. Of course, many human factors are tangled in each story; were they clear, simple energy stories, people would have easily seen disaster signals and changed course. Dr. Chris Stevenson has expanded on Diamond's contention that the Easter Islanders perished by overusing the resources of the island. Stevenson contends that a reduced number of Easter Islanders did adapt to diminished resources and survived until decimated by European diseases in the 1800s (*Science Daily*, Feb. 18, 2009).

18 Joseph A. Tainter, *The Collapse of Complex Societies*, Cambridge University Press, Cambridge, UK, 1988. Tainter concluded that as empires expanded, they became more complex. The administrative energy and military mojo had to increase to run something made more and more complicated by huge geographic spread. When these systems deteriorated, they were

eventually displaced by simpler, more vigorous social organizations that spent more of their free energy gathering energy to sustain themselves.

19 Peter Turchin, *War and Peace and War*, Plume (Penguin Books), New York, 2007.

20 Water exists on other planets or their moons. Water is a major component of many comets. Water from outer space, older than the solar system, has been discovered in meteorites. Satellite photos show multiple hits of water vapor trails hitting earth daily. Where it comes from is unknown, but the constellation Orion has been estimated to pump out enough water molecules each day to fill earth's oceans sixty times over. From Marq DeVilliers, *Water: The Fate of Our Most Precious Resource*, Mariner Books (Houghton-Mifflin), New York, 2000. The intriguing possibility that water on earth accumulated from outer space periodically resurfaces in scientific magazines, but no one is known to have formed a testable hypothesis for it.

21 Percentages from U.S. Geological Survey: http://ga.water.usgs.gov/edu/earthwherewater.html, and originally from Gleick, *Water Resources*, 1996.

22 According to the British Pump Manufacturers Association, www.bpma.org.uk

23 One of the few foreign cases much publicized in the United States was in Cochabamba, Bolivia. The gist of this story is in the archives at *Source Water and Sanitation News*, www.irc.nl/page/2082. The traditional ways of using water have shifted enough that it appears that Cochabambans are drawing too much water, and privatization was supposed to both conserve water and improve its quality. Evo Morales, one of the protest leaders, later became the president of Bolivia, and an opponent of oil and gas contracts with corporations.

One of Bechtel's accounts of this (there are several) was found at www.bechtel.com/2005.html. Subsequently, water shortages spread to many parts of Bolivia, including the capital LaPaz. For instance, according to Rory Carroll and Andres Schipani, "Bolivia: Water People of Andes Face Extinction," *Guardian* (UK), April 29, 2009, the ancient village of Uru Chipaya believes its very existence is threatened after thousands of years by two causes: 1) climate change and 2) Aymara communities living upstream diverting too much water from them. (Uru Chipaya is believed to be older than the Inca Empire, much less the Spanish conquest.) A Google search will unearth many more such dire reports. A more typical, local story also out of global attention is by Alameen Templeton, "Arrears Write-Off Mired in Controversy," *Johannesburg Star*, May 5, 2005. A municipal water system installed water meters as a first step toward privatization. Although the poor, once identified, would be exempted, Soweto residents ripped meters from their residences to protest paying for water which they thought should be free as a basic right to all people.

24 Most American books on water crises mention over-pumping the Ogallala Aquifer, actually a set of aquifers stretching from Texas to the Dakotas. Web rants range from alarmist to claims that restricting water use is a liberal plot, but systems are in place to deal with the problem. For example, see the site of the Texas Alliance of Groundwater Districts: www.texasgroundwater.org, which has sixteen regional water planning districts covering nine aquifers. The region has had periodic droughts, and the last big one resulted in the Dust Bowl of the 1930s—before electric submersible pumps and the big crop circles of today. The doomsday forecast is that decreased precipitation in the region will not let the aquifers recharge at the rate of drawdown, especially if the population served continues to increase. Agricultural irrigation is the major use of water, and

in the United States, growing grass uses more water than any other crop ("Greener Grass; Less Water," *Science Daily*, April 1, 2006: www.sciencedaily.com/videos/2006/0404-greener_grass_less_water.htm)

25 A Western dictionary definition of usufruct is "the right to use the profits and advantages of something belonging to another as long as the property is not damaged or altered in any way." For example, an old American hunting custom in rural areas is that one can hunt small game on others property as long as nothing else is damaged or destroyed. If the property is public, the same doctrine would apply. Specifically for water rights in the Middle East, in local water laws, Islamic Law, the Ottoman Code, and so on, usufruct applies to water sources as immovable property (water not in a container). Water resources and rights to use them may be associated with private property, public property, state property, and sometimes as amalgams of all three. As long as a stranger simply takes what he needs without destroying anything, he will have no trouble with anyone regardless of ownership. South American Indian cultures apply the doctrine of usufruct to allocating common sources of water by the phrase, uso y custumbres (customary usage). A comprehensive legal discussion is Jamal Lawrence El-Hindi, "Compensation as Part of Equitable Utilization In the Israeli-Palestinian Water Context," *Arab Studies Quarterly*, Spring 2000, available online at http://findarticles.com/p/articles/mi_m2501/is_2_22/ai_65653667/pg_1 (Use of water is a significant issue in Israeli-Palestinian disputes, especially as seen by the Palestinians.)

26 Early Christians regarded water worship as pagan, but it took about 1,000 years, for example, to make Christians stop re-christening wells after saints. However, many still believe in Holy Water, use water in rites such as baptism, pray for rain to come in a drought, and for it to stop in a flood; and may visit various miracle springs. One may speculate that weakening the doctrine of usufruct in Christianity helped set the stage for expansion of the industrial revolution in the West, but it is still a part of most other religions.

27 Garrett Hardin, "The Tragedy of the Commons," *Science*, v. 162, 1968, pp. 1243–1248. In the article Hardin describes it more precisely as the "tragedy of freedom in a common." Both the phrase and the article became classics, referenced in situations from the global environment to the internet. It is easy to see, as did Hardin, that no technical solution is possible if immediate maximization of personal benefit is the strategy of all players; this becomes an n-person version of the Prisoner's Dilemma game in which everyone "defects." The social solution is for humans to broaden their perspective and modify their collective behavior, which is usually held to be a "basic moral issue," and indeed the old grazing commons that Hardin used as an example usually had rules they ran by and watchful eyes observing. Today this situation may be termed a "wicked problem," signifying that human beliefs and behaviors are a significant element in resolving it, if it can be resolved.

28 Jasper Becker, "The Death of China's Rivers," *Asia Times* (online), Aug. 26, 2003. This was a concise summary of the water crisis in China. The major rivers tapped out are named by Lester R. Brown, *Outgrowing the Earth: The Food Security Challenge in an Age of Falling Water Tables and Rising Temperatures* (New York: W.W. Norton & Company, 2005), pp. 106–107. They are the Amu Darya (central Asia), Fen (China), Colorado (United States), Ganges (India), Indus (India), Nile (Egypt), and Yellow (China). In addition, many smaller rivers like the Rio Grande on the U.S.-Mexican border have had low flows for decades. Cities like El Paso, Texas have reduced per capita water use by 65 percent by high-use pricing penalties and conservation measures. Population has increased while keeping overall water usage and aquifer pumping rates even with replenishment rates—so far.

29 According to the Edinburgh, Scotland News On Line, Apr. 5, 2005.

30 Jane Perlez, "In Life on the Mekong, China's Dams Dominate," *New York Times*, Mar. 19, 2005.

31 Google "Aral Sea" to brush up on this highly publicized environmental disaster. Google Novaya Zemlya, an old Soviet nuclear test site, to see hundreds of hits varying in credibility because of its classified past. Known for sure is that both the land of Novaya Zemlya and the sea around it are laden with far more nuclear waste than Chernobyl. Offshore in the briny lie seventeen nuclear reactors, six with fuel still in them, plus huge amounts of containerized, lower-level radioactive waste. Whether resurrecting any of this is possible is unknown. It even may be impossible to prevent disastrous leakage from these hulks into the open ocean. Novaya Zemlya is regarded as more contaminated than the Hanford, WA nuclear waste site in the United States, which has 177 tanks full of radioactive brew, 67 of which are confirmed to be leaking, plus huge volumes of lesser radioactive material that was dumped on the ground. (According to Chris Gregoire and Maria Cantwell, "A Toxic Time Bomb in the Northwest," *Washington Post*, Mar. 3, 2008.) Despite this, Novaya Zemlya has a few human inhabitants and a wildlife population, but existence of sites like this are an obvious factor in public fear of nuclear power.

32 United States Geological Survey, "The Future of Planet Earth: Scientific Challenges in the Coming Century," Feb. 2000. Such reports are regularly updated at the site: www.usgs.gov/newsroom/article.asp?ID=653, which refers to many other sites. One of many water quality issues addressed is hypoxia. The best-known example is the "dead zone" at the mouth of the Mississippi River. See: http://toxics.usgs.gov/hypoxia/hypoxic_zone.html

33 Designed by Black & Veach, the Singapore desalinization plant pre-filters sea water; then uses double reverse osmosis. At 4.2 KWH per cubic meter of water, its energy efficiency is best in the world for water desalinization: www.bv.com/wcm/press_release/04072006_8521.aspx The plant supplies about 10 percent of Singapore's water.

34 Ian Sample, *Guardian Unlimited* (UK), "Scientists Offered Cash to Dispute Climate Study, Feb. 7, 2007. The American Enterprise Institute offered British scientists $10,000 for articles that disputed the UN report, "Climate Change 2007," issued Feb. 2, 2007 by the UN's Intergovernmental Panel on Climate Change. The report is the fourth in a series by the panel since 1990. The American Enterprise Institute receives considerable funding from ExxonMobil, and Lee Raymond, its former CEO, is vice-chairman of the institute's board. The Union of Concerned Scientists also documented this disinformation campaign. By January 2008, Exxon said it had dropped this anti-warming campaign. However, the Global Climate Coalition and other industry PR and lobbying organizations continue an active stance against climate change and appear to be suppressing "irrefutable conclusions" by their own staff scientists in industry reports: Andrew C. Revkin, "Industry Ignored Its Scientists on Climate," *New York Times*, April 24, 2009.

That skeptics abound is understandable given the updates and quasi-contradictions that regularly flow to the media as new research discovers more about drivers of climate change. For example, Lawrence, et al had a well-cited article in *Geophysical Research Letters*, v. 35, June 13, 2008 that showed evidence that loss of sea ice could lead to rapid release of methane from permafrost on land. Large quantities of methane going into the atmosphere would accelerate the "greenhouse" effect, but the study lacked a well grounded estimated of the amount lost. But the previous year

Arain, et al, also in *Geophysical Research Letters*, demonstrated that peat and other vegetation covering permafrost would slow the rate of methane release from it (but not stop it). Each finding alters assumptions to be played in global climate change models, and much is extrapolated from data using limited observations. Then Anderson, et al on March 13, 2009 reported in *Science* at study concluding that during the last major global warming period, atmospheric CO_2 also increased, upwelling from the deep around Antarctica, and shifting the Southern Hemisphere atmospheric westerlies southward toward that continent. This appears to be actually happening, in contrast with earlier global climate change models that assumed that its effects would be symmetric between Northern and Southern Hemispheres. That is, no one can know how much we do not know, but from evidence accumulating, climate change now appears to be a "runaway" with man-made greenhouse gases being drivers increasing the rate of change.

The most referenced reports are from the Intergovernmental Panel on Climate Change, which are really collections of reports. Few disputants of the contents seem to have seen the panel's original reports, which can be obtained from www.ipcc.ch/ipccreports/assessments-reports.htm. A 73-page summary report in pdf form was downloaded from: www.ipcc.ch/ipccreports/ar4-syr.htm

However, no serious critic disputes that the level of CO_2 in the atmosphere is rising, and that effect alone may not favor agriculture continuing in its present mode. For example, The U. S. Department of Agriculture Research Service planted ragweed and other plants in Baltimore, which has a CO_2 concentration of 550 ppm, not expected for several decades world-wide. Ragweed thrived, with its pollen count per cubic meter of air rising over 5 times more than for the same ragweed planted a few miles distant, where the CO_2 concentration was nearer 400 ppm. That does not bode well either for allergy or asthma sufferers. (Information from Dr. Howard Frumkin, Centers for Disease Control, based on research first reported by Ziska, et al, *Journal of Allergy and Clinical Immunology*, Feb. 2003, pp. 290-295.) Lewis Ziska later compared the growth of weedy crops (red rice) versus crops bred for high yield (cultivated rice) at different atmospheric CO_2 levels. Biomass of red rice increased in a higher CO_2 atmosphere; cultivated rice did not. But perhaps red rice genetics can be used to breed a hardier version of high-yield rice in a high CO_2 environment. Research reported by Ziska and McClung, "Differential Response of Cultivated and Weedy (Red) Rice to Recent and Projected Increases in Atmospheric Carbon Dioxide," *Agronomy Journal*, Aug. 2008, pp. 1259-1263. This contrasts with the obvious projection that a higher CO_2 concentration will cause all plant life to proliferate. However, one cannot extrapolate sweeping conclusions from a few limited studies.

That is, risks like sea level rise are easy to dramatize, but a combination of numerous small shifts may add up to humans having to adapt a great deal to sustain themselves at our projected population levels.

35 The first paper was by B.H. Keating and W.J. McGuire, "Island Ediface Failures and Associated Tsunami Hazards," *Pure and Applied Geophysics*, 2000, pp. 899–956. A follow up supporting paper was by Steven N. Ward and Simon Day, "Cumbre Vieja Volcano—Potential Collapse and Tsunami at La Palma, Canary Islands," *Geophysical Research Letters* (2001) 3397–3400.

36 The home page of The Tsunami Society with its primary "debunking" paper by George Pararas-Caryannis is at: www.drgeorgepc.com/TsunamiMegaEvaluation.html

37 *The 2007 Benfield Hazard and Risk Science Review*, p. 23.

38 For example, Jeffrey Lacasse and Jonathan Leo drew great publicity by pointing out that the hypothesis that depression is caused by chemical imbalance in the brain, or more specifically an imbalance of serotonin, has never been scientifically proven. This hypothesis was formulated in the 1960s, based on observing that taking a drug was followed by alteration of mood. No direct link between brain chemistry and depression has ever been found, and with present methodologies, it may not be possible to do so. However, after science writers had repeated the hypothesis for years, it was assumed to be a fact. In addition, pharmaceutical companies developed selective serotonin uptake inhibitors (SSRIs) to correct this presumed imbalance. Now heavily marketed, these are among the best-selling prescription drugs. With billions of dollars in sales hanging on the chemical imbalance hypothesis, pharmaceutical companies are not anxious to publicize that it has never been proven. Pharmaceutical advertising probably helped to sustain belief that it had, so media writers rarely asked the obvious question. Jeffrey Lacasse and Jonathan Leo; "The Media and the Chemical Imbalance Theory of Depression," *Society* (2008, pp. 35–45), or www.springerlink.com/content/u37j12152n826q60/fulltext.pdf. An earlier article by the same authors assailed pharmaceutical promotion: "Serotonin and Depression: A Disconnect Between Advertisements and the Scientific Literature," *Public Library of Science and Medicine*, Nov. 8, 2005, at http://medicine.plosjournals.org/perlserv/?request=get-document&doi=10.1371%2Fjournal.pmed.0020392 This case is a high-profile example of a learning oversight very common in all human activity: finding a countermeasure that appears to be effective distracts from seeking root cause and going for a more effective countermeasure.

39 Constance Holden, "Report Warns of Looming Pollination Crisis in North America," *Science*, Oct. 20, 2006 (issued before the outbreak of "disappearing disease"). The article summarizes a National Research Council report. To have a sense of the honeybee trucking business, see Norman Vanamee, "Hives for Hire Stop Only to Pollinate," *New York Times*, June 9, 2004. It describes trucking bees to California almond growers, who had to spend extra to import bees from a distance when regional services had a shortfall of bees. Almonds bloom so early that hives have little chance of recuperating from winter bouts with the mites to be ready for duty. Efforts to breed a mite resistant honeybee have so far been "fruitless." Beekeeping is ancient. The oldest record of it was depicted in carvings on ancient Egyptian tombs about 2400 BCE.

40 The Mid-Atlantic Apiary Research and Extension Consortium at Penn State became the designated coordination center for the CCD Working Group working on bee colony collapse disorder. See: http://maarec.psu.edu/ColonyCollapseDisorder.html. Losses from Colony Collapse Disorder in the United States were 31% in 2007; 36% in 2008, and 29% in 2009. A summary of the CCD Working Group's conclusions, or lack of them, are in ""Saving the Honeybee," *Scientific American*, Apr. 2009, by Diana Cox-Foster and Dennis vanEngledorp, two members of the CCD Working Group. Research included mapping honeybee genomes.

Preliminary reports from 2009 suggested that losses were down because beekeepers took better care of their hives. After outbreaks of CCD in Germany, the Germans suspected the cause to be nicotinoid insecticides and banned their use in 2008. Bayer, a major producer, still insists that they do no harm if properly applied. (Allison Benjamin, "Pesticides: Germany Bans Chemicals Linked to Honeybee Devastation," *Guardian* (UK), May 23, 2008.) American beekeepers threatened to sue Bayer. The CDC Working Group had not reached the same conclusion, but knew of nicotinoids. In 2004, Eric Mussen from the University of California at Davis reported that very low doses of nicotinoids confused bees so that they could not navigate back to their hive: http://entomology.ucdavis.edu/faculty/mussen/05-06-04.pdf Beekeepers not into commercial trucking seemed to have fewer losses. Beekeepers were advised to pay more attention to maintaining healthy, toxin-free hives to reduce stress on bees, which can come from many

sources, including trucking. Then genomic studies suggested that CCD bees might carry an extra load of picorna-like viruses, related to Israeli acute paralysis virus in bees there (Berenbaum, et al, "Changes in Transcript Analysis Related to Colony Collapse Disorder in Honeybees," found as a pre-print on PNAS: www.pnas.org/content/early/2009/08/21/0906970106)

A review of the situation with honeybees from a beekeeper's viewpoint is Rowan Jacobsen, *Fruitless Fall*, Bloomsbury, New York, 2009. On top of all this, English beekeepers have a problem with thievery; hives are worth so much that they are targets for theft ("Beekeepers Stung by Hive Rustlers," *BBC News*, June 2, 2009).

41 "Plight of the Bumblebee," *New Scientist*, Upfront Section, 15–21 July, 2006. This reports a study appearing in *Journal of Applied Ecology*, DOI: 10.1111/j.365-2664.2006.01199.x. The most popular bumblebees imported to pollinate commercial greenhouses, when they escape, out-compete domestic bumblebees and displace them. That bumblebee populations have been in decline in Europe for the past 60 years has been well documented, and in the UK the situation is sometimes termed a crisis. (Dave Goulson, Gillian Lye, and Ben Darvill, "The Decline and Conservation of Bumblebees," *Annual Review of Entomology*, Jan. 2008.) Considerable decline has been seen in North American for the past ten years. Causes are varied: Introduction of competing species, loss of diverse flora suitable for pollination, and use of pesticides.

42 World wide, about 20 species of frogs are known to have disappeared; many other species are in decline. Frogs are important players in ecological balance. For one thing, they hold insect populations in check. As with honeybees, so single reason for disappearance has been identified. This situation is covered from time to time by many science publications, and an Australian government site has a good summary of it: www.wettropics.gov.au/pa/pa_frog_crisis.html Bat disappearance is a more recent, sudden phenomenon; and bats, too, are important insect predators. For a summary, see: Tina Kelley, "Bats Perish, and No One Knows Why," *New York Times*, March 25, 2008.

Interestingly, no report found on disappearances and declines suggested that antibiotics in the environment are a contributing factor, but this is a long-running issue in the United States. The American Medical Association has long opposed feeding antibiotics to animals raised for food, which is done to reduce losses to disease of livestock bred for maximum meat or milk yield. Constant exposure to antibiotics makes bacteria antibiotic resistant, which is a concern in human health care, and low levels of residual antibiotics have been found in drinking water, plants, feral animals, and human tissue (a Google search yields many credible citations). The Obama administration has proposed a ban on feeding antibiotics to animals, but it is not expected to pass Congress (Gardiner Harris, "Administration Seeks to Restrict Antibiotics in Livestock, *New York Times*, July 13, 2009). Of course, the livestock industry wants critics to prove antibiotics harmful beyond any shadow of doubt, while the health vigilantes want the livestock industry to prove that use of prophylactic antibiotics is safe.

43 Elizabeth Rosenthal, "Near Arctic, Seed Vault is a Fort Knox of Food," *New York Times*, Feb. 29, 2008. This project attempts to find a stable, well-managed home for a huge number of seed varieties held in banks in poor locations around the world. Whether concentrating so much in one warehouse is a good idea can be debated. Agricultural sages have for centuries understood that the key to escaping a crop plague is finding a variety that is more resistant to it. The modern version of this is an ongoing part of the "green revolution." Some veterans of this revolution like Norman Borlaug are still going, trying to breed varieties of crops that stay ahead of mutations in plant diseases and scourges world wide ("The Famine Fighter's Last Battle," *Science*, May 8,

2009). Agreeing to share seed is another aspect of globalization. It is not simple negotiating, and people who do not understand what is at stake often destroy seed banks. See "Scientists Seek Easier Access to Seed Banks," *Science*, June 12, 2009.

Managing evolution through genetic engineering could play a role, but having an arsenal of seed varieties is the old standby remedy, and mono-cropping a seed variety because it has a high yield or great taste invites disaster if a new pathogen suddenly gallops through it. An example is the ongoing battle of the banana. Bananas are a staple in parts of Africa, but the battle to save the banana is greatly shaped by the process to transport them from tropical trees to temperate-climate supermarkets as a cash crop. Early in the 20th century, the Gros Michael was the preferred crop banana, but it was nearly wiped out by a fungus called Panama disease, related to Dutch Elm disease, but thought to have originated in Suriname. Huge amounts of fungicide to control this fungus sickened banana workers, whose plight for years drew protests from the equivalent of today's anti-globalists. (The phrase "banana republic" was coined to describe governments strongly influenced by heavy-handed banana companies.) In the 1960s the Gros Michael was replaced by the Cavendish, a variety more resistant to Panama disease. Now the Cavendish is threatened by mutated versions of Panama disease, so this is a never-ending battle. Finding a replacement is a race between conventional hybrid breeders and genetic engineers, with experimentation guided by the market. Europeans won't accept genetically engineered bananas, but Americans will. And any breed acceptable to consumer tastes must also be robust enough to withstand handling on the way to market, ripening while en route. From Dan Koeppel, "Can This Fruit Be Saved?" *Popular Science*, August 2005.

44 Go to: www.antarctica.ac.uk/ and use the search function for "The Ozone Hole" to retrieve extensive graphs and reports. American data can be found at NOAA's Earth System Research Laboratory Site: www.esrl.noaa.gov/gmd/dv/spo_oz/

45 The Center for International Earth Science Information Network at Columbia University is a good site to start discovering research reports on the effects of UV-B radiation on plankton: www.ciesin.org/TG/OZ/aqecosys.html A good summary of plankton discovery and classification is at: http://news.mongabay.com/2006/0504-coml.html and much of this work is actually by the Census on Marine Zooplankton: www.cmarz.org/ More may be known about chlorofluorocarbon chemistry in the stratosphere than on the effects of low-level UV-B exposure on plankton. UV is used to induce chemical polymerization, so its potential is severe, but at what level UV might severely disrupt the biology of plankton or other organism is not well defined, and may not be possible to precisely define. The concentration of plankton at the ocean surface, visible by satellite observation, affects solar absorption. However, plankton also live in abundance and great variety beneath the surface. Too little is known about them. Paradoxically, the accumulation of dead plankton at the bottom of bodies of water is one of the sources of hydrocarbons.

An interesting side effect of the ozone hole is that its presence appears to be slowing the melt rate of Antarctic ice. ("Increasing Antarctic Sea Ice Extent Linked to Ozone Hole," *ScienceDaily*, April 22, 2009.) Incidentally, Freon was invented in 1928 to replace methyl chloride, which caused fatalities when it leaked from refrigerators. No one then could have foreseen that Freon could retard formation of ozone high over Antarctica, so what is the social obligation of innovators to foresee consequences of their innovation, and what kind of warning systems do we need that things are going awry?

46 John Roach, "Source of Half of Earth's Oxygen Gets Little Credit," *National Geographic News,* June 7, 2004. This popularly written article summarizes facts from several sources. The role of phytoplankton in oxygen production is well known among scientists working the field, but not to the public. Whether ocean acidification or ocean warming will diminish plankton blooms on a global scale is uncertain, but shifts in plankton species mix and the predators that feed on them have been observed, but pollution of the ocean surface could be just as big a facto. Too much is unknown. For example, the existence of unique biology in the surface micro-layer of the ocean, where gas exchange takes place, has only recently been discovered. A proposed research program on this phenomenon in 2006 was found at http://www.nerc.ac.uk/research/programmes/solas/events/scimeeting06/cunliffe.pdf This research was first disclosed in the public media by Carl Zimmer, "Scientists Find a Microbe Haven at Ocean Surface," *New York Times,* July 27, 2009. Much research is reported in the *Journal for Plankton Research* (http://plankt.oxfordjournals.org/). So far scientists have raised no special alarm about plankton, as with alarms about overfishing the larger species of fish that humans use for food, but it is a crucial area for humans to learn a great deal more about as quickly as possible.

47 Stephen Jay Gould and Niles Eldridge, "Punctuated Equilibria: an Alternative to Phyletic Gradualism" 1972. It can be found at: www.stephenjaygould.org/library.html and this paper began debate on evolution occurring in spurts among phyla living in isolation and at the edge of their ecological environment so that adaptation would be required (and favored). Punctuated equilibrium is a complex theory related to mass extinction and re-evolution of life, but is not restricted to it. The theory is in opposition to the concept of evolution being slow and gradual, almost uninterrupted. It remains controversial among paleontologists, and differences are still being worked out. Recent evidence has begun to confirm that evolution can indeed take place almost at the pace of environmental change, at least among short-lived organisms. Although Gould was famed as an advocate of punctuated equilibrium, the concept appears to have stemmed from a 1954 paper by the equally famed biologist, Ernst Mayr.

48 According to *National Geographic's* review of satellite photography at NASA Goddard Space Flight Center. (Originally reported by Mike Toner, *Atlanta Journal-Constitution,* Aug. 20, 2002.) The 6 percent reduction was from a study reported by NASA Goddard Sept. 16, 2003 at www.nasa.gov/centers/goddard/news/topstory/2003/0815oceancarbon.html Later studies can be found and are no more optimistic. Phytoplankton are genetically diverse, so species seem to rebalance to adjust to changes in ocean temperature and acidity, but a great deal is unknown about the cycles by which they feed on nutrient, and by which other organisms feed on them. Victor Smetacek and James Cloern, "On Phytoplankton Trends," *Science,* March 7, 2008.

49 David Appell, *Scientific American* ("In Focus" section.) An early hypothesis, with limited evidence, was that small soot particles, as from diesel exhaust, might have more attenuating effect than suspected earlier. A study reported in 2009 used more advanced methods of measurement, and concluded from about 3250 meteorological stations world-wide, that solar radiation reaching earth's surface had decreased on average for the entire world between 1973 and 2007 (Wang, Dickinson, and Liang, "Clear Sky Visibility has Decreased over Land Globally Between 1973 and 2007," *Science*, Mar. 13, 2009.) Visibility had dimmed the most over South Asia, South America, and Australia, while it had increased over Europe. The global average showed greater global dimming, but not as much as suspected earlier. Dimming is caused by aerosols, notably sulfur dioxide from burning high-sulfur fuels. Aerosols affect cloud formation (water vapor) and together these are a major factor reflecting solar radiation back into space, while increased cloud formations tend to prevent heat from the earth radiating into space. These factors have been points of contention in climate change models.

50 In July 2005, reports in the mainstream media noted that from the North Sea (BBC) to the Northern Pacific *(USA Today)*, the 2005 spring and summer plankton bloom was small, and cold water plankton were being displaced by warmer water plankton, causing die-offs of the larger species that feed on cold water plankton. A 2009 report on Antarctic plankton suggested a similar species displacement due to warming, with about a 12 percent decrease in plankton density in the sea. (Montes-Hugo, et al; "Recent Changes in Phytoplankton Communities Associated with Rapid Regional Climate Change Along the Western Antarctic Peninsula," *Science*, Mar. 13, 2009.) Overall, the situation with plankton could be grim, but understanding of it is piecemeal, far from complete enough for scientists to jolt politicians absorbed in other concerns.

51 According to the *2004 Status of Coral Reefs in the World* (by the IUCN—The World Conservation Union) 58 percent of the world's reefs are endangered. Much of the bleaching can be traced to the peak El Ninos of the last twenty years. Reefs not stressed by further damage seem to be slowly recovering, but the overall outlook remains bleak if ocean temperatures rise. Coral reefs can incorporate a different mix of minerals in skeletal building, depending on water PH, but no one knows how long this shift would take in nature. Stephen Palumbi of Stanford University has observed zoooxanthellae that are more heat and acidity robust than most, but is not optimistic longer-term. (Announcements are at www.eurekalert.org/pub_releases/2009-05/su-ssf051909.php) Carilli, et al., observed that reefs recover faster if the surrounding ocean is less polluted ("Local Stressors Reduce Coral Resilience to Bleaching," *PLoS ONE*, July 22, 2009). About 100,000 known species of plants and animals are known to be associated with reefs. The total number of those unknown and therefore not catalogued is much higher, and even a ballpark estimate is presently "unknowable."

52 The term "wicked problems" is growing in popularity to describe situations in which no deterministic solution is possible, and even a "Nash equilibrium" outcome in which no participant can do any better, is impossible or if so, it does not hold very long. "Wicked Problem" originated from Horst W.J. Rittel and Melvin M. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4, 1973, 155–169. This paper and a much refined description of the idea can be accessed from Strategy Kinetics at www.strategykinetics.com and from a white paper accessible from that site: Robert E. Horn and Robert P. Weber, "New Tools for Resolving Wicked Problems: Mess Mapping and Resolution Mapping Processes."

53 Life expectancy data is from the World Health Organization 2007 Report: www.who.int/whosis/whostat2007/en/index.html. The rapid increase in longevity that has been experienced in many places in the world, as in the United States in the late 19th and early 20th centuries, is usually attributed to improvements in basic sanitation, disease prevention (as with vaccines), and public health education, than by any great improvement in curative health care delivery. Most of that came from the mid-20th century onward – the "medical miracle" era.

54 Figures picked off a graph compiled by the Center for Sustainable Systems, University of Michigan; can be seen at http://css.snre.umich.edu/css_doc/CSS04-15.pdf.

55 A couple of these are briefly described at http://dieoff.org/page110.htm and www.footprintnetwork.org/en/index.php/GFN/page/methodology/ (with the *Ecological Footprint Atlas 2008)*. Gigi Richard references a number of carrying capacity models at www.iere.org/ILEA/leaf/richard2002.html Any carrying capacity estimate is a function of the factors and assumptions in the model used, of course, but all known models give pessimistic

estimates. But because there are so many red flags flying, the reason for Compression proposing drastic reductions in resource use do not rely exclusively on carrying capacity calculations.

56 James Lovelock, *The Revenge of Gaia*, Basic Books, New York, 2006, p. 141. Lovelock is best known for proposing the Gaia Hypothesis, that the entire global biosphere is one big interdependent system, so that what happens in one part of it affects all the rest to some degree. This has now been advanced to a theory by evidence supporting it, for instance by observing that coal dust from China carries far around the world, that no part of the oceans are completely void of evidence of human activity, and so forth

57 Estimates are based on both *Ward's Automotive* and the Motor Vehicle Manufacturers Association figures for government-registered vehicles in all countries. No one knows how many more road vehicles are driven without being registered, or how many more internal combustion engines are operating on tractors, motorcycles, lawnmowers, pumps and other kinds of equipment. The number of registered vehicles on the road may roughly parallel the total, but no way is known to estimate by how much the total is too low.

Auto industry executives often cite numbers well below these, but their sources are unknown. Other estimates are well above the author's projections. For example, a study by Oxford Brooks University in England estimates the present total global vehicle population to be 1.48 billion, with each vehicle accounting for 1.85 tons of waste over its lifetime. That methodology is also unknown, but it is presumed that the waste figure does not include the total weight of all fuel burnt. That study projected that the automotive industry would generate 3.65 billion tons of scrap between now and 2030. Recycling all that stuff would be a huge undertaking. Of course, if the rate of vehicle production remains cut by a third or so due to global financial malaise, the population of registered vehicles will not surpass a billion until 2010 or after.

58 This was done for fun based on figures from *Ward's Automotive* and looking at a Wal-Mart parking lot. Other ratios are also revealing if one can find data. For instance, pick a country and divide its total population of vehicles by the reported length of all the highways. If all the vehicles took to the roads at once, how much space would be between? By this estimate, the highest density of vehicles on the road would be in Taiwan, but that does not mean much, for actual traffic density depends on how many vehicles are actually being driven at once. As is well known, vehicle owners living in crowded locations like Tokyo or New York are not as apt to drive them for every errand as owners in rural Texas.

59 Estimated from Table HS-40, *Statistical Abstract of the United States 2003*, Mini-Historical Statistics.

60 Closely spaced wooden workers houses and shacks helped spread the Chicago Fire though a city full of wood in a very dry season. At the end of WW II, plenty of Americans still lived in shacks. "Communities" such as hobo jungles, once popular, could still be found. This extra-legal economy and way of life, disdained by the middle class, transitioned into homeless shelters and low-income housing projects. Recent housing area figures are from *Statistical Abstracts of the United States 2003*, Table 994. However, this table is not consistent with Table HS-40, from the same source's Mini-Historical Statistics. From that, one can estimate that an average new housing unit in 1920 was 1700 sq. ft. In 1950, it was down to 755 sq. ft. Then it began to balloon up to 2800 sq. ft. by 2002. (Estimates from different sources are similar, but not totally consistent.)

61 Denny Lee, "Taking the Garage Along for the Ride," *New York Times*, Jan 14, 2005. Big motor homes with all the amenities were the fastest growing segment of the U.S. RV market in 2005.

62 Estimates calculated from various tables in *The Statistical Abstract of the United States*, 2003.

63 Neil deGrasse Tyson, "Energy to Burn," *Natural History*, October 2005. Tyson estimated that Americans were about 20 pounds overweight on average, or collectively about six billion pounds overweight. Based on rough estimates like this, wags looking for eye-grabbing figures estimate that American obesity could come close to feeding either Iraq or Afghanistan for a year. Another waggish computation is that the total calories in the 50 gallons of cola the average American consumes each year is sloppily equal to the total calories larded in his 20 pounds of extra fat.

64 Various tables in *The Statistical Abstract of the United States, 2003*. Consumer debt data is from the Federal Reserve G19 Series. The doubling estimate in mortgages is from Table 1132 in the 2009 *Statistical Abstracts of the United States*, but the rise shown exceeds that debt service ratio series on mortgages from the Federal Reserve which does not suggest nearly as sharp a rise in debt: www.federalreserve.gov/releases/housedebt/default.htm

65 Estimates based on data from McCann-Erikson, the *Statistical Abstract of the United States*, 2003, and World Bank income per capita figures.

66 To see how pervasive this is becoming, check: www.madisonandvine.com Besides product placement in large-audience media, as soon as any social networking technology starts to amass users, marketing entrepreneurs look for angles that will cause individuals to "twitter up" with each other. Readers will have no trouble finding suggestions on doing this.

67 Douglas Rushkoff, *Coercion*, Riverhead Books, New York, 1999. One of Rushkoff's examples is the well-known story of Hill & Knowlton concocting the tale of Iraqi soldiers taking Kuwaiti babies off incubator oxygen to die, thus whipping up anti-Iraq sentiment running up to the first Gulf War. The story was impossible to corroborate. Everybody involved distanced themselves from direct responsibility for it, but it made the news. Trawling smear-or-distort myths, hoping for a media bite, is not unusual. DeGraff, Wann, and Naylor have a particularly readable exposé of this in *Affluenza*, Barrett-Koehler, San Francisco, 2001 (Chapter 20). See also Anthony Pratkanis and Elliot Aronson, *Age of Propaganda*, Henry Holt, New York, second edition, 2001, a well-researched study on the psychology of persuasion.

68 According to the International Swaps and Derivatives Association: www.isda.org/index.html Scroll down the left side to find the ISDA Market Survey Historical Data (either in Excel or PDF formats). The notational amount of interest rate derivatives soared from $865 billion in 1987 to $465 trillion in 2008. Credit default swaps (the core of "toxic assets") were not tracked until 2001, but rose to $62 trillion by 2007; then dropped to $54 trillion. By comparison, the total world GDP in 2007 was $54.3 trillion and the United States GDP was $13.8 trillion, about a fourth of the world total.

[69] From a U.S. Department of Labor survey, Table 1 on time spent by adults in daily activities: www.bls.gov/news.release/atus.t01.htm A Canadian survey was about the same: http://www40.statcan.ca/l01/cst01/famil36a.htm

70 Juliet Schor, *Born to Buy: The Commercialized Child and the New Consumer Culture*, Scribner, New York, 2005; and *The Overspent American: Why We Buy What We Don't Need*, Harper Paperbacks, New York, 1999. Schor is much better documenting many points similar to those made by anti-consumer activists.

71 See www.adbusters.org for activities that have been concocted to protest excessive consumption. Adbusters' latest grab for attention is Blackspot Debt Collection Agency to buy uncollected debt from collection agencies for pennies on the dollar; then forgive it. How this is to be funded is unclear. See the Blackspot Campaign on the Adbuster page.

72 James P. Womack and Daniel Jones, *Lean Solutions: How Companies and Customers Can Create Value and Wealth Together*, Free Press, New York, 2005. Womack recommends process kaizen of customer service considering the customer's time as valuable, not just the seller's time.

73 Tom Osenton, *The Death of Demand*, Financial Times Prentice Hall, Saddle River, NJ 2004.

74 One clue is in, "Category Killers: 5 Nanotechnologies That Could Change the World," Forbes/Wolfe Nanotech Report, from Angstrom Publishing, a subsidiary of Lux Capital, New York, September 2004, p. 3. Five years ago, the report foresaw that many old companies and industries could have their existence threatened; but did not consider whether nanotech would spur as much growth as it displaced. For example, biotech analysts foresaw customized, genetic medicine undercutting old pharmaceutical companies' big development and marketing costs, but enthusiasm for high-spiking tech stocks' is no indicator that they will displace old economic mainstays that soaked up unemployment with extensive low-to-medium skill work. At present carbon nanotube production is energy intensive; carbon is vaporized at high temperature so the process takes about 200 Kwh per gram. Carbon nanotube's tensile strength is about 100 times that of steel, but the cheapest industrial grade nanotubes still cost about 100 times steel. We won't make boat hulls out of them, but the unique properties of nanocarbon materials presents a bright future saving resources indirectly through many fold increases in electrical conduction, materials adsorption, tensile strength, and even quantum Hall effects. Graphene sheets could replace silicon in computers to have computational power just now being imagined.

75 Wikipedia's overviews of Anti-Globalization and related movements are up to date, and as expected, disputed. (To start, see http://en.wikipedia.org/wiki/Anti-globalization.) Many fragmented protests coattail on Anti-Globalization. The only unifying element is opposition to global-scale corporate growth in its present form, leading to the quip that anti-globalists could be anarchists if they were better organized. Most of the movement's articulation and activism comes from intellectuals rather than the global poor whom they often try to represent.

76 James Brooke, "Down and Out in Mongolia," *New York Times*, Dec. 29, 2004. The story is unusual only because most American media coverage concentrates on American textile workers.

77 Larry Richter, "Diamonds' Glitter Fades for a Brazilian Tribe," *New York Times*, Dec. 29, 2006. The story of the clash of values between the Cinta-Larga and miners is typical of many such stories all over the world during the era of colonial and industrial expansion.

78 One of the first critiques of the global financial system was Joseph E. Stiglitz, *Globalization and Its Discontents*, W.W. Norton, New York, 2002. Stiglitz described the errors of the World

Bank and IMF in promoting economic growth and reviving sick economies all over the world in much more detail than is possible here. William Easterly (*The White Man's Burden*, Penguin Press, New York, 2006) soundly flogs the notion that policy makers far removed from the places they attempt to help can discover how to really help people; entrepreneurs focused on the spot can do much better with specific innovations. He cites modern, de facto empires blundering time and time again, both politically and economically, by trying to model the rest of the world after established industrial society. Steve Schifferes summarized much global discontent in early 2007 in "Globalization Shakes the World," BBC, Jan. 21, 2007, capturing the fear that no institution is capable of regulating global business development in the interest of all the people of the world. Of course, after the financial system shake up in 2008, one can find no end of articles critiquing it from every viewpoint.

79 This passage, typical of those found on anti-globalization web sites, is from "Re-Criminalization of Dissent," notes from Concordia University Conference, March 2002, was found at www.polarisinstitute.org/pubs/pubs_pdfs/Criminalizing%20Dissent.pdf.

80 Quote from a report on the annual World Social Forum by Saritha Rai, "Anti-Globalization Forum Adds Variety of Causes to Its Agenda, *New York Times*, January 20, 2004.

81 Hernando de Soto, *The Mystery of Capital*, Basic Books, New York, 2003, opening sentence, page 1. De Soto is one of the rare people who has a strong faith that the global capitalist system could do a lot of good, but it made too many mistakes by not understanding the background of the people it tried to bring into a "modern world."

82 Li Gao, Jonathan Lindsay, and Paul Monro-Faure, "China: Integrated Land Policy Reform in a Context of Rapid Urbanization," World Bank Report, Agricultural and Rural Development Notes, Feb. 2008, at http://siteresources.worldbank.org/EXTARD/Resources/Note36.pdf The Western press minimally covered the evolution of property rights in China, including the Rural Contracting Law of 2002, and the Law on Property of 2007. Those unfamiliar with this situation in China will find this report to be a dispassionate overview of the problems, and of discussions between the World Bank and the Chinese Research Development Center of the State Council on further proposals. The shrinkage of export markets in 2008-2009 exacerbated unemployment in China so that finding a way to maintain civil order is a much greater problem, and one being more actively reported.

83 Joseph Kahn, "China's Haves Stir the Have Nots to Violence," *New York Times*, Dec. 31, 2004, and "China Worries About Economic Surge That Skips the Poor," *New York Times*, Mar. 4, 2005. The Chinese government had to begin once more to speak of a "harmonious society" through "scientific development." But as Paul Krugman noted in a *New York Times* op-ed piece ("China's Dollar Trap," April 3, 2009), the Chinese leadership has yet to recognize that they are stuck in a system that let them pick up the debt with which Americans bought the goods produced in the plants that had sprung up there – and like Americans, could not figure out how to get off the endless growth express.

84 For example, see Prafulla Das, "Tribals Vow to Oppose Displacement," *The Hindu* (online newspaper of India), Jan. 3, 2007. Thousands of "tribals" attended a memorial meeting to pay tribute to thirteen persons killed by police firing in the industrial development Orissa Jaipur district on Jan. 2, 2006. The original protest was over construction of a boundary wall for a Tata Steel plant. Those assembled a year later vowed to continue resistance to industrial society

confiscation of their land. In 2008, Tata had to relocate production of the mini-vehicle Nano from a plant being constructed in West Bengal because similar protests threatened to be violent and ongoing. (Reading the political news from India, one is struck by the polemic paralysis of Indians convinced either that the government must "take care of the poor," moving them off the land and out of the alleys, educate them and create jobs for them in competitive industries – but the government's rural help programs suffer because, for instance, competitive doctors do not want to spend their lives in a rural, backward place with nothing to work with. Such conundrums have to be overcome.)

Another economy with periodic unrest is Thailand. Nominally a democracy, Thailand is split by a divide between the military, royalists, and the business elite and a rural majority of the "poor" who feel that they have been neglected. This has led to frequent coups and changes of prime ministers, and has been marked by riots off and on. A demonstration (or riot) on April 11, 2009 was particularly embarrassing to the "elitists" in power, who had to cancel a summit meeting of East Asian leaders at in the resort town of Pattaya when rioters took over buildings where the summit was to be held. Several foreign leaders had to be airlifted from the premises by helicopter. See: Bill Tarrant, "Thai Protesters Force Asia Summit Cancellation," Reuters, April 11, 2009.

85 "Panama: Poverty Despite Economic Growth," *Prensa Latina*, Feb. 1, 2007.

86 John Pilger, *Freedom Next Time*, book manuscript reviewed by *Al Jazeera,* Aug. 29, 2006. Pilger is a noted social critic.

87 Celia W. Dugger, "Supermarket Giants Crush Central American Farmers," *New York Times,* Dec. 28, 2004.

88 Vanessa Burgos, "Mexico-Guatemala—the Other Border," originally in *Upside-Down World*, Nov. 14, 2007. Can be found at www.bilaterals.org/article.php3?id_article=10328 The same kind of methods used to ferry illegal immigrants from Mexico to the United States are used to ferry them from Guatemala into Mexico. The problems – and controversies – with down-and-out migrants are similar in both places. Human smuggling is not confined to trails leading to the United States. Multi-million dollar smuggling operations are moving people south from Somalia or Ethiopia toward South Africa (Brian Hungwe, "Tracking Africa's People Smugglers," BBC, Aug. 1, 2009 found at http://news.bbc.co.uk/2/hi/africa/8178587.stm).

Global rural-to-urban population migration, tracked for decades by the United Nations Office of Population Studies, projects 57% urban by 2025 and 70% urban by 2050 according to the table found at: www.un.org/esa/population/publications/wup2007/2007urban_rural.htm The World Bank and other agencies that worry about such trends dryly suggest that unique approaches will be needed to avoid having billions more economic shut-outs became a serious global problem. A typical agency report is "More than Half the World is Now Urban, UN Report Says" from the World Bank, July 11, 2007. Related reports and programs of the World Bank can be found at: http://econ.worldbank.org/ by drilling down on such topics as "migration and remittances."

89 Manufacturing employment comparisons for 10 countries can be found from a US Bureau of Labor Statistics Report at Mfg employment Comparative Civilian Labor Force Statistics www.bls.gov/fls/flslforc.pdf. Manufacturing employment in India has held steady at about 8 million or so (out of over 1 billion population, according to its Annual Survey of Industry 2004–2005: http://mospi.nic.in/asi_table1_2004_05.htm). Statistics on manufacturing employment in

China are so confusing that estimates vary widely. According to a US Bureau of Labor Statistics study, Manufacturing in China, Table 3, it was 88-108 million in 2004: www.bls.gov/opub/mlr/2005/07/art2full.pdf. The report details the problems in making such estimates. Chinese manufacturing employment exceeds that of all the OECD countries combined, and yet the percentage of the workforce engaged in it is less than in the United States. Assuming that manufacturing is going to soak up unemployment forever seems to be an idea whose time has now passed.

90 *Manufacturing & Technology News*, "Manufacturing Educator Pleads With Industry to Help Recruit Students," Feb. 28, 2008. A professor pleads with foundries and metal casting companies to help make a future in their industry seem attractive to young people while still in elementary school, for youth think of a career in metal forming as a dead end. The article is typical of all kinds of "school-to-work" programs across the United States. The problem is not just with the youth. Many managers don't see that technical, high-quality manufacturing not only requires hands-on tacit skills, but broad skills dealing with people, technology, and knotty problems serving both customers and the environment well. If the pay is modest, native-born Americans go for something believed to hold more promise and be "cleaner," so factory jobs are not only outsourced to workers outside the United States, many are "outsourced" to immigrants coming in. Rather casual observation of agricultural and service industry work is sufficient to see the same phenomenon.

91 Simon Kuznets, "Economic Growth and Economic Inequality," *American Economic Review,* Vol. 45, 1955, pp. 1–28. In Figure 1.3 a higher Gini Coefficient signifies greater income inequality derived from the inequality of different percentile segments from national income data. However, data quality is so variable that only large differences suggest anything meaningful. Gini coefficients were from www.nationstats.com for years ranging from 1992 to 1998. (Numbers in parentheses denote that nation's rank in inequality among 112 nations listed, so being ranked 1 means having the highest inequality.) Life expectancy at birth is also from www.nationstats.com. GDP per capita is given at purchasing power parity with the United States in the same year. Some have been inflation-adjusted, but to what years could not be found. GDP per capita for 2003 is directly from the *CIA World Factbook*, and GDP per capita for other years is from www.nationstats.com, which gives its source as the *CIA World Factbook.*

92 Michael L. Ross, "Nigeria's Oil Sector and the Poor," Report to the U.K. government, May 23, 2003, found online at www.polisci.ucla.edu/faculty/ross/NigeriaOil.pdf On p. 2 Ross cites a long list of references over time that conclude that resource rich countries tend to be less democratic, be more prone to unrest and civil wars, have more corruption, and for most people, economic growth, is slow, zero or even negative. Nigeria could be Exhibit A in this line up of countries. Interested readers can check recent Nigerian history, starting with the BBC at: http://news.bbc.co.uk/2/hi/africa/8169359.stm Many different groups, most likely including Nigerian government officials, divert crude oil from oil company pipelines to "bunkers" from which they can sell it, so even production and sales figures are murky. About half of Nigeria's oil output is exported to the United States, and the Energy Information Administration lists its reserves at 36.2 billion barrels, second only to Libya in Africa. Both countries have "sweet" crude, highly desired because of less refining and lower sulfur.

Nigeria is Africa's most populous nation with about 125 million people in 2003, a lot of people to be restless. Lagos, the capital, is densely populated with about 8 million people, and growing rapidly. Besides the unrest over oil revenues, the city has been cited as a favorite dump for electronic waste from industrial societies. See: Sam Olukoya, "As E-Waste Dump, Lagos

Imperils People," Inter Press Service News Agency, Jan. 23, 2008. Environmental dumping is just one more reason for Nigerians to seethe.

Environmental damage in the Delta, source of most Nigerian oil, is considerable, and the politics of this are entangled in a history of failed democracy amidst tribal and religious conflict. The ongoing saga of the writer Ken Saro-Wiwa has kept this situation alive in Western media. Jad Maouwad "Shell to Pay 15.5 Million to Settle Nigerian Case," *New York Times*, June 10, 2009. Allegedly to avoid stirring more publicity about the Wiwa vs. Shell case, Shell Oil settled it before going to trial, accused by plaintiffs of complicity in the sham trial and execution of Ogoni tribal protest leader Saro-Wiwa in Nigeria in 1995. The plaintiffs regarded the trial outcome as a symbolic victory just because a corporation was held accountable. An old video describing the incident is at: www.shellguilty.com/wiwa-v-shell-video/ (site sponsored by the Center for Constitutional Rights, which is dedicated to legal action in such cases). Except for a statement denying complicity, Shell has made no public comment about Wiwa-vs.- Shell, but it's 2008 Corporate Social Responsibility Report refers to Nigeria (www.shell.com/home/Framework?siteId=nigeria) In 2006 violence in Nigeria caused oil companies to repatriate the families of Western managers and executives. Oil output dropped 20 percent or so because of terrorism or threats of it. Nigerian production was up in 2008, but unrest continued, including attacking and kidnapping oil company personnel (*Alexander's Gas and Oil Connection*, Jan. 29, 2009). By June 2009, attacks by the "MEND" rebels had escalated until daily production of 1.6 million barrels was about half of capacity according to *Al Jazeera*, "Poor Miss out on Nigeria Oil Riches," June 9, 2009.

93 See for instance, Carmen Gentile, "Analysis: Chad Unrest May be over Oil," UPI, Feb. 7, 2008, which described unrest over a disputed election; for background, see Nick Kotch, "African Oil –Whose Bonanza?" *National Geographic*, Sept. 2005. Eventually the World Bank pulled out of a financing agreement for an oil pipeline carefully planned with an Exxon-led extraction program: "World Bank Announces Withdrawal from Chad-Cameron Pipeline After Early Repayment," Bank Information Center, Sept. 14, 2008 (found at www.bicusa.org/en/Article.3892.aspx). Chad is also embroiled in border conflicts with Sudan.

Information on Chad is harder to find than for Nigeria. Wikipedia has a rundown on the history of conflicts in Chad at http://en.wikipedia.org/wiki/Civil_war_in_Chad_(2005–present) It may be as accurate as any; hard to say. It's a very confusing tangle to follow from afar. For an example see "Chad Carried Out New Air Raid in Darfur," *Sudan Tribune*, July 26, 2009 (www.sudantribune.com/spip.php?article31836) By comparison with major oil regions, Chad has only 1.5 billion barrels of proven reserves, and Sudan has about 5 billion barrels (Energy Information Administration figures). A great deal of turmoil has been stirred up over relatively low reserves of petroleum, but there are other factors in the conflicts, like severe drought.

94 Greg Flakus, "Analysts Concerned Venezuelan Turmoil Affecting Oil Prices," *Voice of America News*, www.voanews.com, as ported to EIN News (www.einnews.com), Sept. 12, 2004. Reading Venezuelan news for years numbs one to "left-wing" and "right-wing" advocates endlessly talking past each other with objectivity being the victim of both. A letter illuminating all-too-common blind spots is from Claudio Bifano, President of the Venezuelan Academy of Physical, Mathematical, and Natural Sciences, in *Science*, June 19, 2009. The Chavez government fired researchers from the Venezuelan Institute of Petroleum Research (without saying whether oil company funding had also unduly influenced research); Chavez wants research directed at "social aims."

95 A typical observation is from Thomas L. Freidman, "The Oil-Addicted Ayatollahs," *The New York Times,* Feb. 3, 2006. He noted that the fortunes of Iran are tied to oil prices, and that the former Soviet Union collapsed because it overextended when oil prices were high in the 1970s. It could not sustain an empire (and the drain of invading Afghanistan) when oil prices collapsed in the 1980s. By 2009, Hugo Chavez had to cut the Venezuelan government budget and trim spending when oil prices dropped to $40 per barrel. The history of prior "left-wing" politicians was beginning to repeat (*BBC*, "Chavez Cuts Budget over Oil Price," March 22, 2009).

96 This exchange began with Stanley Fischer, "Globalization and its Challenges," Richard T. Ely Lecture, January 2003, published in *The American Economic Review,* Vol. 93, N0. 2, May 2003, pp. 1–30. *The Economist's* interpretation was "Catching Up," August 21, 2003. James Galbraith of the University of Texas composed the most popular exposé of the *Economist's* gaffe, originally on opendemocracy.net. Salon.com ran a column by Galbraith summarizing the dust-up on Mar. 22, 2004. The latest gini coefficients, 40 for China and 37.8 for India, are both slightly below the United States (40.8) according to www.nationmaster.com.

97 For example, "In the Shadow of Prosperity," *The Economist*, Jan. 20, 2007.

98 Thomas Piketty and Emmanuel Saez's studies are widely accepted because they are methodologically thorough. A paper summarizing their work through 2003 is "Income Equality in the United States, 1913–2002," at http://elsa.berkeley.edu/~saez/piketty-saezOUP04US.pdf

99 2007 data are in papers cited on Saez's web site: http://elsa.berkeley.edu/~saez/, and have been referenced in editorial commentary such as David Cay Johnson, "Income Gap is Widening, Data Shows, *New York Times*, Mar. 29, 2007. With the financial collapse, interest in this topic in the media picked up very quickly.

100 Elizabeth Sawhill and John E. Morton, "Economic Mobility: Is the American Dream Alive and Well," 2007 by the Economic Mobility Project sponsored by the Pew Charitable Trusts with participation by representatives from The Brookings Institute, The American Enterprise Institute, The Heritage Foundation, and The Urban Institute—plus a panel of economists; found at: www.economicmobility.org/assets/pdfs/PEW_EMP_AMERICAN_DREAM.pdf. Similar, more recent reports can be downloaded from the same site: www.economicmobility.org. The subject is laden with controversy on the inferior economic status of women, blacks, immigrants, youth, elderly, and so on, compared with white males in their prime, and the parties spin the data to fit their views. However, the study concludes that upward mobility in the United States is not much different from that in many other countries, and much older studies also reached the same conclusion. See for example, Robert Erickson and John H. Goldthorpe, "Are American Rates of Social Mobility Exceptionally High?" *European Sociological Review,* 1985, pp. 1–22.

101 During the past twenty years, the relationship between income, social status, health, and quality of life has received serious study, if little publicity. Two books having somewhat different contexts summarize it nicely: Richard Wilkinson, *The Impact of Inequality*, The New Press, New York, 2005; and Michael Marmot, *The Status Syndrome*, Times Books (Henry Holt) New York, 2004. Their findings are too comprehensive to summarize succinctly, but their conclusions are contrary to conventional thinking in a business culture that stresses "going for the win" both inside companies and between them. The economic distinction between haves and have-nots has a status counterpart: socially accepted and socially disdained. A social status of respect or no respect, not economic income strata, is associated with people tending toward high-immunity or

low-immunity in personal health. This is not discussed much in popular media, but related issues occasionally make a mainline story; for example, Shari Rudavsky, "Is Your Paycheck Worth the Stress?" *Indianapolis Star*, Nov. 15, 2005.

102 Donna Y. Ford, Tarak C. Grantham, and Gilman W. Whiting, "Another Look at the Achievement Gap," *Urban Education*, Feb. 2008. A culture with a long history of being socially disdained is one of low expectations. That is, the attitude of the socially disrespected is, "No matter what I do or what I achieve, it will be neither appreciated nor rewarded, so why try?" For example, the authors' find that gifted black elementary school students cannot connect their culture with school achievement. If they have positive school achievements, behaviors, and attitudes, they are "acting white," no longer part of the group. If they have negative school achievements, behaviors, and attitudes, they are "acting black." (The author's own experience with "inner-city black" college students is that education tended to estrange them from former friends, and sometimes family, torn between pride of achievement and social ostracism. In work places, a similar attitude has been experienced with low-status workers of any race. Enthusiasm proposing ideas for improvement sets them up for disdain from co-workers. Some identify with their "class" by describing themselves – and much else – using profuse profanity, for instance.)

103 Figures are taken from multiple reports of the UN-Habitat State of the World's Cities, 2006/7, at http://ww2.unhabitat.org/mediacentre/sowckit2006_7.asp. For a more qualitative description of life in big urban slums, see Robert Neuwirth, *Shadow Cities: A Billion Squatters, A New Urban World*, New York, 2006; or Mark Kramer, "*Dispossessed: Life in Our World's Urban Slums*," Orbis Books, Maryknoll, NY, 2006. Determining how many people are displaced because of environmental reasons is a murky area. For example, would people permanently relocated in the United States because of Hurricane Katrina fit that category? World wide, the numbers include only those counted as receiving aid, which could be 25 million or more, with many more millions in vulnerable locations (Michael Renner, "Environment a Growing Driver in Displacement of People," *Vital Signs 2009*, Worldwatch Institute, Washington, DC, pp.89-91).

104 Amy Chua, *World on Fire*, Doubleday, New York, 2003. Now a professor at Yale Law School, Chua's family was one of the Chinese upper class in the Philippines. She describes a typical scam as a company or institution favored by the government, and perhaps partly funded by it, which can take on associates of the rulers as "consultants" or similar roles, paying them a good deal for doing very little. For safekeeping the money is frequently sent outside the country. A person raised from a child in this environment may never understand that others regard it as unethical; it is just how things work. Many "terrorist" movements have a degree of economic motivation. For example, the Taliban in Pakistan have drawn on resentment of many of the poor toward the landlord class in a country where feudal systems have never been fully displaced, and they identify capitalist institutions with their old masters. (Jane Perlez and Pir Zubbair Shah, "Taliban Enlist an Army of Pakistan's Have-Nots," *New York Times*, April 17, 2009.)

106 Shailendra Singh, "Island Populations Thinning Out from Migration," Inter Press Service News Agency (www.ipsnews.net) Jan. 2, 2007. Four government coups since 1987 resulted in 140,000 Fijians of Indian heritage (from India) leaving Fiji; departures of skilled people continue at a rate of about 500 per month. Much of the income of people remaining in Fiji is remittances from relatives in industrial societies. By 2009 Inter Press News Agency was reporting that the government installed in the latest coup (2006) still had no date for elections, corruption was deep and widespread, and politicians were unwilling to make "tough decisions" while more of the population slipped into poverty. The population of Samoa, Tonga, and the Cook Islands has a very similar pattern of dependence on remittances from abroad, and a similar "brain drain," but

not as much political turmoil. This situation is akin to that of Latinos migrating to the United States, or to that of thousands of Iraqis displaced by the Iraq War that began in 2003.

108 Noorina Hertz, *The Debt Threat*, HarperCollins, New York, 2004. Hertz is a long-time critic of laissez faire capitalism (Judge Business School, Cambridge University, UK, but now visiting Erasmus University, Netherlands), who thinks that the current financial crisis represents a breakdown in the global capitalist system that will transform it to better serve social needs, especially in developing countries. She calls this "co-op capitalism" replacing "Gucci capitalism." See Noreena Hertz, "The New Co-Op Capitalism," *The Daily Beast*, April 4, 2009; on line at: www.thedailybeast.com/author/noreena-hertz/

107 John Perkins, *Confessions of an Economic Hit Man*, Berrett-Koehler, San Francisco, 2004. Web sites and occasional news reports dig into the soft underbelly of global corporate domination methodology. Most present only allegations. This is a "full confession" by a participant. An interesting contrast is John B. Taylor, *Global Financial Warriors*, W.W. Norton, New York, 2007. Taylor recounts his exploits mostly in the post 9/11 world, arranging debt relief to various countries, setting up a stable Iraqi currency, and trying to establish some accountability for World Bank project disbursements in hopes that funds would actually reach those in need. The contrast between the two books shows why the huge gap between Wall Street financial thinking and third-world system realities make well-meaning investment backfire. Reality is that lasting impact is likely only from development people, on-site and on-the-ground, giving people examples of change which they can adapt when they see they need to change and when they want to change.

108 *Manufacturing & Technology News*, Feb. 28, 2008; "Hunter and Ryan Hope Press Corps Can Help Convince Congress to Take on China." Six congressmen and members of the China Currency Coalition hoped to persuade members of the press to write articles about the economic devastation in the United States from cheap Chinese imports so that fellow legislators would feel compelled to force China to revalue its currency upward. This was only one example of promotional ideas by industries and unionists frustrated by loss of business and loss of jobs.

109 Some comparative poverty levels as percentages of total population: United States, 12%; United Kingdom, 14%; France, 6%; Germany, 11%; China: 8%; India 25%; Kenya, 50%; Venezuela, 38%; Columbia, 49%; Bolivia, 60%, Brazil, 31%; Nigeria, 60%; Sudan, 40%; Haiti, 80%. Most of the places where unrest simmers have poverty levels above 50%, or are pockets of high poverty in populous countries. (All numbers are rough approximations using suggestive indicators, and the places to draw a line using them are arbitrary – but that does not mean that the condition they attempt to quantify does not exist.) Source: country profiles in*2007 CIA World Factbook*.

110 World Wildlife Federation News Center, "Tuna Commission Comes Up with a Disgrace, Not a Decision," Nov. 24, 2008. (In archives at www.panda.org/wwf_news).) This article reported disputes on the Mediterranean blue fin tuna fishery, and to get the flavor, read the letters from fishermen in response to it. The World Wildlife Federation has many more like it on fisheries all over the world. No part of the world has escaped a fishery collapse; each follows a drearily familiar pattern. Catches aren't completely recorded; data is skimpy; scientists and officials report impending doom based on what they do know, but parties with livelihoods at stake stay in denial until there is no point denying anymore. It's not a new problem either. At least two well-researched books describe the fishery collapse phenomenon beginning as far back as the 19th century; modern technology just accelerated it: Callum Roberts, *The Unnatural History of the Sea*, Shearwater Books (Island Press, Washington DC, 2008. And Charles Clover, *The End of the*

Line: How Overfishing is Changing the World and How We Eat, University of California Press, Berkeley, 2008.

111 Shannon Brownlee, *Overtreated*, Bloomsbury, New York, 2007. The author, a medical writer, pulled together a lot of evidence and connected the dots on health care better than most. A race for new facilities and the latest technology eats resources, while wellness programs and prevention remain minimally effective. Commendable programs to improve work flow and quality of delivery don't touch the waste at the core of a system strangling in its own complexity as various players contend to build sales volume by having their products prescribed by physicians, and paid for by insurance. Atul Gawande, MD, comes to a similar conclusion as summarized in "The Cost Conundrum," *The New Yorker*, June 1, 2009 (based on an interview with Gawande, who has several popular publications). Similar logic is in a brief article by another physician, Sandeep Juhar, MD, "Many Doctors; Many Tests, No Rhyme or Reason," *New York Times*, March 11, 2008. (See also footnote 71, Chapter 4)

112 Nam P. Suh, *Complexity*, Oxford University Press, New York, 2005. Suh defines "imaginary complexity" as that which exists because we do not understand an area well enough for it to become simple. This complexity exists because we have yet to knife our way though our ignorance to a clearer understanding of a better process or of a natural phenomenon.

113 Amory Lovins, Hunter Lovins, and Paul Hawkens, *Natural Capitalism*, Back Bay Books (Little, Brown), New York, 2000. This was one of the first books to try to translate environmental issues into language executives can understand.

114 Indexes of publicly traded Baldrige winners have consistently outperformed the market, and financial indexes of conspicuous "lean performers" have generally exceeded the S&P 500 index. One financial analyst, Cliff Ransom, regularly recommends manufacturers with lean, quality operations and room to grow the top line. However, being lean does not offset carrying a big financial load in a competitive market,as shown by GM, Chrysler, Ford and the bankruptcies of auto suppliers Collins & Aikman, Delphi, and others. Efficient production is of no avail if customers do not buy the output. Richard Schonberger concluded from considerable data that lean, as actually practiced, tends to degenerate in expansionary markets (companies get fat), and the effects are nowhere near their potential. For a short summary of Schonberger's conclusions, see: http://ebiz.uoregon.edu/poms2008/Plenary.pdf From an environmental perspective, the Global Lamp Index (60 companies taking "biological living system" approach to the triple bottom line) consistently outperformed stock market averages for the years 1996–2005. Joseph H. Bragdon, *Profit for Life*, Society for Organizational Learning, Cambridge, MA, 2006 (Table 5-2, p. 89). From all this and much more, one can conclude that expansionary financial thinking cannot be reconciled with serious efforts to minimize use of resources. Even the definitions of "success" are different.

Chapter 2: Learning from Toyota

1 Many points in this chapter were gleaned from conversations with Professor Emeritus Jinichiro Nakane, Waseda University, Tokyo, and from meetings of the organization known as JAPICS, which he chaired for many years. JAPICS had many members from Toyota, including its past chairman Fujio Cho.

2 The Toyota Way was seen on a visit to The Toyota Institute in 2003.

3 Jeffrey Liker, *The Toyota Way*, McGraw-Hill, 2004. Liker's description of The Toyota Way as fourteen principles is well done, but they are not The Toyota Way. Neither his book nor this chapter can adequately explain The Toyota Way. To learn it is to live it, and the learning is never finished.

4 Both the family and the company were originally named Toyoda. Sakichi Toyoda began developing looms in 1890, and incorporated as Toyoda Boshoku Corporation in 1918. When the automotive division separated from the loom division in 1933, the vehicle company was named Toyota to distinguish it.

5 The term "Lean Manufacturing" is from *The Machine that Changed the World*, James P. Womack, Daniel T. Jones, and Daniel Roos, Scribner, 1990. The book resulted from a five-year study of the global vehicle industry by the MIT International Motor Vehicle Program. Womack and Jones followed up with *Lean Thinking*, Simon & Schuster, 1996. Womack established the Lean Enterprise Institute (www.lean.org) to promote lean thinking more broadly. In the 1990s "lean" became the generic name for TPS-like thinking.

6 Jim Huntzinger, "The Roots of Lean," *Target*, Vol. 18, No. 2, 2002, pp. 9–22. Training Within Industries (TWI) was based on Charles Allen's century-old, well-tested, four-step training method. Toyota's Job Instruction (JI) cards today are almost identical to those issued by TWI in 1944. TWI Job Instruction is for coaching and holding standard work. TWI Job Methods was a forerunner of kaizen. JI plus train-the-trainer cascades new work concepts quickly: Workers become trainers training more workers, and so on. However, American managers during WWII resisted anything from "the government" that suggested that they weren't expertly running their operations, and its use began to fade before that war was officially over. The use of TWI Job Instruction became embedded in Toyota's practice of TPS, with its origin not much thought about, and in the United States it was all but forgotten until its revival at the beginning of the 21st century. One can now find books about it.

7 *The Evolution of a Manufacturing System at Toyota*, Takahiro Fujimoto, Oxford Univ. Press, 1999, Figure 3.2, p. 66. Toyota began in the textile loom business, not automotive, and later branched into housing. The earliest roots of TPS are in the loom business, but the major development of TPS was within Toyota Motor Manufacturing.

8 Taiichi Ohno had a long-time tiff with Shigeo Shingo, the well-known author for whom the Shingo Prize is named, and an industrial engineering consultant to Toyota. Both are now dead. One can only guess at the issues, but it is known that Ohno thought Shingo claimed more credit for TPS than he merited. And Shingo was obviously more into creating technical solutions than inducing others to figure them out on their own. One can easily imagine Ohno being upset if

Shingo undermined his system of human development by teaching techniques without forcing people to observe and think "why" on their own.

9 Much of the material about suppliers is from the work of Professor Jinichiro Nakane and was reported in "Family Ties," Robert W. Hall and Jinichiro Nakane, *Target*, publication of the Association for Manufacturing Excellence, Vol. 6, No. 3, Fall 1990, pp. 4–11.

10 *Zero Inventories*, Robert W. Hall, McGraw-Hill Trade; ISBN: 0870944614, 1983, pp. 284–294.

11 See for example, "Knowledge Management Based on Your Organization's Approach to Life: Customer Intimacy," Melissa Rumizen and Bill Baker, *Target*, Vol. 21, No. 5, 2004, pp. 24–29.

12 Michael J. Kennedy, *Product Development for the Lean Enterprise*, Oaklea Press, Richmond, VA, 2003. Much of the section on Toyota's new product development system is from the work of Kennedy and the late Alan Ward at the University of Michigan, and the National Center for the Manufacturing Sciences.

13 David C. Kang, *Crony Capitalism*, Cambridge University Press, Cambridge, U.K., 2002. This book primarily describes the nefarious dealings of elite families with large holdings that are intertwined with governments, but "cronyism" also implies that the elitists naturally regard the primary purpose of their organization as the perpetuation of their position. To do that, they must have strong control systems. They cannot trust in development of all the people, nor tolerate broad visibility of company operations, so it's very unlikely that they could foster a "TPS culture" or a "community of excellence." In a bygone age, the elitists might have been patriarchal controllers; in a global financial economy they are likely to be market cap manipulators. On March 11, 2003, *The New York Times* reported such a case in "10 Top Executives in South Korea Indicted on Stock Charges," by Don Kirk.

14 Robert W. Hall, "Tokyo Sekisui, *Target*, Issue 2, 2008.

15 All societies are reluctant to admit that they have "skeletons in their closet" or to contradict their own folklore, so Japanese are not unusual. Japanese have had many financial scandals, and post-bubble, its banks were very slow to admit the size of their non-performing loan portfolios (which may have prevented runs on the banks). In foreign relations, unwillingness to admit WWII atrocities, much less apologize for them, cost Japan dearly for decades.

16 Figure 2-4 summarizes ideas from the writings of Edward T. Hall, *Beyond Culture*, Bantam Doubleday Dell, New York, 1976, and several of Hall's other books. Edward T. Hall is unrelated to the author. A renowned anthropologist, he began studying the cultures of Southwestern American Indian tribes in the mid-20th century, originating the concept of high-context and low-context cultures, and extended his comparisons to differences in business cultures.

17 Li-Jun Ji, Richard Nisbett, and Kaiping Peng, "Culture, Control, and Perception of Relationships in the Environment," *Journal of Personality and Sociology*, Vol. 78, No. 5, pp. 943–955. (American Psychological Association) Several similar Asian-American comparison experiments have taken place at the University of Michigan, and are reported elsewhere.

18 David Magee, *Turnaround,* Harper/Business, New York, 2003, pp. 87–89, outlines the problems Nissan had fallen into with suppliers. Nissan had cross-holdings and long-term relationships with suppliers, but without the rigorous mutual improvement processes of Toyota. The book concentrates on Carlos Ghosn's activities as the architect of improvement, a theme very attractive to Western business readers. However, his style of leadership was not that of TPS—still too much directing; too little on developing people.

19 James M. Perry, *Arrogant Armies,* John Wiley & Sons, New York, 1996. Military disasters from Braddock at Ft. Duquesne to Task Force Ranger in Mogadishu illustrate how ignorance of opponents' abilities and complacency led to disaster. In many cases, including Custer at the Little Big Horn (not reported in the book), commanders blindly relied on tactics that had worked for them in the past without thinking through what might be different or what had changed.

Blind reliance on "what worked in the past," described as arrogant, may actually have deep psychological and neurological roots. A recent rat lab experiment in Portugal has stimulated broader interest in this. Rats subjected to chronic stress were likely to revert to habitual behavior when a routine for obtaining rewards no longer worked. Even if they had learned differently, under stress they continued old habits anyway. The neurological reasons for this were explored, but the upshot was that stressed rats were likely to revert to old patterns rather than adopt new ones under changed circumstances. Plenty of casual observation of humans suggests that we may do the same, but so far as is known, no research has attempted to test this conjecture. (Eduardo Dias-Ferreira, et al, "Chronic Stress Causes Frontostriatal Reorganization and Affects Decision Making," *Science,* July 31, 2009, pp.621-625.)

20 These observations are offered based on nearly 30 years of seeing "lean" companies, and from over 20 years of writing and editing lean operations company cases for *Target,* publication of the Association for Manufacturing Excellence, an organization that has promulgated "lean, teams, and quality" since its founding in 1985.

21 *IndustryWeek,* a publication of Penton Publishing, has sponsored the Ten Best Plants Award since 1990. Current winners can be found on the *IndustryWee*k web site, as well as a package of aggregate statistical benchmarking performance measures of Ten Best Plants finalists (25 each year): www.industryweek.com

22 The Shingo Prize, run from Utah State University, awards prizes based on criteria according to teachings of the late Shigeo Shingo, who consulted with Toyota during the formative years of TPS. A complete listing of all Shingo Prize winners can be found at www.shingoprize.org/Recipients_Business.cfm

23 Gerald J.S. Wilde, *Target Risk,* PDE Publications, Inc., Toronto, Ontario, Canada; 1994 and 2001 editions. The 1994 edition is online at http://psyc.queensu.ca/target/. Target Risk refers to people driving at a level of personal accident risk at which they feel confident, regardless of safety technology or prescribed safety rules.

24 John Schwartz and Matthew L. Wald, "Shuttle Panel Considers Longstanding Flaws in NASA's System," *New York Times,* April 13, 2003. Prof. Vaughan, mentioned in this article, is a sociologist who reviewed the 1986 Challenger disaster from the viewpoint of NASA's work culture and institutional mind set.

25 John Schwartz, "For NASA, Misjudgments Led to Latest Woes," *New York Times*, July 31, 2005. Fuel tank insulation, subject to both extreme temperature differences and aerodynamic turbulence, is a more difficult technical challenge than was long recognized. The Columbia accident reports from NASA were found at http://caib.nasa.gov/ and the accident reports on the 1986 Challenger disaster, which are referenced, were found at: http://history.nasa.gov/sts51l.html

26 H. Thomas Johnson and Robert S. Kaplan, *Relevance Lost: The Rise and Fall of Management Accounting*, Harvard Business School Press, 1987. This seminal book kicked off a great deal of ongoing controversy about internal cost accounting; then performance reporting in general. Kaplan went on to develop and advocate use of the Balanced Scorecard. Johnson became interested in the inability accounting to include external environmental costs. Much of the thinking about financial measurement and environmental sustainability so far has concentrated on checking whether reducing natural resource use and toxic releases also yields cost savings to companies. The inability of cost accounting to recognize waste reduction for lean operations has long been recognized, and beginning in 2005, these issues have a regular conference and forum at www.leanaccountingsummit.com.

27 An American-based exception is Ventana Medical Systems. One headquartered in Sweden, but with American operations, is Autoliv. A number of Japanese operations like Sekisui Heim House parallel Toyota in the development of people for autonomous work and process improvement. (From cases that have appeared in *Target*, publication of the Association for Manufacturing Excellence.)

28 John Lippert, "In a Supersized World; Toyota Slims," *International Herald-Tribune*, Feb. 22, 2006. The technology is a smaller, less costly mold for casting aluminum engine blocks, in production in the U.S. at Bodine Aluminum, a Toyota subsidiary, as well as in Japan.

29 Richard J. Schonberger, *Best Practices in Lean Six Sigma Process Improvement*, Wiley & Sons, 2007. Schonberger compares performance measures using corporate financial reports. Back in the early 1980s the Toyota Motor Manufacturing Company's inventory turns approached 80 when it was a local industry in Aichi Prefecture with inbound travel distance from suppliers being the shortest in the world. In addition, the value of finished cars transferred off its books to Toyota Sales Company, so weeks of finished goods inventory being shipped abroad never showed up on the manufacturing company's books. Today Toyota's overall inventory turns are about the same as other vehicle companies, while in-process inventories in Toyota plants remain very small.

30 Just-Auto.com Editorial Team, "Belgium: Toyota Turns to Workers for Better Quality in Europe," Dec. 12, 2005. Toyota now has three Global Production Centers for training. The first one opened in Japan in 2003; followed by ones in Europe and the United States. These centers became necessary to develop workers, new managers (and some older ones) in "the real TPS" without the misunderstandings of inexperienced managers in far-flung places who were not fully engrained in the system. Lapses in system rigor show up quickly in quality lapses, so Toyota had to shore the system up to retain its quality reputation.

31 Associated Press, "Toyota May Delay Models to Work on Quality Control," *New York Times*, Sept. 25, 2006. Earlier news articles indicated that Toyota's top management was aware of the growing problem, and was determined to fix problems at their source. Merely adding the waste of inspection and rework could not prevent quality errors from occurring.

32 Hirohisa Sakai and Kakuro Amasaka, "HIA, Highly Reliable Production System by Developing Intelligence Operator," paper presented at the 17th Annual Conference of the Production and Operations Management Society, Boston, MA, April 30, 2006. Operators in the future must understand advanced technology, including programmable and embedded software, in order to kaizen production processes. The intent is for Toyota workers, world wide, to become as knowledgeable as two-year technical school graduates. Toyota's global IT system should enable operators to learn technology, plus be a medium for them to share ideas and standardize improvement in work methods in comparable tasks among Toyota plants everywhere.

33 The "dealer problem" is a legacy from old wars between dealers and vehicle manufacturers. For anti-trust reasons, auto companies cannot legally mandate how independent dealer companies in the United States run their businesses. Vehicle manufacturers can only mandate policies on spare parts, service systems, and vehicle warranties.

34 "The Patent Scorecard 2003," *Technology Review*, Massachusetts Institute of Technology, Vol. 106, No. 4, May 2003, p. 59.

35 "Japan; Toyota Standardizes Economy Meter," Just-Auto.com, Oct. 3, 2006. As an example of Toyota thinking, a feedback system, somewhat like that in the Prius, gives drivers feedback on driving in an environmentally friendly manner. The psychology of seeing instant mileage augments the hybrid drive system. Toyota estimates that this feedback alone will cut fuel usage by four percent. As an example of more advanced thinking, Toyota is reported to have displayed a "1/X" (one "exth) car made substantially from plant based material like seaweed, so the intent to adapt to Compression is serious (From Just-Auto.com: "JAPAN: Plant-Based Plastics for Prius," April 7, 2009). The broader question is whether Toyota can escape its own growth trap to become a leader in quality personal transportation in a rapidly changing world.

Chapter 3: Learning to Learn

1 The prevalence of non-systemic thinking frustrated Stafford Beer, Henry Minzberg, Jay Forrester, and other pioneers advocating systemic or process thinking. This kind of thinking is far from new as a concept; it's just hard to do.

2 Learning loops began with the concept of double loop learning from Chris Argyris and Donald Schon, *Theory in Practice*, Jossey-Bass, San Francisco, 1974. Double-loop learning never became big in general management training, but variations have been used for over three decades in organizational development. Interestingly, Argyris first thought of it as an aid to strategic thinkers, not for everyone in general. Learning loops using feedback from intelligent logic circuits is an old concept in systems engineering, and these are often more complex than anything consciously diagrammed for human organizations, even organizations of systems engineers.

3 Bateson, well known as the husband of Margaret Meade, was himself a distinguished anthropologist, linguist, and cyberneticist. Probably his most influential idea was that of the double bind, roughly defined as any situation in which a person or thing is "damned if you do, damned if you don't, and unable to question anything."

4 Donald O. Hebb, *The Organization of Behavior*, John Wiley & Sons, New York, 1949. Hebb's pioneering work opened much further research on neural learning. An even earlier pioneer was Richard Semon who originated the concept of an engram, describing it as a "mnemic trace" or associative set in the brain that could be triggered. (Although passé in the field, "engram" was a convenient term for Compression.) From these skimpy beginnings, neuroscience has progressed very rapidly in recent decades. Researchers now investigate the effects of brain chemistry on neural processes. For example, a molecule called PKMzeta has promise of either enhancing or retarding neural connectivity, thus improving or blanking out memory traces. (Benedict Carey, "Brain Researchers Open Door to Editing Memory," *New York Times*, April 5, 2009.)

5 From Gerald M. Edelman, *Second Nature: Brain Science and Human Knowledge*, Yale University Press, New Haven, 2006, p. 23; Edelman attributes these stages of learning to J.B.S. Haldane.

6 Ivan Amato, *Super Vision*, Harry N. Abrams, Inc., New York, 2003. The opening chapter briefly compares many features of animal and human sensory capabilities.

7 Eye physiology sources include Amato, op. cit; a University of Utah Medical School web site, and various others.

8 William Sheehan and Thomas A. Dobbins, "Lowell and the Spokes of Venus," *Sky & Telescope*, July 2002, pp. 99–103.

9 An online rendition of the original gorilla video could be found for years at a Harvard web site that appears now to have been taken down. Viewers were asked to count the number of times the team in white exchanged the ball, and if thoroughly engrossed, few ever became aware of the gorilla. However, a similar video produced by Viscog Productions has recently been seen at: http://viscog.beckman.illinois.edu/flashmovie/15.php

10 Gary Giddons, "Put Your Voice Where Your Mouth Is," *New York Times,* Dec. 29, 2004.

11 Susan Blackmore, "Abduction by Aliens or Sleep Paralysis?" in *Bizarre Cases, Committee for the Investigation of Claims of the Paranormal* (CSICOP), Amherst, NY, 2000, pp. 30–39. CSICOP seeks scientific explanation for the miraculous goings on frequently reported in tabloid journalism.

12 Mark Ritchie, *Spirit of the Rainforest*, Island Lake Press, Chicago, 1996. Napoleon Chagnon studied the Yanomamö for years and wrote one of the most used anthropology texts about them, *Yanomamö: The Fierce People*; Holt, Rinehart, and Winston, New York, 1968. Because of this many Americans have heard of the Yanomamö, but Chagnon also became a lightning rod for controversies around such studies of non-modern tribes. Ritchie seems to have avoided such controversy, while drawing from his own observations as well as those of others.

13 Bertrand Russell and Alfred North Whitehead worked many years on *Principia Mathematica* (completed in 1913), attempting to construct a "mathematical theory of everything," much as Issac Newton's work of the same name had summarized the laws of classical mechanics in 1687. Russell and Whitehead stimulated interest in fundamental mathematics, but when they failed to achieve a tight logical construct, their doubts that it was possible deepened. However, despite growing doubts, David Hilbert and others kept seeking axiomatic frameworks that could interlink into an airtight logical universe. In 1900, Hilbert had posed twenty-three unsolved problems, In the 1920s, Gödel began working on Hilbert's second problem, proving the consistency of analytical logic. When his theorem popped the postulate that consistency of analytical logic was possible, the whole axiomatic house of cards came tumbling down. Since then most scientists and mathematicians have been content to establish consistency of logical threads through the universe of shifting reality, but the temptation to proclaim a "model that explains everything" is still with us, and naïve proponents may claim that a very simplistic model explains everything to their satisfaction.

14 Alan Turing (in 1937) and Greg Chaitin (much later) proved that to solve some propositions a computer would never stop running without deciding anything. Somewhere in all proofs is the concept of paradox, or undecidability, the limit to which anything is knowable. A Latin term for this is "ignoramabus," an apt description of a condition to which we are all subject.

15 Douglas M. Hoffstadter, *Gödel, Escher, Bach, an Eternal Golden Braid,* Random House, New York, 1979. This Pulitzer Prize winner briefly made paradox and self-referencing a popular cocktail party topic.

16 Kurt Gödel directed his proof to refuting Russell and Whitehead's *Principia Mathematica.* An English version of Gödel's Theorem, "On Formally Undecidable Propositions of Mathematica Principia and Related Systems" (with some notes added) has been found at www.geier.hu/GOEDEL/Godel_orig/godel3.htm. Web sites that display the original theorem paper seem to come and go, so one must generally look in a university library. The mathematically oriented wanting to learn more can start with The Kurt Gödel Society: http://kgs.logic.at/ However, web surfers will find many sources discussing the implications of Gödel's Theorem, and some postings that attempt to refute it.

17 David Berlinski, *Infinite Ascent: A Short History of Mathematics*, Modern Library (Random House) New York, 2005. In non-mathematical language, Chapter 9 summarizes the history of Gödel's incompleteness and its significance in formal mathematics, philosophy, and science, but mathematicians still struggle to question assumptions that may be unwarranted. In a broader context, see also Walter Truett Anderson, *Reality Isn't What It Used To Be*, Harper/Collins, New York, 1990. Anderson summarizes the implications of Gödel's Theorem on the eternal issues something like this: For the religious, God exists on pure faith. Proving that God exists based on logic is scientifically undecidable. By Gödel's Theorem, if God is omnipresent and omniscient, comprehending God is beyond human understanding; no human brain can model all of that. On the other hand, a God that is humanly comprehensible is no longer God, but a human construct. These infinite loops of logical paradox go nowhere.

The practical lesson from Gödel's Theorem is that no symbol and no model is the reality that it represents, but we are apt to be deluded that it is, and unconsciously so. A crude schoolyard lesson illustrating this was imparted to the author at about age 5. Using a stick, a wise old man of about age 7 poked two holes in the dirt. Pointing to one, he said, "That's your ass." Pointing to the other, he said, "That's a hole in the ground." Then he asked, "Where's your ass?" I pointed to the first hole. "No," he said, "Your ass is where it always is. You don't know your ass from a hole in the ground." Crude it may be, but this lesson obviously formed an indelible engram, as it does for most people. Any model is an abstraction, a incomplete version of reality. It may be inescapably necessary for us to think about reality, but it cannot capture everything in that reality.

18 Children unable to grasp abstraction learn the fable version: A lazy hare wakes up too late to overtake a tortoise. The liar's paradox (All Cretians are liars; I am a Cretian) is also Zeno's. Gödel took off from Russell's paradox (posed by Bertrand Russell in 1901): Does the set, S, of all sets that do not belong to themselves belong to itself? Perhaps the paradox most familiar to moderns is from *Catch-22* by Joseph Heller: If a combat pilot fears death, he is sane, so he must fly combat missions; if he pleads insanity because of his fear, he proves that he is sane, so he is obligated to fly in combat anyway. (See footnote 3, Bateson would call this a double bind.)

19 From the 19th Koan of Mumonkan, found at www.angelfire.com/electronic/awakening101/mumonkan.html. The concepts of both infinity and zero were not fully formed in the modern sense by either ancient Orientals or ancient Greeks.

20 Rebecca Goldstein, *Incompleteness,* Atlas Books (Norton), New York, 2005. Scholars have sought loopholes in Gödel's Theorem ever since it was published. For example, the famed philosopher Ludwig Wittgenstein considered Gödel's theorem to be a trivial paradox unrelated to serious thought. Wittgenstein himself suggested that all learning was limited because aesthetic appreciation was beyond formal description. However, that contends that since the human sensory system does not employ known mathematical logic, it can perceive absolute truth outside the mathematical-logical domain. Obviously the human brain is capable of sensing many phenomena that are not structured by any logical model or even self-conscious thought pattern. However, as soon as sensory input is organized into some form of cause and effect logic, even if not explicitly described, it becomes subject to Gödel's Theorem. And if a perception is so indescribable as to be only emotion, from intense pleasure to excruciating pain, is it anything other than a biophysical experience never fully translated to logical human consciousness?

21 Douglas Hofstadter, *I Am a Strange Loop,* Perseus Books, New York, 2007. Hofstadter is one of many authors exploring the quirks of human consciousness, including its limitations. We're prone to depend on self-referencing information even when we are aware that it is incomplete or

inconsistent. We accept what we see as prima facie evidence if we trust the source – which is why companies work so hard to build brand image.

The mechanics of our conscious thinking are physio-chemical processes in our neurological tissues. In addition to powers and flaws of the biology affecting this consciousness, it functions by generating and manipulating "symbols" (engrams) that are subject to Gödelian paradox. We can never investigate or comprehend all reality underlying our conscious experience, so at some point we have to trust our mental models – self-reference. Furthermore, if we can't associate these symbols with anything we can sense, we're utterly at sea.

On p. 200, Hofstadter gives an example: Translating an explanation of a "soap digest rack" in a 21st century American supermarket to an ancient Sanskrit. Sanskrit had no words for this; no vocabulary that could associate "soap digest rack" with any other Sanskrit word. If unable to connect one idea with another, a language is an empty model devoid of explanatory powers, not even wild and ridiculous ones. To describe the basics of 21st century American commercial society – electricity, power generation, detergent, washing machine, TV, marketing, ad infinitum – Sanskrit would have to invent new symbols. Even then, without seeing anything to relate these symbols to, an ancient Sanskrit could never really understand. He would be happier with folklore concocted from his own experiences, enhanced by his own imagination.

In a larger sense, the instinct to self-reference from old, established mental models of how things work inhibits discussing a future in Compression. The language of expansion is inadequate for it, because little that has been experienced in expansion provides mental hooks for learning to think in a very different way.

22 Probably the best-known anti-rationalist philosopher was Jacques Derrida, famed for "deconstruction." He held that all descriptions of reality cannot be separated from the symbolism by which they are expressed. He concentrated more on literary and philosophical critique than scientific critique, but attacked all descriptions or models by pointing out self-contradictions, paradoxes, or unconsciously assumed social viewpoints. Derrida was aware that the logic of deconstruction entangled itself in the same loops as any logic model it deconstructed, like defining the "meaning of meaninglessness." But others did not, so deconstruction branched out into post-modernism and other social theories holding that scientific logic is no more valid than any other; and in addition is rife with patriarchal attitudes and other non-egalitarian practices. Brief overviews of Derrida, deconstruction, and related concepts are easily found on the web.

In the abstract, deconstruction is hard to grasp, but a well-known example from quantum physics is the paradox of Schrodinger's cat. The spin of an electronic is unknowable because its state can only be determined by measurement, while measuring the spin appears to change the spin. But reality being hard to separate from description may be better illustrated by a baseball story (probably apocryphal) about Ted Williams, the eagle-eyed home run king, and Jocko Conlan, the colorful umpire. In a game with Conlan behind the plate, the catcher muffed a catch and the ball squirmed under Conlan's face mask, hitting him in the larynx, for once silencing Jocko's booming voice. He could call neither ball nor strike. Williams, ever impatient, screamed at Jocko, "Well, what was it?" After a long pause, Conlan croaked, "It ain't nothin' until *I say* it is."

23 Howard Gardner, *Frames of Mind: The Theory of Multiple Intelligences,* Basic Books, New York, 1983, 2nd edition published in 1993. Gardner followed up with at least four more books expanding on this theme, and many other people have done "twists" on his basic framework, especially in the education field.

24 Stafford Beer was well known for trying to clarify ideas about holistic, cybernetic systems to executives – and for being frustrated in his attempts. One of his last books was *Beyond Dispute: The Invention of Team Syntegrity,* John Wiley & Sons, New York, 1994. Jay Forrester, *Industrial Dynamics,* Pegasus, New York, 1961 began as an MIT researcher on computer engineering and wound up as a pioneer simulating large social systems. Russell Ackoff, *The Democratic Corporation,* Oxford University Press, 1994, is a well-known pioneer in Operations Research that came to see that an operating corporation must assume a more organic form than a structured hierarchy.

25 Philip E. Ross, "The Expert Mind," *Scientific American,* August, 2006. An "expert mind" seems to have implanted a multitude of engram patterns that can be grasped as a whole by a single stimulus, whereas novices have to struggle to make a lot of new logical connections. That is, a chess grandmaster can call up from experience the implications of a board formation in a glance, whereas a novice might spend hours mentally mapping out the many possibilities.

26 Elkhonon Goldberg, *The Wisdom Paradox,* Gotham Books, New York, 2005. Goldberg, a clinical professor of neurology, describes a shift of the "center of gravity" of the aging brain from right to left hemisphere. The left hemisphere stores an arsenal of patterns to call up for quick solutions to a wide range of problems, and these accumulate and modify with age. However, the brain's logic for deciding whether to admit a new pattern to the long-term arsenal also becomes more discriminatory. For a more standard psychological assessment, see Hart et al., "Feeling Validated versus Being Correct: A Meta-Analysis of Selective Exposure to Information," *Psychological Bulletin,* July 2009, pp. 555-588. The authors sift through numerous prior studies of how people select what information to pay attention to given their prior beliefs about often controversial topics. As expected, they found that people tend to favor information sources that validate prior beliefs, but not exclusively. Source selection bias varied greatly depending on the subject and the individual, and in some situations almost everyone favors "learning the truth."

27 If a human has never experienced visual stimulation in infancy, forming the neural circuitry to process visual stimuli in adulthood is very difficult, and impossible to do completely. Full adults that suddenly can detect photons have such an intense experience that many must rest part of the daytime in the dark in order to "recover." However, if sight is suddenly conferred on an adult, blinded at age 12 or so, adaptation is easier, if never to the level that might have been. Arguments about whether to restore sight to people of various ages continue. See: "Those Who Were Once Blind Can Learn to See, Study Shows," *Science Daily,* Feb. 20, 2007. (Online at www.sciencedaily.com/releases/2007/02/070220021337.htm.)

28 Jeff Hawkins (with Sandra Blakeslee), *On Intelligence,* Times Books, Henry Holt, New York, 2004. The statement is reasonably consistent with Hawkins theory of how the brain works, which is somewhat different from mainstream. Hawkins seeks better pathways for faster and deeper human learning.

29 Maia Szalavitz, "So Long Crystal Meth, Hello Cocaine," Statistical Assessment Service, June 12, 2007.

30 Charles Taylor, "Blind Spot: Hitler's Secretary," Salon.com, January 31, 2003. The article reviews the documentary movie by the same name, directed by Andre Heller and Othmar Schmiderer. Junge's account was also the primary basis for "Downfall," a German film on the final days of The Third Reich.

31 Susan Choi, "The Bubble Girl," *New York Times,* July 12, 2004.

32 William Perdue, *Terrorism and the State,* Praeger Publishers, Westport, CT, 1989. Perdue notes how difficult it is for a people to accept that they are the aggressors; they have to justify defending themselves, responding to aggression in others. Note that this book was written long before the controversies surrounding the 9/11 attack and before the Iraq War began.

33 Search "water chemistry" or "water physics" on the Science site: www.sciencemag.org/ Quite a few studies turn up, suggesting that scientists do not understand the complex nature of "simple" H2O molecules nearly as well as desired. Water is essential to all carbon-based life, including humans. Each of us is a bag of water chemistry that is about 75% water by weight.

34 Clayton Christiansen, *The Innovators Dilemma,* Harvard Business School Press, Boston, 1997. In this, his seminal book, and in later writing, Christiansen illustrates with cases how changing a would-be innovative company's business model forces a change not only in old legacies and cultures, but a shift in present customers' expectations of the company. Quickly shifting to a new business model is inhibited by fear that upsetting current customers will lead to financial collapse, cannibalizing the old business model before the new one can kick in. Christiansen's primary case is Digital Equipment losing out on mini-computer mainframes to the personal computer. Likewise, IBM "culture" rejected the personal computer because it could not quickly convert system to market to businesses to systems to market to consumers. The thinking patterns of IBM's people could not quickly evolve in a different direction.

35 The learning curve was first reported by T.P. Wright, "Factors Affecting the Cost of Airplanes," *Journal of the Aeronautical Sciences,* February, 1936. It soon found wide use in military production. For example, the author found a curve that tracked the time to produce center wings for B-24 bombers at Willow Run during World War II. Later it was even adapted to track the learning of athletic skills and the learning time of adaptive computer algorithms (for example, Haussler, Kearns, Seung, and Tishby, "Rigorous Learning Curve Bounds from Statistical Mechanics," in *Machine Learning,* v. 25, 1996, pp. 195–236). A learning curve is a smoothed general trend that approximates a sequence of improvement steps (or discrete learning events); some major; some minor, but merely tracking operations with a learning curve does not prompt an organized program of process improvement.

36 Zipf's Law was developed by experimentation and observation by George Zipf, a Harvard linguist. He discovered that the most frequently used word occurs twice as often as the next more frequent one, and so on, down to words very rarely used (a complex variant of a Pareto diagram). Word use frequency profiles even characterize specific authors, so for example, they are used to help "prove" whether Shakespeare really wrote all his works.

37 The importance of a syntax pattern is sometimes illustrated by amusing people in meetings with exercises trying to count the total number of letters in messages, or to spot words missing in them. Once our engrams detect what they expect to see, we stop processing the detail of the message. Stored engrams thereby "fill in" whatever word or letter is missing, or fail to spot letters in words that are read as word patterns, not as sequences of letters. The author surmises that this basic capability in almost all of us may be related to the ability of expertly trained minds to call up huge chunks of information based on a few cues (see footnote 25).

38 Noam Chomsky, *Aspects of the Theory of Syntax*, MIT Press, Cambridge, MA, 1965. Chomsky proposed a theory of Universal Grammar, grounded in how human brains and physiology devise speech. It's a major topic in linguistics, but data and debate supporting a Universal Grammar remain ongoing. (Chomsky is best known to the public as a political "liberal.")

39 Eric Chaisson, *Cosmic Evolution: The Rise of Complexity in Nature*, Harvard University Press, Cambridge, MA 2001. The last half of the book proposes free energy density as a measure of the direction of evolution from galaxies to human societies. This theory builds on old theories of minimal action, where action is the product of mass, velocity, and distance (mvd theory). Pierre Louis de Maupertuis first proposed that natural systems organize to "do work" using minimal energy in 1744. Many others followed, like the biometrician Alfred Lotka in 1922. Today scholars from diverse fields have begun to pursue this concept as explaining the direction of evolution as leading to more complex systems, calling the thinking "Big History."

40 Stuart A. Kauffman, *Reinventing the Sacred*, Basic Books, New York, 2008. Kauffman has long proposed collective autocatalysis as a theory of life arising from complexity. When enough molecules of sufficient complexity evolve, some will automatically catalyze reactions of others, and collectively they "take off" sustaining a life of their own. The larger scale system emanating from that will have characteristics that cannot be projected from the molecular components – independence of system characteristics at different levels. As his title suggests, Kauffman explores the implications of such a theory for science, technology, economics, philosophy, and religion. A colleague, Robert Ulanowicz, explores this idea further in *A Third Window; Natural Life Beyond Newton and Darwin*, Templeton Press, West Conshohocken, PA, 2009. Both authors build on the concept of self-organization by independent entities, or chaos theory, as it is popularly termed.

41 For example, R-Theta of Mississauga, Ontario does this. The product line is heat sinks for electronic equipment. Check www.r-theta.com and look for their "r-tools." An older pre-computer example is a door hardware company that simply generated variations in design of door handles, locks, and so on from the order specs on lines of the sales forms. The lines corresponded to steps in the process to make them. Any experienced employee could interpret how to build a unique order using standard processes directly from the sales order. Billions of combinations were possible not counting variations in key profiles. Simple process; complex output.

42 Hans Baumann, *The Ideal Enterprise*, Vantage Press, New York, 2002. Baumann refers to scaling factors as "the law of the sphere," the mass of a sphere increases by the 3/2 power of the surface area, so Baumann says that an organization should not take on too much "weight" compared with the surface area that executes exchanges with customers. Scaling issues are very important dealing with Compression, just as they have been very important to the discovery of many scientific laws and the creation of many models in physics and engineering. See G.I. Barenblatt, *Scaling*, Cambridge University Press, UK, 2003.

43 Bacon was as much philosopher as practicing scientist. He codified the thinking of other scientists of his time so that it began to be accepted. Whether he personally "did much science" is doubted.

44 Robert Temple, *The Genius of China*, 1986, Carlton Publishing Group, London (Prion imprint), 1998. Some discoveries attributed to the West were actually found in China much

earlier, sometimes millennia earlier. Some were subsequently lost or abandoned, so that many Chinese do not realize this. Temple condensed the lifetime scholarship of Dr. Joseph Needham, Cambridge University, whose work undercut some Western technological folklore. The lodestone was used in China BCE. The needle end of old Chinese compasses pointed South, not North.

45 To give William Gilbert his due, despite his exaggerated pitches, his *De Magnete* was very insightful for the time, and he advocated evidentiary reasoning before Bacon wrote on the subject. The early scientists were not "strictly scientific." Even Isaac Newton dabbled in alchemy in addition to Principia Mathematica. From Episode #613, *Engines of Our Ingenuity,* John Lienhard, University of Houston.

46 The philosophy of science covers the logic and rules of scientific evidence. A readable explanation of scientific methodology is by Carl Sagan, *The Demon-Haunted World: Science as a Candle in the Dark,* Ballantine Books, New York, 1996. His chapter 12, "The Fine Art of Baloney Detection," is hard to top. Michael Shermer narrates an extended version of Sagan's baloney detection kit on You Tube, where one can also find many other explanations of the scientific method, even one done in rap style. None get much play.

A more recent book that explains the difference between science and the arts of persuasion is Sherry Seethaler, *Lies, Damned Lies, and Science*, FT Press Science, Upper Saddle River, NJ, 2009. Unfortunately, too few people actually "doing science" have time to dig deeply into the wily ways scientific processes can be misrepresented, much less convey scientific reasoning to the public. Chris Mooney and Sheril Kirshenbaum explore the problems of large segment of the public comprehending unfolding scientific issues in context when their view of science is limited and often distorted (*Unscientific America*, Basic Books, New York, 2009). Their evidence may not support scientific ignorance becoming worse, but in Compression a modicum of scientific understanding is necessary to participate in dialog on what to do on more issues.

47 Orrin H. Pilkey and Linda Pilkey-Jarvis, *Useless Arithmetic*, Columbia University Press, New York, 2007. The authors make a case for abandoning use of quantitative models based on unchecked assumptions that are never validated. Useless for prediction, they reduce to self-referencing in a quantitative format. Examples cited range from errors estimating the annual codfish fish catch prior to the collapse of fishery stock to errors in modeling groundwater damage from mines. Since we cannot track the logic of every study or claim in detail, we have to rely on the competence and integrity of those that we think have.

In addition, we are psychologically susceptible to trusting the confident blather of an ignoramus over a knowledgeable source that admits gaps and uncertainties in knowledge. The psychology of this is sometimes called "telling someone too much." Telling what one knows; and only what one knows is a very difficult personal discipline; few of us like to let a fact interfere with a good story. Don Moore and Joseph Radzevick explored this in "Competing to be Certain (But Wrong): Social Pressure and Overprecision in Judgment," a paper given at the Psychological Science Convention, San Francisco, May 23, 2009. The title of the session in which they presented their paper was also revealing, "Often in Error, Rarely in Doubt."

48 K.D. Bomben, "Scientific Truth," a reference by Skeptic Friends Network, found online at www.skepticfriends.org/forum/showquestion.asp?faq=15&fldAuto=64 (posted April 23, 2002).

49 Also from K.D. Bomben, and mercifully brief, if not highly explanatory.

50 W. Edwards Deming originated the Deming Circle in the PDCA format, which became popular in Japan in the 1950s, and is the one most commonly used. It was similar to a schema that Deming's mentor, Walter Shewhart, had used earlier, and over time Deming occasionally varied this format. As used by others, PDCA has had so many nips, tucks, and varied interpretations that, as Deming himself would say, its detailed history is unknown and unknowable. (See John Butman, *Juran: A Lifetime of Influence*, John Wiley & Sons, New York, 1997, pp. 115–119 and pp. 141–142.)

51 Coaching college juniors to indentify and solve problems using PDCA was the most difficult challenge of the author's teaching career. A college semester was far too short to imbue a scientific pattern of process problem solving in the brains of business students already saturated in transactional thinking.

52 E. Bright Wilson stressed careful observation as the key to original discovery in a masterful description of the scientific method (Chapter 3 of *An Introduction to Scientific Research*, McGraw-Hill, New York, 1952). In an interesting parallel, Taiichi Ohno, "father" of the Toyota Production System, said that he was stirred to carefully observe work methods by writing work instructions. He wanted the workers to write their own work instruction, and he found that when they did, they learned to observe more carefully too.

53 Gary G. Bergmiller, *Lean Manufacturers Transcendence to Green Manufacturing: Correlating the Diffusion of Lean and Green Manufacturing Systems*, PhD Dissertation, University of South Florida, 2006. Bergmiller concluded that lean operations reduced environmental waste just by reducing waste as seen by the customer. He reviewed 41 operations that had been honored with a Shingo Prize, indicative of being above average in lean proficiency. Those companies that embraced Green practices had significantly better Lean results, but being Lean did not necessarily confer outstanding Green results, particularly in toxic releases. For that, companies must directly address toxic releases. So far as is known, none of these companies contemplated anything as drastic as Compression. From this study, Bergmiller proposed a "zero waste manufacturing system" and began to work with companies to implement such a system.

54 Howard T. Odum, *Environmental Accounting, Emergy and Decision Making*, John Wiley, New York, 1996. This book encapsulates Odum's major work, but he wrote many papers and handbooks. He died in 2002, but his influence continues at the Howard T. Odum Center for Wetlands, University of Florida, Gainesville (www.cfw.ufl.edu/). Odum's concept of emergy formed the basis for many environmental researchers' and analysts' estimation methodologies. An internet search will turn up numerous books and papers by Odum.

55 The chain of logic in this paragraph is one aspect of James Lovelock's *Gaia Hypothesis*, or *Gaia Theory*, that the entire global biosphere is one single self-regulating system: everything eventually has an effect that eventually extends to every other part of it. Evidence for this is slowly accumulating. For example, a well-publicized satellite mapping of the oceans shows that 41 percent is strongly affected by multiple human-made drivers of change (or imbalance). Only the regions near the poles were nearly unaffected. (Halpern, et el, "A Global Map of Human Impact on Marine Ecosystems," *Science*, Feb. 15, 2008). When the Associated Press summary of this was presented on America Online on Feb. 16, 2008, most reader comments about it dismissed the observation as highly "politicized;" and some regarded it as conspiratorial propaganda from some plot to disrupt their "way of life."

56 Jens Peter Ellekilde Bonde and Jorn Oleson, "Interpreting Trends in Fecundity Over Time," editorial in *British Journal of Medicine*, Feb. 16, 2008 (Vol. 336), pp. 339–440. (Although an editorial, the piece reviews the significance of numerous studies of human fertility from several points of view.) Studies of endocrine disruptors have been increasing for about 20 years, typified by those on atrazine, one of the most widely used herbicides in the United States, but banned by the European Union since 2003. The "research battles" on atrazine follow a familiar pattern that can be seen by running down a list of publications by the American Chemical Society at: http://pubs.acs.org/action/doSearch?searchText=%5Ball%3A+endocrine+disruptor+atrazine%5D As studies began to accumulate showing that atrazine has disruptive effects, articles by the manufacturer began to appear arguing that evidence remains inconclusive. In general, in Europe the balance of proof to show that a chemical is safe falls more on the manufacturer, while in the United States, the burden of proof falls more on a regulating agency to show that a chemical is not safe.

57 "Cradle to cradle" has become a generic phase for processes and products that reuse materials already in use, requiring no virgin material to be extracted from the earth. The term comes from *Cradle to Cradle*, William McDonough and Michael Braungart, North Point Press, New York, 2002. That physical book is itself unique because it is printed on a medium synthesized from plastic resins and inorganic fillers, which the authors claim to be recyclable for a near-infinite number of use cycles. This demonstrates the authors' ideal of "up-cycling," improving material quality with each re-use cycle, not merely reusing it. The book's inks too, while indelible, are also recyclable.

58 The EPA performance measurement system can be extracted from http://epa.gov/performancetrack/program/ems.htm. One might think that the EPA would be the standard used by most organizations. However, many other preliminary performance measurement tools are out, some by other government agencies. An example is the greenhouse gas reporting calculators from the Energy Information Administration at: http://www.eia.doe.gov/oiaf/1605/reporting_tools.html

59 MBDC's newest DFE certification criteria (2008) are posted for review at www.mbdc.com/docs/Outline_CertificationV2_draft.pdf.

60 A quick overview of the Wal-Mart Packaging Scorecard was found at www.walmartfacts.com/articles/4564.aspx. In July 2009, Wal-Mart updated this with a list of 15 questions that it wanted each of its 100,000 or so suppliers to answer. This list was found and downloaded as a pdf at: http://walmartstores.com/Sustainability/9292.aspx Many suppliers will find that responding to these questions forces them to make measurements that they never before contemplated. However, they barely begin the kind of action needed in Compression. But this program is necessary to carry out a longer-term Wal-Mart ambition; to code consumer packaging so that buyers can quickly assess the environmental impact of their purchases.

61 Michael J. English and William H. Baker, Jr., *Winning the Knowledge Transfer Race*, 2006, McGraw-Hill, New York, 2006.

62 John Shook, *Managing to Learn*, Productivity Press, New York, 2008. Shook uses a case study narrative to illustrate how learning to use A3 papers at Toyota was really a process of learning to think, and of learning how to mentor others to learn to think. Since the A3 paper

format is based on PDCA logic, in practice people are starting to use "A3" as a designation for that form of logic. That makes little difference; it's the systemic logic and clarity that counts.

63 The most official source on Kepner-Tregoe is the company itself: www.kepner-tregoe.com. Wikipedia's description of TRIZ cites many "official" sources, but it originated from Genrich Altshuller and the Altshuller Institute http://www.aitriz.org/.

64 After Action Reviews (AAR) originated with the U.S. Army. It has gone through several revisions, so it has a behavior component as well as methodology. The Army now uses it for both small units and large task forces, and variations of AAR have been used by many other organizations, including commercial companies. The SOL Coaching Model is used by the Society for Organizational Learning (Peter Senge's organization). The SOL Coaching Model also has a disciplined structure, but emphasizes dialog behavior (listening).

65 Charles H. Fine, *Clockspeed*, Perseus Books, New York, 1999.

66 Punctuated evolution is possibly the best-known legacy of the late paleontologist, Stephen J. Gould. His collected works on this subject and much else can be found at the Stephen J. Gould Archive (www.stephenjaygould.org/library.html).

67 The term "Johari window" has morphed into many forms and been used in many different contexts (and using many different spellings) since its first use by Joseph Luft and Harry Ingham (Joe & Harry) in 1955.

68 Douglas K. Smith, *On Value and Values,* Prentice-Hall, New York, 2004. Smith's definition of bond density is based on check sheets (shown in the book) that ask people to report common interaction points. Whether he obtained any data on frequency of interaction is unclear.

69 A summary of high-context vs. low-context classroom teaching is from Rick Reis, Executive Director of the Alliance for Innovative Manufacturing at Stanford University. His Tomorrow's Professor Mailing List is at http://ctl.stanford.edu/Tomprof/postings/464.html Although individuals exhibit much within-group variance, females are more high-context in behavior than males, and males of Northern European descent appear to be more low-context than almost any ethnic group. By contrast, American Indians from the Southwest are unusually high-context. For example, see Roberto Ibarra, "Context Diversity: Reframing Higher Education in the 21st Century," which can be found at www.compact.org/20th/read/context_diversity. High-context and low-context cultures are from the anthropologist E. T. Hall (see Chapter 2, Figure 2-4 and footnote 16).

Chapter 4: Dispelling Our Expansionary Habits

1 The author concocted the "space sovereignty" design before referring to other designs except as a vague memory of graduate students' wild ideas in the 1960s. A rotating sphere or torus so obviously lets centrifugal force act as artificial gravity that the author's concept bumbled into the same pattern as the Stanford torus, Gerald K. O'Neill's Island One, and others. Rotation speed to create 1 g of force suggests at least a one-mile diameter to avoid spinning like a whirligig.

O'Neill's designs inspired many others. His most elaborate one was "Island Three" (in *The High Frontier*, William Morrow, New York, 1977): two counter-rotating cylinders, each about four miles in diameter, twenty miles long, with a zero gravity manufacturing chamber at the core, and a twenty-mile diameter agricultural ring outside them. Being much bigger, Island Three rotated slower than the author's brainstorm. Most "serious designs," not strictly sci-fi, presume being on station in earth orbit, or at least in solar orbit, within range of a "friendly sun."

Survival in cramped quarters deep in space away from our sun deepens the issues in "spaceship economics." For instance, the author estimated an upper population limit based on 900 square feet of outer wall space per person. If half that space is used for living quarters, equipment, and commons, then feeding one person from 450 square feet presumes extraordinarily efficient carbon photosynthesis – or sci-fi invention of energy sources and chemistry for it. The "spaceship economy" concepts are also original. Most galactic games like EVE (www.eveonline.com/) just extend the expansionary system of thought. Noted economists have also tried their hand at this. For instance, Kenneth Boulding's 1966 creation can be seen at: http://dieoff.org/page160.htm

2 This problem is often illustrated by complex traveling salesman optimization or protein folding models. Iterating with a "slow" digital supercomputer, computation time can exceed the age of the universe.

3 A thick wall plus air inside attenuates solar radiation sufficiently to allow astronauts to survive a few months in near-earth environments. Radiation effects on multiple generations in deep space are unknown.

4 Both U.S. and Russian near-earth spacecraft now use 101.3 kPa (about 15 psi) atmospheric cabin pressure with 21 percent oxygen, which replicates sea-level earth atmosphere. Early U.S. spacecraft used 34.5 kPa, and the shuttle uses 70.3 kPa; both with elevated levels of oxygen. This increases the potential of a spark to cause a fire, but it also reduces the pre-breathing time of an astronaut acclimating to the reduced pressure inside a space suit donned for extra-vehicular tasks. That problem is similar to deep-sea divers getting the bends. To minimize biological adaptation, it is assumed that human living quarters in deep space would have a planned atmosphere replicating that on earth. An atmosphere very different in pressure and composition from that on earth would introduce another unknown in how humans could adapt to permanent life in deep space. See NASA/CR-2005-213689.

5 Patrick L. Barry and Dr. Tony Phillips demonstrate the Coriolis effect at a NASA site: http://erc.ivv.nasa.gov/vision/space/livinginspace/23jul_spin_prt.htm One can also find video demonstrations on You Tube.

6 Advanced versions of O'Neill's *Island Three* assume a nearby sun, slower rotation, and replication of a daily solar cycle using mirrors and closable windows, This attempts to reduce vertigo from spinning in starlit emptiness, and preserve a semblance of earth's diurnal cycles.

7 Loss of bone density during six-month stints on the International Space Station have been found to be greater than anticipated (Tariq Malek, "Space Station Astronauts Lose Bone Strength Fast," Space.com, Jan.26, 2009, which was found at www.space.com/scienceastronomy/090126-astronauts-bone-strength-loss.html). Rapid loss of bone density earlier in life has been associated with physical problems, like susceptibility to hip fracture, later in life. To help offset this, more vigorous exercise programs while in space are being devised. A summary of the physiological problems of weightlessness was found at Mark Prado's PERMANENT www.permanent.com/s-centri.htm. Prado documents serious issues designing craft for near-earth space ventures.

8 Eugene N. Parker, in "Shielding Space Travelers," *Scientific American*, March 2006, notes that we've barely begun to seriously address long-term radiation risks. A similar analysis is Rob Edwards, "Cosmic Rays May Prevent Long-Haul Space Travel," NewScientist.com News Service, Aug. 15, 2005, which was found at www.newscientist.com/article.ns?id=dn7753

9 William J. Broad, "Orbiting Junk, Once a Nuisance, Now a Threat," *New York Times*, Feb. 6, 2007. The amount of debris orbiting earth increased dramatically after the Chinese exploded a satellite in a test on Jan. 11, 2007. On Feb. 10, 2009 two satellites in orbit (Kosmos 2251 and Iridium 33) collided for the first time, added to orbiting junk. On March 12, 2009 the International Space Station evacuated astronauts to the Soyuz "escape ship" when NASA could not pinpoint an oncoming bit of debris fast enough to maneuver the space station out of the way, now done routinely (see, "Debris Near Space Station was Bigger than Reported, "Reuters, March 13, 2009. www.reuters.com/article/scienceNews/idUSTRE52B5DJ20090313?sp=true). This article also suggested that this was the fifth "emergency evacuation," but the first time it had been reported. By April 2009 the European Space Agency was advocating steps to prevent and remediate space junk (Melissa Eddy, "Europeans Urge Cleaning Up Space Junk," Associated Press, April 2, 2009). The U.S. Strategic Command was monitoring 13,943 bits of junk four inches or more in diameter, with unknown thousands of smaller pieces. Of course, junk is a man-made problem in near-earth orbit, not outer space. One can barely imagine the unknowns preserving or renewing a spinning domicile in deep space for millennia.

10 The official history of Biosphere 2 plus ongoing, related research is at www.biospherics.org Wikipedia's brief history includes behavioral rifts: http://en.wikipedia.org/wiki/Biosphere_2.

11 Albert A. Harrison, *Spacefaring: The Human Dimension*, University of California Press, Berkeley, 2002. Chapter 11 has one of the few serious discussions of sex in space. The Discovery Channel has a "cute" video at: http://science.discovery.com/videos/spaced-out-sex-in-space.html In Feb. 2007, the news highlighted the alleged affair of Astronaut Lisa Nowak with Astronaut William Oefelein, which culminated in an attempted murder. However, the psychology and physiology of birth-to-death life in space has not been seriously studied—if it can be studied.

12 During the 20th century, dramatic human improvement became rather prosaic – almost expected. For example, American life expectancy nearly doubled. When prosthetics, like pacemakers, artificial joints, and corneal implants began coming into common use, bionic wonder-humans came and went as an entertainment theme. Serious enhancement is progressing

in medicine, artificial intelligence research, robotics, and in less sanctioned ways such as performance enhancing drugs taken by athletes.

Enhancing human capabilities with computer-controlled devices external to the human body is now "old hat." Examples are aircraft that can only be flown by computer control, either wholly (Predator drones), or in part (Apache helicopter).ß Robots now have faster vision and reaction times than humans. The ever tightening interface between man and machine is illustrated by a video at: www.youtube.com/watch?v=yIpNZ2Eo2CA (You Tube has many other such videos.)

But for direct human enhancement, caffeine was a low-tech precursor of chemicals now used to boost mental capacities of unimpaired people. Methlyphenidate (Ritalin) and amphetamines have been widely used. Wikipedia posts a long list of chemicals that someone believes can boost brainpower -- but beliefs supported less by scientific testing than the lore of folk drugs like St. John's Wort. A paper in *Nature* Dec. 11, 2008 (Greely, et al, "Toward Responsible Use of Cognitive-Enhancing Drugs by the Healthy") kicked off an ongoing series of articles, surveys, letters, and blogs on mind-enhancing drug use, including ethical questions, of course. The downsides of drugs used for physical enhancement (notably anabolic steroids) are well known. Surveys showed that a non-trivial number of college students and faculty now use mind-enhancing drugs. No known survey has checked usage in other populations.

These developments keep edging closer to an envisioned transhuman future, which is the mission of the World Transhumanist Association (www.transhumanism.org). It advocates the ethical use of technologies to expand human capacities. Philosophical questions about transhumanism are moving from sci-fi imagination to real issues. Will humans control computers (and the machines that computers control), or will computers control humans? (John Markoff, "Scientists Worry Machines May Outsmart Man," *New York Times*, July 26, 2009.)

That begs a question associated with Compression. If human or superhuman intelligence were embodied in a "computerized" physical package, could it be supported by significantly lower energy and materials requirements than the physical needs and consumptive psychology of a biological human? Existence as surrogate humans (avatars) is commonplace in gaming, and this kind of interaction in computer simulations has triggered serious philosophical discussion. An original paper on this is Nick Bostrom, "Are You Living in a Computer Simulation?" *Philosophical Quarterly,* April 2003, pp. 243–255. Bostrom's Future of Humanity Institute at Oxford University, dealing with such matters, was found at www.fhi.ox.ac.uk/

13 The Space Foundation's web site is: www.space-frontier.org. An extensive list of possibilities that have commercial promise is at www.cygo.com/space_products.html.

14 For example, Todd Lewan, "Chipping at Privacy?" *Chicago Sun-Times,* July 22, 2007. The article describes embedding radio frequency identifier tags (RFID) in workers in high security areas with microchips so that recognition would be automatic. This has long been done in animals. Wary critics think this presages embedding RFID in many more people in many other circumstances. Some protested a plan to embed them in Alzheimer patients.

15 Robert Kaplan and David Norton, "The Balanced Scorecard: Measures that Drive Performance," *Harvard Business Review,* Jan-Feb. 1992. This was the seminal article for practices now used by many companies, and promoted in various modified forms by numerous consultants.

16 PACE Awards are given annually to automotive suppliers for outstanding innovation. Sponsors are *Automotive News* and the Transportation Research Center. (The author is one of the judges.) Responsible Shopper is a program of Green America (www.coopamerica.org/). The Great Places to Work Institute produces many of our Best Places to Work lists (www.greatplacetowork.com/)

17 Brian H. Maskell and Bruce L. Baggeley, "Lean Accounting; What's It All About?" *Target* (publication of the Association for Manufacturing Excellence), Issue 1, 2006. This is a starter article. It can be downloaded from www.leanaccountingsummit.com/resources.asp, along with more recent material on lean accounting. Many distortions come from confounding cost accounts needed by managers with accrual system accounts used to aggregate financial numbers from an investor's viewpoint.

18 "Accurate" is not an accurate descriptor for prices, cost figures, or accounting systems. A dollar does not have standards of comparison to measure against that are as fixed as a standard meter when measuring distance or length. Even gold varies in human value. The only thing a dollar measures with accuracy is another dollar. Every other cost measure is a human valuation subject to change, so costs are more aptly termed "indicators," a term that macroeconomists use for macroeconomic numbers that are obviously subject to variance in compilation.

19 Roger Lowenstein, *When Genius Failed: The Rise and Fall of Long-Term Capital Management*, Random House, New York, 2000. This book explains LTCM in detail, including background on the "cast of characters." Wikipedia's brief account roughly parallels the book at: http://en.wikipedia.org/wiki/Long-Term_Capital_Management. The fall of LTCM was a precursor to the much bigger crash of highly leveraged hedge funds in 2008, but to keep the fall-out from just LCTM from infecting big institutional counterparties – crashing the system – the Federal Reserve had to ride to the rescue with a wind-down plan. Experience with LTCM should have taught Wall Street that in practice, trading complex slices of market risk were likely to exceed the risk boundaries of the models, but these lessons were obviously shrugged off.

A more general review of the entanglements inherent in creating and trading financial derivatives is Richard Bookstaber, *A Demon of Our Own Design*, Wiley & Sons, New York, 2008. Readers can find many of the issues at Bookstaber's blog site: http://rick.bookstaber.com/

20 Alex Barrionuevo and Jenny Anderson, "Wall Street is Betting on the Farm," *New York Times*, Jan 19, 2008. Figures were taken from the Commodity Futures Trading Corporation per Bloomberg News. A year later, the spikes that critics attributed to excess speculation had abated. U.S. wheat prices to American farmers had dropped by as much as half, but they had almost as profitable a season (USDA), but grain prices remained high for hard-pressed countries. Investigations of 2007-8 market volatility concluded that while trading volume by money managers had increased, other causes of the price spikes were the value of the dollar and low end-of-season stocks (according to the University of Illinois Extension, for one).

However, whatever the multiple causes, they made no difference to the poorest people on earth who still lacked money to buy food. For example, the NGO Mercy Corps reported Afghan families skipping meals and eating subsistence food. That is, the poorest of people living on a cash market were still at the whip end of the lags, public policy consequences, and self-contradictory effects of global agricultural marketing as actually practiced. (Sonni Efron, "World Hunger, the Crisis Inside the Economic Crisis," *Los Angeles Times*, March 12, 2009. In July 2009, the United Nations Food and Agriculture Organization (FAO) issued "Crop Prospects and

Food Sanitation #3" warning that food prices in many parts of the world still exceeded the means of government and NGO food buyers. (Found at www.fao.org/docrep/012/ai484e/ai484e00.htm).

To many Americans, it may seem incredible that the USDA Supplemental Nutrition Assistance Program (SNAP) fed 32.6 million people in February 2009 (www.fns.usda.gov/FSP/faqs.htm), and food subsidies are a "social necessity" in much of the world, including industrial societies, and much of the "developing world," food subsidies are acknowledged to be a political necessity. For example, since the 1940s the Arab Republic of Egypt has had a food subsidy program as a bulwark against political instability, with its cost reaching as high as 14% of its annual budget. (Google turns up numerous references to this benchmark program.) By contrast, the food policy of Sudan just to the south of Egypt is "limited and largely ad hoc"(UN Food and Agriculture Organization Special Report found at www.fao.org/docrep/009/j9213e/j9213e00.htm). Sudan has had both good crop weather and very bad, depending on the region, and its Darfur region has been the epicenter of ongoing violence disrupting agriculture in addition to nature's harshness. Sudan is a well-publicized "basket case" for food assistance, whereas in Egypt it is quiet and well organized. In many places, free market efficiency growing and distributing food seems far removed from the daily facts of life. If food production capacity diminishes, the capacity of this food allocation system will be strained, and perhaps in ways unlike prior expansionary experience in which agricultural overproduction could be sent almost as a gift to areas in dire need.

21 European emissions markets got off to a rocky start because excessive issuance of carbon credits drove prices down; excessive numbers of "grandfather status" awards; and giving away tradable permits (free money) instead of auctioning them off. A quick rundown of issues with these markets and their shortfalls stimulating environmental sustainability is: "Carbon Markets Create a Muddle," *Financial Times*, April 26, 2007. A summary of these markets' "success" is: Mark Scott, "Europe's Carbon-Trading Pioneers," *Business Week*, April 28, 2008. When what should qualify as a marketable carbon credit is still subject to dispute, it's easy for the objective of capping overall greenhouse gas emissions to get lost in a rush to trade something. (See "Forests Could Undermine Carbon Market: Greenpeace," Reuters, Mar. 30, 2009. This article refers to adding credits for safeguarding forests to the markets, and doing so could swamp the credits for reducing smokestack emissions.) Of course, a Google search turns up a cacophony about carbon market fairness and unfairness. For instance, the world's indigenous people insist that instead of assuring reduction of CO_2 sent to the air, carbon markets perversely expand incentives to "exploit" fossil fuels. See: Haider Rizvi, "Carbon Trading Blasted by Indigenous Groups," *One World US*, May 6, 2008 (has been found at http://us.oneworld.net/node/160386).

22 Herman Daly, *Beyond Growth*, Beacon Press, Boston (paperback), 1997. Despite the critique of one of Daly's specific recommendations, he is right-on that economic thinking has to be more closely tied to physical processes, both natural and man-made. One can sample his thinking in "Steady-State Economics" at: http://dieoff.org/page88.htm. Daly was familiar with M. King Hubbert's contention that real economic growth is physical, and that it depends mostly on energy.

In testimony before Congress in 1974 (at www.technocracy.org/natureofgrowth.htm) and elsewhere, Hubbert's back-of-the-envelope economic analysis concluded that when industrial growth (physical growth) could no longer take place, the monetary system would either have continuous inflation, or the effective interest rate would be zero. Much earlier, Frederick Snoddy, a Nobel Laureate chemist in 1921, arrived at more detailed conclusions that he laid out in *Wealth, Virtual Wealth and Debt*, George, Allen & Unwin, London, 1926. Snoddy influenced Nicholas Georgescu-Roegen, an economist who extended these thermodynamic arguments to contend that the human economy is really a form of living system, which is similar to the reasoning used by Daly. Georgescu-Roegen's book, *Entropy and the Economic Process* (published posthumously

by iUniverse, 1999) has been dinged for its thermodynamic errors, but praised for its questioning of expansionary economics. (See footnote 1, Chapter 1.)

H. Thomas Johnson came to a similar conclusion in "Lean Management and True Sustainability," in *Lean Manufacturing 2008* (Yearbook) Society of Manufacturing Engineers, which can be found at: www.sme.org/cgi-bin/get-item.pl?ME08SUP2&2&SME. Most recent environmental "economists" have tried to reconcile expansionary economic ideas with the concept of limited world resources by improving our ethical understanding, and there's a long list Bill McKibbon, Hazel Henderson, Paul Hawken, and others, many of whom (like the author) are not university-trained economists, but perhaps it takes outsiders to dislodge an established pattern of thinking. A number of groups interested in sustainability economics have sprung up. Wikipedia's entry on "environmental economics" lists many of them as external links.

23 Juan Williams, "The Faithful's Wayward Path," *New York Times* (Op-Ed page), January 20, 2003.

24 Kalle Lasn, *Culture Jam: How to Reverse America's Suicidal Consumer Binge—and Why We Must*, Perennial, New York, 2001. Lasn founded Adbusters (www.adbusters.org/) a non-profit group that promotes an annual "Buy Nothing" day and "TV Turnoff Week" to protest commercial suasion. High-fashion consumption is easy to ridicule, but Adbusters deplores all consumption excesses. For instance, in 2008 Adbusters condemned "shopping mania" when a Wal-Mart employee in Valley Stream, NY was crushed to death by shoppers while opening the store on Nov. 28, the day after Thanksgiving, which is Adbusters' annual Buy Nothing Day.

Adbusters seems to have inspired other anti-commercial sites like Sprawlbusters: www.sprawl-busters.com/, whose first target was Wal-Mart. Many protesters interpret Wal-Mart's low-cost operations as promoting excess consumption. Others allege environmental "greenwash," despite its suppliers regarding Wal-Mart as an ogre for pressing environmental sustainability on them (see http://walmartwatch.com/img/blog/environmental_fact_sheet.pdf) Wal-Mart's environmental goals and program are at: http://walmartstores.com/Sustainability/7951.aspx.

Anti-consumerism usually concentrates on offsetting the excesses of commercial persuasion as described by Douglas Rushkoff's *Coercion*, Riverhead Books, New York, 1999. Reality is that all these protests' effect on retail sales is insignificant compared with that of the financial slowdown.

25 Gerald Wilde, *Target Risk*, PDE Publications, Toronto, 1994. *Target Risk 2*, which came out in 2001, can be viewed at http://psyc.queensu.ca/target/ Wilde's research on driver behavior led to the concept of "individual risk homeostasis," which is that after safety devices were installed in a vehicle, drivers adjusted driving habits to resume about the same risk of accidents as before, by driving faster, braking later, and so on. The theory is that unless humans recalibrate their perceptions of risk probabilities and consequences, they are likely to continue living in an acceptable lifelong danger zone, no matter what fail-safe technology is installed. The concept has its detractors, but it can be extended to human safety and process integrity in general (think health care operations, for instance), but it has not matured to become a factor in most practice.

26 Carpet design for recycling is no trivial problem. Components need to be easily separable, not degrade when reprocessed, and be safe in use. Interface uses Nylon 6, which recycles well and also is relatively resistant to flame. (In a hot fire all polymers release deadly fumes, 50–80% of fire victims die from inhaling smoke, but research on this is far from conclusive.) Interface designs have about half the total mass of most carpet. This reduces the energy needed for

manufacture, transport, and installation—but if an application requires a softer floor, some mass has to be added. Anyone looking for quick, easy solutions will not find them. However, looking at carpet more broadly than just selling more of it opens the imagination. Interface has made headway on issues that otherwise would never be addressed because the "market" does not demand that they be addressed.

27 Marjorie Kelly, *The Divine Right of Capital,* Berrett-Koehler Publishers, Inc., San Francisco, 2001. Douglas Rushkoff greatly extends her argument in *Life, Inc*., Random House, New York, 2009, contending that the corporate system of thought, bolstered by PR, has turned most social relationships into a brand image of the real thing. Double entendre commercial messages persuade people that they are individualistic while inducing them to buy whatever service everybody else is using. Their free will is limited to choices among similar brands. Computer software enables us to do "whatever we want," only better, but channels our self-expression into similar formats (familiar clip art on every page). And is social networking merely brand competition among egos (I am my brand)? Organizing to resist this on a big scale is apt to be confounded by "Astroturf" infiltration, so Rushkoff recommends activism at the community level, free of commercially motivated media influence.

28 Noreena Hertz, *The Silent Takeover,* The Free Press, New York, 2001.

29 David C. Korten, *The Post Corporate World,* Berrett-Koehler, San Francisco, 1998. p. 187.

30 Mark Bowden, *Killing Pablo,* Penguin Books, New York, 2001, pp. 28–29.

31 Jeremy Hope and Robin Fraser, *Beyond Budgeting,* Harvard Business School Press, Boston, 2003. *Beyond Budgeting* began in Europe and the United Kingdom, but the book introduced it to the United States. The core concept is to eliminate all but top-level budget numbers, doing away with pressure to perform to detailed budget numbers. This eliminates using a budget as an excuse or crutch. Managers must become leaders exercising more judgment and guiding real activity. Getting rid of budgetary command-and-control is not easy. Those who became dependent on it may be lost without it, and replacing budget figures with Key Performance Indicators (balanced scorecard) accomplishes little if accompanied by command-and-control mandates to hit targets. Any form of management by results tempts managers to play games because it is a game. If performance is over or under a goal, was performance poor or was the goal ridiculous? This kind of thinking pervades investor-driven business, as seen on daily business news broadcasts when market valuations respond to whether earnings or economic indicators did or did not meet "somebody's" expectations. Ridding organizational administration of the time wasted planning a detailed budget accords with the goal of eliminating waste through lean practices. In the United States, *Beyond Budgeting* centers on the Beyond Budgeting Round Table: www.bbrt.org.

32 A Google hit list on Corporate Social Responsibility still favors philanthropy and public relations. For an example of this thinking, Philip Kotler and Nancy Lee outline strategies for corporate support of causes in *Corporate Social Responsibility*, John Wiley & Sons, New York, 2004. A typical decades-old rebuttal is Betsy Atkinson arguing that corporate money should flow to investors to confer on charities that they prefer. The primary responsibility of a business being to make money, managerial agents should not pick causes for them ("Is Corporate Responsibility Responsible?" *Forbes*, Nov. 28, 2006). Environmental sustainability and regard for effects on people in far off places is just now becoming part of Corporate Social Responsibility (CSR), so that it factors into a company's core "business model." (See footnote 23 in Chapter 6.)

33 Paul Maidment, "Re-Thinking Social Responsibility," *Forbes*, Jan. 28, 2008. This report from the World Economic Forum in Davos, Switzerland noted that both government and corporate leaders were beginning to see that joint efforts on a broad front would be necessary to continue improving life in much of the world. Despite the global financial crisis, the World Economic Forum in 2009 continued to emphasize multi-stakeholder inclusiveness. See www.weforum.org/en/index.htm.

34 The web site for Corporation 20/20 is www.corporation2020.org/, which is sponsored by the Tellus Institute, Boston at www.tellus.org/

35 M. Gigi Durham, *The Lolita Effect*, The Overlook Press, New York, 2008. A professor of journalism at the University of Iowa, Durham summarizes 13 years of research into companies exploiting the market demographic of girls aged 8–12, which is part of the $170 billion per year global youth market. Their products and advertising present a distorted, unrealistic view of feminine sex from almost anyone's view, by persuading girls to look as hot as Paris Hilton or Britney Spears. The objective is for girls to spend money to create this effect on themselves.

36 Stephen A. Ruffa, *Going Lean*, AMACOM, New York, 2008. Ruffa does an unusually imaginative job of explaining the perils of a high breakeven point and low flexibility by plotting measures called Value Required vs. Value Available.

37 This kind of language is far from new. Picture symbols are older than phonetic alphabets. Chinese characters dating back 5000 years have higher information density than written English, but phonetic language is unlikely to fade away. Its obvious advantage is that encoding a limited set of characters for electronic transmission is much easier, but less attachment to fixed symbols may also stimulate expressing innovative concepts or nuances of meaning, However, the booming popularity of text messaging world wide is changing all language. More symbols like emoticons are blending into phonetic language. One of the sites from which you too can download emoticons is: www.download32.com/free-emoticon-icons-software.html

38 This refers to the Beyond Budgeting movement, cited in footnote 31. Cases about eliminating the budget can be found at www.bbrt.org.

39 Howard Gardner, Mihaly Csikszentmihalyi, and William Damon, *Good Work*, Basic Books, New York, 2001.

40 The percentage is from *Science*, May 14, 2008, p. 1549. Undue industry influence on academic research isn't new. Only the villains change. In the 1960s, agricultural research and tobacco companies were the ogres. In recent years, pharmaceutical and genetically modified seed companies have assumed that role. Outright fraud unrelated to research support is not new either. Regularly reading *Science* is to periodically read of some new episode of it.

41 David Cohn, "Open Source Biology Evolves," *Wired*, Jan. 17, 2005. Another *Wired* article (April 11, 2005) reported that rapidly growing online journals let more scientists read journal articles quicker, but left unresolved whether advertisers or authors pay for the service. The issue is that if a payer is calling the piper's tune, the motives of article selection and review become suspect.

Probably the most popular on-line service is the Public Library of Science (PLoS), which began in 2003 and has steadily expanded coverage, mostly in the life sciences: www.plos.org. On line science and technology news services, like Physics Today (www.physicstoday.org) or Newswise (www.newswise.com) are not the same as on line peer-reviewed journals. Newsgathering and scientific review are two very different processes having different objectives. By 2005 a Directory of Open Access Journals (www.doaj.org) had begun, and by 2009 it claimed to list 4025 journals in all kinds of fields, with 1443 of them searchable on-line. Although open-source science journals are now coming of age, receptivity to them is mixed. Their influence is stronger in multidisciplinary fields than in more specialized fields with a smaller number of participants, where review times may be lengthy, but older pre-print services are readily available (Evans and Reimer, "Open Access and Global Participation in Science," *Science*, Feb. 20, 2009.)

Pre-print circulation of papers is starting to change the peer review process that accepts research as a contribution to science. For example, Cornell University hosts a pre-print server for physics papers called arXiv, from which physicists can download pre-prints to hash amongst themselves on blogs. *Nature*, for example, allows authors to submit pre-prints to recognized pre-print servers, but like other scientific journals, "embargos" public release of a paper until a it passes peer review, thus becoming recognized as a contribution to scientific knowledge. *Nature's* editorial and review policies are at: www.nature.com/authors/editorial_policies/publication.html

42 Julie Bosnan, "Reporters Find Science Journals Harder to Trust; Not Easy to Verify," *New York Times*, Feb 13, 2006. By this date, the problems of trusting the conflicts of interest in journal articles had had wide exposure, but they were not being quickly resolved.

43 Marcia Angell, *The Truth About the Drug Companies*, Random House, New York, 2004; and Jerome Kassirer, *On the Take*, Oxford University Press, Oxford, UK, 2004.

44 Lawrence K. Altman, "For Science's Gatekeepers, a Credibility Gap," *New York Times*, May 2, 2006. After the well-publicized case of Dr. Hwang Hu Suk fabricating evidence of human cloning, medical journalists found that journals tightened disclosure standards, but that their processes for submitting and reviewing journal articles still had holes.

45 Shannon Brownlee, "Doctors Without Borders," *Washington Monthly*, April 2004. Adriane Fug-Berman ("Not in My Name," *Guardian*, U.K., April 21, 2005) briefly describes ghostwriting, which is a continuing problem. On Feb. 3, 2009 The Public Library of Science (PLoS) hosted a debate on "What Should be Done to Tackle Ghostwriting in the Medical Literature?" posting it to www.plosmedicine.org/article/info:doi/10.1371/journal.pmed.1000023) All sides agreed that unless data selection, main points, and conclusion are the genuine judgment of the researcher, scientific fraud has occurred. They made a distinction between professional medical writers having intent to influence and merely assisting with the editing. Kassirer, (footnote 43) and one of the panelists, cited estimates that about 10 percent of all medical journal articles were still ghostwritten. The medical writers on the panel recommended that all journals use a checklist. In addition, most universities' research policies now ban research agreements with companies or any other organization if clauses restrict open publication or allow ghostwriting. PLoS has recently been going after ghostwriters more aggressively. See the action PLoS is taking against Wyeth at www.plosmedicine.org/static/ghostwriting.action.

46 "Madison Ave. Plays a Growing Role in Market Research," by Melody Petersen, *New York Times*, Nov. 22, 2002.

47 Kassirer, op cit, on p. 16. noted that the American market for CME ten years ago in 1999 was about $600 million, per the American Council for Continuing Education. After Kassirer, Angell, and others publicized CME practices, researchers and MDs became more suspect of "education" by companies. Attitudes and practices began to tighten. Some surreptitious operators may still be in the business, but in 2008, almost all the 741 registered CME providers on the Accreditation Council for Medical Education list were recognizable medical schools or institutes. On the other hand, one could still find market advice on "leveraging CME as a channel of influence."

48 Dr. James N. Weinstein, editor-in-chief of *Spine*, in early 2006 proposed a National Clinical Trials Consortium to overcome the obvious biases within the present ragtag system conducted by companies and different subcontractors, but all paid for by a drug company desiring a positive outcome. (*Newswise*, Jan. 30, 2006 at www.newswise.com/articles/view/517606/?sc=mwtn.)

49 Stephan Heres, John Davis, Katja Maino, Elisabeth Jetzinger, Werner Kissling, and Stefan Leucht;"Why Olanzapine Beats Risperidone, Risperidone Beats Quetiapine, and Quetiapine Beats Olanzapine: An Exploratory Analysis of Head-to-Head Comparison Studies of Second-Generation Antipsychotics," *American Journal of Psychiatry*, 2006 163: 185–194. This study of pharmaceutical-funded research on product claims became a classic widely quoted in editorials. While the obvious statistical problem is that bigger and bigger study populations are needed to have confidence that small differences actually exist, in most cases, studies simply omitted from trial any drug that might show clearly superior performance.

50 Business logic undermined Big Pharma's mid-20th century public service obligation that every ethical house should carry a full line in the interest of public health, whether profitable or not. The story of vaccines illustrates the change. In the 1950s, polio vaccine was big news. Any vaccine given to huge numbers of people was profitable. But then financial reporting rules nearly dried up U.S. national vaccine stocks according to David Brown, "Vaccine Stockpile About to Run Dry," *Indianapolis Star*, April 17, 2005 (originally in the *Washington Post*). Companies aren't paid for stockpiled vaccine until it is used, so they can't recognize revenue from it until it is used, and risk of obsolescence in storage is high. In the spring of 2005, only Merck agreed to replenish their portion of the stockpile of established biological vaccines, and commercial research on vaccines was at low ebb.

Consequently, a vaccine for meningitis B was first developed, low budget, in Cuba in the 1980s (but MPSV4 vaccine for meningitis A has been in use since 1981). More varieties of meningitis B vaccine are being developed in India. In 1999, SmithKline-Beecham signed an agreement with the Cuban Finlay Institute to develop and market meningitis B vaccines in Europe and the United States, and in 2005 began to distribute it in the U.S. as Minactra. (Political note: BBC reported the SmithKline-Beecham agreement on July 29, 1999. However, in U.S. media accounts this was buried in one of the few stories on Cuban bio-development: Judith Miller, "Washington Accuses Cuba of Germ Warfare Research," *New York Times*, May 7, 2002). Today, unless one makes diligent inquiry, Americans are unlikely to know who developed or produced their vaccines. In regions like Africa meningitis remains a season scourge, and better vaccines are needed (Leslie Roberts, "An Ill Wind, Bringing Meningitis," *Science*, June 27, 2008).

But perhaps Big Pharma executives are less intentional ogres than victims of their own system of profit-driven thinking. Now pharmaceutical companies *are* investigating newer routes to vaccines, like synthetic antigens that boost immune system ability to ward off cancer, and in faster route for preparing flu vaccines. Flu vaccine has to be reformulated to match recent strains seen in the population, and the old 1940's method uses three chicken eggs for each dose of

vaccine, requires lead times while waiting for virus to adapt to growing in an egg. To escape this, Baxter and Sanofi-Pasteur have been working for several years on cell methods to make flu vaccine. (Teresa Phillips' Biotech/Biomedical blog, May 5, 2009: http://biotech.about.com/b/, a posting now taken down). And VaxInnate, Acambus, Merck, and Dynavax are racing to create a cell-based universal flu vaccine that also includes protection from swine flu.

51 The Henry J. Kaiser Family Foundation, "Trends and Indicators in the Changing Healthcare Marketplace," 2004 Update, April 2004: Pharmaceutical promotion data were from Exhibit 1.20. The Henry J. Kaiser Family Foundation (www.kkf.org) regularly updates extensive data on health care indicators. The data cited may no longer be found, but this site regularly posts updated fact sheets on health care and the health care industry prepared by the Foundation's staff.

52 Jamie Reidy, *Hard Sell*, Andrews McMeel Publishing, Kansas City, 2005. Reidy obviously stretches his tales for entertainment, made more humorous because he sold Viagra, but his account of being a rep for Pfizer from 1995–1999 is still sobering. The closest he comes to acknowledging professional responsibility is on the book jacket, "I realized that Pfizer paid me a lot of money to do a job I couldn't justify to my own mother. At that point I realized that I had a story to tell." In Britain, another former pharmaceutical rep who quit as a matter of conscience is directing a movie, *Side Effects*, a satire about silly, dubious things reps have done to sell drugs.

Large pharmaceutical companies have now reduced the number of their reps in the field, probably more because of industry consolidation than muckraking about sales practices. Continued overall biotech industry growth has largely offset these cutbacks. For a glimpse of selling in the pharmaceutical industry today, see www.pharmaceuticalsales.com/excerpt.html and rather than over-the-top goofiness, sales techniques advocated today are more like www.tarp.com/affinity/ But even when both are at their best, contrast the mission of an MD with goals of a pharma rep.

53 Kassirer, *On the Take*, op cit, p. 49.

54 David Amsden, "Life: The Disorder," *Salon*, Nov. 25, 2005, found after zapping pop ups at (www.salon.com/mwt/feature/2005/11/25/adult_add).

55 Ray Moynihan, Iona Heath, and David Henry, "Selling Sickness: The Pharmaceutical Industry and Disease-Mongering.," *British Journal of Medicine*, April 13, 2002 (http://bmj.bmjjournals.com/cgi/content/full/324/7342/886; requires registration to access). This site lists a number of publications addressing overly aggressive pharmaceutical promotion, both overtly and by covert PR infiltration of medical education. The article itself gives examples: GlaxoSmithKline flogging Lotronex for hyped up symptoms of "irritable bowel function;" Roche promoting awareness of "undiagnosed social phobia" to pump sales of Aurorix. Even normal baldness has been promoted as a disease.

56 The U.S. prescription pharmaceutical market grew to $286 billion in 2007, about 10 percent of the $2.7 trillion or so in total health care spending according to IMS Health's annual review of that market. Although more than half of total prescriptions were for generic drugs, generics accounted for only about 20 percent of the market revenue.

57 A noted case of off-label promotion was Eli Lilly with Zyprexa. Allegations boiled along for several years with citations in the *New York Times*, AHRP, and other sources. The first accusations were that Lilly withheld or delayed evidence of weight gain and other serious side

effects from Zyprexa. Then it came out that in 2003 John C. Lechleiter, who later became Lilly's CEO, suggested in an internal e-mail that Lilly representatives "could discuss" Zyprexa with pediatricians and child psychiatrists, whatever that is interpreted to mean. Other documents allegedly said information could be given to treat dementia in the elderly, another off-label use. One of the better accounts of the nature of the controversy, the difference between promoting and informing, was by *Medical News Today* (www.medicalnewstoday.com/articles/59295.php), and *Bloomberg News* had one of the most comprehensive media summaries, "Margaret Conin Fisk, Elizabeth Lopatto, and Jeff Feeley, "Lilly Sold Drug for Dementia Knowing It Didn't Help, Files Show," June 12, 2009 (www.bloomberg.com/apps/news?pid=20601109&sid=aTLcF3zT1Pdo) Zyprexa is olanzapine, so for more context, see also footnote 49 in this chapter.

Lilly's official policy was and is that representatives must not promote off-label use with doctors, and the FDA refused to consider an application by Lilly to broaden Zyprexa's prescription for treatment of schizophrenia to persons under the age of 18. See: Alex Berenson, "Lilly E-Mail Discussed Off-Label Drug Use," *New York Times*, March 14, 2008. The company's early position on this was at http://newsroom.lilly.com/ReleaseDetail.cfm?ReleaseID=299792. This situation finally blew up into a record $1.42 billion legal settlement involving thousands of lawsuits (*Wall Street Journal*, "Eli Lilly Agrees to Settle Zyprexa Marketing Cases," Jan. 15, 2009.) Lilly's press release after the settlement was found at: www.prnewswire.com/cgi-bin/micro_stories.pl?ACCT=916306&TICK=LLY&STORY=/www/story/01-15-2009/0004955154&EDATE=Jan+15,+2009

58 Popularly sold prescription guides, such as *The Pill Book*, Bantam, New York, warn of drugs' side effects, but may be dated. Up-to-date awareness of these interactions is expected of professional physicians and pharmacists, but the drug companies attempt to influence the drug registries which these publications draw on. Kassirer, in *On the Take* op. cit., cites a case of this.

59 Robert Steinbrook, M.D., "For Sale: Physicians' Prescribing Data," *The New England Journal of Medicine*, June 29, 2006. Data on prescriptions has been collected for uses other than pharmaceutical marketing for decades, but over time companies began selling the data to pharmaceutical marketing personnel. Now many physicians sign up for the Data Restriction Program, which bars pharmaceutical marketing personnel from access to their personal record. However, drug companies can still access aggregate data for research purposes.

60 The Center for Public Integrity, which tracks Washington lobbies, claims that as an industry the pharmaceutical lobby is the largest, spending a record breaking $168 million in 2007; and $189 million if device makers are added (http://projects.publicintegrity.org/rx/). The Center for Responsive Politics (www.opensecrets.org/lobby/) reported about the same total spending in 2008 as in 2007, but that pharmaceutical lobbying rose to $47 million in just the first three months of 2009. Common Cause reported that health care lobbying surged to $2600 per legislator per day during the 2009 summer hearings on health care reform ("Legislating Under the Influence," Common Cause, June 24, 2009, p. 3). However, the single lobbying organization that by far spent the most during 2008 remained the U.S. Chamber of Commerce at $91.6 million.

61 Alex Berenson, "Revamping at Merck to Cut Costs," *New York Times*, Nov. 29, 2005. Vioxx cost Merck billions of dollars in settlements. In November 2007 Merck agreed to pay $4.85 billion to settle Vioxx claims (Carrie Johnson, "Merck Agrees to Blanket Settlement on Vioxx," *Washington Post*, Nov. 10, 2007). Sales had been about $2.5 billion per year. The plaintiffs' official site is www.officialvioxxsettlement.com/; Merck's is www.merck.com/newsroom/vioxx/ Rumbles about "who won" this debacle were still roiling blogs in 2009.

62 Melody Petersen, "Diuretics Value Drowned Out by Trumpeting of Newer Drugs," *New York Times*, Dec. 18, 2002. Later, Horace Judson, *The Great Betrayal*, Harcourt, New York, 2004, on p. 159 cites a study of scientific fraud; twenty-two of twenty-six cases cited were medically related. Other searches for scientific malfeasance have found more examples in biomedicine than elsewhere. Readers can form their own conjectures. On the other hand, skeptics of a drug can also overstate their case, as with Avandia (Trevor Butterworth, "Statistical Meltdown over Avandia," Statistical Assessment Service, July 11, 2007. Statistical Assessment Service monitors statistical misinterpretation in media reports.)

63 "A Cure for the Common Trial," *Science*, May 12, 2006. The Public Library of Science started a journal, PLoS Clinical Trials, dedicated to publishing all methodologically sound clinical trials regardless of outcome. It became the PLoS Hub for Clinical Trials at: http://clinicaltrials.ploshubs.org/home.action. One controversy was whether those who need to know will spend time wading through the flood of clinical trials. One opinion is that to be read, even scientific literature has to attract readership interest, and readers can judge for themselves how well the site is meeting that challenge.

64 Reed Abelson "Hospitals See Possible Conflict on Medical Devices for Doctors," *New York Times*, Sept. 22, 2005. This article cited Dr. William Overdyke's relationship with Sulzer as a particularly egregious case of going over the line.

65 Barry Meier, "Repeated Defects in Heart Devices Exposes a History of Problems," *New York Times*, October 20, 2005. The basic cause of failure was body fluids slowly seeping through polyimide insulation, eventually causing a short. That this could cause a flaw had been known in the industry, but only after several months of investigation did medical journalists learn about it. What Guidant knew or should have known is easy to say in retrospect, but defect data trickles in, so exactly when does enough accumulate to show a regular pattern of failure? Guidant contended with three issues. First, when a slowly degrading flaw like this is suspected, what do you advise customers—patients and doctors—and the media – and when? Second, once having finished a design, testing it, and having the FDA approve it, what justifies re-opening all that again? Somebody has to "prove it doesn't work." Third, of course, is the ever-present temptation not to disrupt a flow of cash income. According to Doug Bartholomew, "Quality Takes a Beating," *IndustryWeek*, March 2006, the immediate leakage stemmed from foreign material in a supplier's crystal timing component, but as with many such problems, it was hard to pin down.

Guidant is not the only company to suffer problems with heart devices. On October 15, 2007, the FDA issued a recall for Medtronic Sprint Fidelis defibrillator leads. The possibility of a failure – complete fracture of the lead – was quite small, but the consequences could be fatal to the few people affected. Go to www.fda.gov/ForConsumers/ and search on Medtronic Sprint Fidelis to see the FDA record of this case.

In May 2006, Boston Scientific bought Guidant, and as a "new broom," management recalled all Guidant products with any prospect of catastrophic field failure. It toughened quality systems, especially in product design and clinical trials. The author has met many dedicated people in all three of these companies. All were highly mindful of patient welfare. If anything, their quality checking systems were too cumbersome – too easy to make an error plugging through procedures even when they had fail-safe features. The problems lie in process flaws and human foibles – inability of people who mean well to perform to perfection. But in this industry the public expects perfection. Law firm web pages are filled with the latest updates on potential liabilities of medical companies.

Lost in this conflict is the severity of the challenges to actually execute to perfection every process involving medical instrument use, from initial design concept through production to surgical implanting in a harsh operating environment – the human body – where the device should function flawlessly for an extended period, years in most cases. Even our very best systems of work do not yet have the detailed, open communications or the learning systems to anticipate the most insignificant appearing problems before they materialize.

Accounts of financial performance are nearly oblivious to such challenges, instead emphasizing aggressive deals and risks to boost returns. An example is Shawn Tully's perspective on Boston Scientific buying Guidant, "The (Second) Worst Deal Ever," *Fortune*, Oct. 6, 2006.

66 Barnaby J. Feder, "A Parts Supplier to an Aging Population," *New York Times*, March 26, 2005. While surprising to outsiders, its well known within the industry that orthopedic device sales representatives spend much of their time in an operating room. They are expected to answer questions on the spot and to assist with technical issues if necessary – all without touching the patient. De facto they are part of the medical team, so a big component of such a job is not product promotion, but daily learning about their devices and how they are actually used by customers.

67 Reed Abelson and Stephanie Saul, "Ties to Industry Cloud a Clinic's Mission," *New York Times*, Dec. 17, 2005. An earlier article is Andrew Pollack, "Medical Researcher Moves to Sever Ties with Industry," *New York Times*, Jan. 25, 2005.

68 Reed Abelson and Andrew Pollack, "Patient Care vs. Corporate Connections," *New York Times*, Jan. 25, 2005. Paul Krugman, "Drugs, Devices, and Doctors," *New York Times*, Dec. 16, 2005. Krugman ripped the actions of the Cleveland Clinic as symptomatic of the problems of "the medical-industrial complex" throughout the United States.

69 Senate testimony of Peter R. Orszag, director of the Congressional Budget Office, Jan. 31, 2008, Table 4, found at www.cbo.gov/ftpdocs/89xx/doc8948/01-31-HealthTestimony.pdf. Orszag became the Director of the Office of Management and Budget in the Obama Administration.

[70] Comparisons were derived from Annex Tables 1 and 2, World Health Organization, World Health Report 2006 at www.who.int/whr/2006/annex/en/index.html. For the downside of Cuban medicine, the Cuban-American National Foundation alleges that it reeks of medical apartheid (preferred care for foreign medical tourists, but not for average Cuban citizens). The foundation's report was at (www.canf.org/Issues/medicalapartheid.htm), but has been taken down. However, various blogs allege the same. Almost everywhere, patient psychology rates routine treatment more on bedside manner than technical competence, but when patients critically need a procedure, they want the "latest and best," if they can get it.

[71] Shannon Brownlee, *Overtreated*, Bloomsbury USA, New York, 2007. Atul Gawande, "The Cost Conundrum," *The New Yorker*, June 1, 2009, came to a similar conclusion. The article is based on an interview with Gawande, who uses McAllen, Texas, as an example of profit motives infecting medical and health care practices. Gawande, a practicing surgeon, has become a well-known author and critic disclosing the problems of health care from the inside. From the outside, Clayton Christiansen takes off on many of the same points from a market economy perspective, declaring the bloated health care industry to be ripe for disruptive innovation (*The Innovator's Prescription*, McGraw-Hill, New York, 2009). All three propose revolutionary change, but none have the notion of *Compression* in mind.

72 Elliot S. Fisher and H. Gilbert Welch; "Avoiding the Unintended Consequences of Growth in Medical Care," *Journal of the American Medical Association* (1999), 281: 446–453. Writing before Brownlee wrote *Overtreated,* and before the estimate of 100,000 medical error deaths per year began to influence the field, Fisher and Welch argued that cost management does not prevent health care expansion. Health care is resource-driven. Give physicians more options – more diagnostic tests or therapeutic procedures – and they will find reasons to use them, if only to assuage patients who think that using the latest whiz-bang indicates that they are getting superior care. Fisher and Welch identified four fallacies driving medical care expansion: 1) Constrained models of disease (specialists look for what they specialize in), 2) Excessive extrapolation (e.g. reading too much into tests), 3) A missing level of analysis (e.g. the patient's psychology), and 4) Assuming that more is better.

Since the 1960s data have shown big differences among physicians – and big differences among hospitals – in treatment for similar conditions. That translates into big cost differences too. These studies stimulated the idea that, like standard work in a factory, cost-managing clinical pathways to a best practice standard would both improve outcomes and reduce costs. This hasn't worked. One reason is that psychology is a factor in health care. Patients want to be special, not just another workstation with a number in a medical factory. However, even if a patient's medical needs fall in line with a standard clinical pathway, that does not preclude health care workers paying special attention to each patient, respecting them as a person.

73 Alex Berenson, "Tax Break Nets Drug Firms Billions, *International Herald Tribune,* May 9, 2005. The article alleges that the American Jobs Creation Act allows drug companies to repatriate foreign profits at a 5.5% tax rate. In the pharmaceutical industry, both sales and prices are higher inside the United States, but the industry reports far higher international profits. This can be arranged by using imaginative international transfer pricing among divisions of the company. This is not new. It's a decades old practice in global companies with multiple divisions; the 5.5% just adds a little sweetener. National governments are slowly starting to reduce the options for using tax havens and transfer pricing.

74 A typical announcement of progress is Czerniak, et al, "Understanding the Development of Human Bladder Cancer by Using a Whole-Organ Genomic Survey," *Laboratory Investigation,* May 5, 2008. Genomic mapping to discover precursor pathways to various kinds of cancer has been an increasing focus of medical research for several years. Cancer is genomics' research beachhead, but other maladies are sure to follow. Optimists initially thought that a single genetic anomaly might pre-sage one specific disease, but that proved much too simple.

A general review of research on this human "diseasome" as of early 2008 is Andrew Pollack, "Redefining Disease, Genes and All," *New York Times,* May 6, 2008; but this field is moving fast, and only those in it have much chance of keeping up. Genomic research on the "diseasome" keeps revising and re-revising how diseases are defined. The more that is discovered, the more complex it becomes. A combination of genetic triggers seems necessary for abnormal gene expression to transmit to cells. Since transmission may use multiple proteinomic pathways, a great deal of interactive complexity has to be unraveled.

Clearly understanding precursor genetic "flips" and their pathway to cellular malignancy is only a first stage. Then the issue is how to attempt intervention. This has to be carefully considered because, for example, switching a tumor suppressing gene "back on" might encourage mutants of the same gene to trigger metastasis even faster: for example, "Stabilizing Cancer-Fighting p53

Can Also Shield a Cancer Promoter," *Newswise*, May 22, 2008 at www.newswise.com/articles/view/541054/?sc=dwhn.

Because of the complexity of interactive genetic expression, it will be necessary to track the changes in an individual's genetic profile at regular intervals to detect changes, and use "expert systems" to analyze them. See: Nicholas Wade, "Genes Show Limited Value in Predicting Disease," *New York Times*, April 15, 2009. This is all so new that many different potential avenues to prevent and remediate disease are suggested by a recent *Science* article and in its references: Mark Boguski, Kenneth Mandl, and Vikas Sukhatme; "Repurposing with a Difference," *Science*, June 12, 2009. Because of the complexity, making research much more network based is the goal of an initiative by the National Institutes of Health called Clinical and Translational Science Award Program (http://sciencecareers.sciencemag.org/ctscinet). This field is a poster child for the development of vigorous learning enterprises proposed in Chapter 5.

75 Jan Hoffman, "Awash in Complexity, Patients Face a Lonely, Uncertain Road," *New York Times*, Aug. 14, 2005. A good recap of how patients must sort their way through conflicting specialized opinion and conflicting third party payer rules in order to receive treatment.

76 Cases of outright journalistic fraud surface from time to time. Daniel Shorr, the PBS commentator with sixty years experience in the field, referred to lies and plagiarism, then profiting by them, as the most egregious breaches of journalism ethics in a column in *The Christian Science Monitor*, May 16, 2003. However, journalists think such blatant fraud is rare. More pervasive is commentators masquerading as objective reporters and would-be reporters blurring the distinction between factual reporting (as well as it can be done) and advertising, and management using budget and staffing controls to limit journalists' coverage. The Society of Professional Journalists' "Project Watchdog" (www.spj.org/pdf/projectwatchdog.pdf) reveals a great deal about the plight of journalism today. The Society's code of ethics is at: www.spj.org/ethicscode.asp

77 Kathryn Q. Seelye, "Bloggers as Media Trophy Hunters," *New York Times*, Feb. 14, 2005.

78 Rory O'Connor, "Journalism Drowning," MediaChannel.Org, June 1, 2005 (original article disappeared from this site). Deans of prominent schools of journalism agreed that education of journalists was in a sorry state, and that in practice, journalistic standards were even sorrier. The Carnegie Foundation and the John S. and James L. Knight Foundation announced the inception of million dollar grants to bolster the education of new entrepreneurial, blogging journalists, the fear being that on-line news would be no more than a cacophony of contention unless some sources were recognized as trying to present an objective view of events in important places – like the obscure recesses of political and regulatory systems in federal, state, and local governments. Everybody having an opinion but few facts bodes ill for rational decisions in a democracy.

However, a Google search of journalism outreach programs today shows that most are still aimed at K-12 students. Only a few target untrained people trying to be citizen journalists. In schools of journalism, learning new media consumes more of the curriculum. A quick tour of curricula revealed a variety –from traditional Indiana University (http://journalism.indiana.edu/) to quick-hitter seminars at The Poynter Institute (www.poynter.org/). No courses seemed to be aimed directly at addressing various points or skills suggested by the Society of Professional Journalists code of ethics.

79 Ted Koppel, "And Now, A Word for Our Demographic," *New York Times* guest editorial, Jan 29, 2006. "The popular illusion that journalists are liberals does them too much honor. Like all mercenaries they fight for money, not ideology; but unlike true mercenaries, their loyalty is not for sale. It cannot be engaged because it does not exist. Their total lack of commitment to any cause has come to be defined as objectivity. Their daily preoccupation with the trivial and the banal has accumulated large audiences, which in turn, has encouraged a descent into the search for items of even greater banality."

80 Heather Timmons, "Britain: More Cuts at BBC," *New York Times*, Mar. 22, 2005. Mark Sweeney updates financial troubles at the Beeb, "BBC Worldwide Profits Slump 27%," *Guardian UK*, July 14, 2009 (www.guardian.co.uk/media/2009/jul/14/bbc-worldwide-profits-slump).

81 David Shaw, "Special Report: Crossing the Line," *Los Angeles Times*, December 20, 1999. Editorials from all over the United States lambasted the Staples Center breach of journalistic ethics long after the situation at the *Los Angeles Times* had degenerated further. This breach was subtle, perhaps born of business ignorance. It should have served notice to everyone to brush up on journalistic ethics. Instead, publishers continued down the slippery slope.

As the finances of traditional print media continued to weaken, business cutbacks and intrusions continue, culminating in one of the most egregious breaches: Katherine Weymouth, publisher of the *Washington Post*, sent an invitation to Obama administration officials and lobbyists to pay $25,000 a session to meet at "*Washington Post* salons" with *Post* editors and reporters, and with each other. According to *Politico*, which broke the story, an unnamed health care lobbyist tipped off a reporter because it stepped over the ethics line (Mike Allen and Michael Calderone on *Politico*, July 2, 2009 at; www.politico.com/news/stories/0709/24441.html). The story was updated later as uproar ensued. When a breach astonishes Washington lobbyists inured to influence peddling, it's pretty bad. Weymouth cancelled the salons, but the story didn't end. According to *Politico*, she still entertained ideas for making up financial losses at the Washington Post with a major source of money flow in Washington, bringing influential people together.

Politico (www.politico.com/) is an on-line news service begun by two former *Washington Post* reporters. On July 14, Ken Silverstein from *Harper's* noted that *Politico* had co-sponsored an "Oktoberfest" with the Glover Park Group (lobbyists), with beer from the National Beer Retailers Association at the Democratic National Convention in 2008 (found at: www.harpers.org/archive/2009/07/hbc-90005330) This exchange degenerated into finger pointing among journalists on who was providing the sleaziest "escort service" for the Washington elite.

82 Al Jazeera issued an extensive ethical statement after Western criticism in 2004. It can be found in the "about us" section on the home page, http://english.aljazeera.net/

83 Check the *Tribune* web site (www.tribune.com) for the financial statements and the background of board members. The *Tribune* conglomerate was not simple, and it is now in Chapter 11 bankruptcy. Deciphering the footnotes takes a research analyst. The Chandler family (old *L.A. Times* owners) sold their interest in the Tribune Company, and an indeterminate percentage of ownership is an ESOP. In the Tribune's financial statements one can see the confusing clashes between having a public service commitment, being "competitive," and being beholden to the capital markets. Minimum Google time is sufficient to recap a series of tiffs between Tribune-appointed management and the *L.A. Times* newsroom.

84 Estimates of news readership profiles are available from several sources. The 54% readership survey was from *Editor and Publisher's Yearbook*, 2002. A more recent, widely cited survey is from the Joan Shorenstein Center at Harvard, "Young People and News," which was found at www.hks.harvard.edu/presspol/research/carnegie-knight/young_people_and_news_2007.pdf Couple this decline in readership with a decline in advertising, and traditional print newspapers have obviously entered survival mode – do something different or die.

85 Vance Packard, *The Hidden Persuaders*, Random House, New York, 1957. Packard pioneered criticism of media. Edward R. Murrow described commercial TV as "used to distract, delude, amuse, and insulate us." In 1961, Newton Minnow first called it a "wasteland." Marshall McLuhan became famous for saying "the medium is the message," and co-authored a book of almost the same title, *The Medium is the Massage*, Random House, New York, 1967. Dale Minor reviewed pressures to distort reporting during the Vietnam Era in *The Information War*, Tower Publications, New York, 1970. A long history leads to the media protest weblogs of today.

86 Ironically, Independent Press Association, formed in 2000 to assist small publication distribution, failed in 2006, largely because it could not manage chaotic finances. A similar group, New York Community Media Alliance (www.indypressny.org), is still going, promoting news you can't find elsewhere. Other sites like Salon.com, *Pro Publica*, and *Upside Down World* claim to provide various alternatives to mainline media, which are accused of unintended bias more by chasing revenue and commercial reciprocity than by overt propaganda—that is, what is not covered is significant.

However, this development leads to other issues, like veracity and identifying sources of reporting. For example, *Upside Down World* specializes in Latin American politics with a declared "left-wing" bias. Its perspective is overt, but identifying responsibility for reporting can be problematic. (One cannot be sure whether authors are using their real names, or pseudonyms, perhaps out of fear of retribution; whether they were on the scene, reporting second hand, or just pretending.) *Upside Down World* invites submissions from anyone, so readers must rely on its editors to sort out ethical reporting. This resembles the problem that Wikipedia editors have switching off biased attacks so that contributors collectively represent a relatively unbiased "wisdom of the crowd." As traditional newsrooms fade, professional investigative reporters are continuing their tradition in new kinds of media.

87 A typical story critical of Clear Channel slash-and-burn cost cutting concerned a subsidiary billboard company in Massachusetts, by Kevin Cullen, "Clear Signs of Greed," *Boston Globe*, October 17, 2007. Whether prior featherbedding or other circumstances led up to the reported union-busting episode was unclear from the article; only the workers' view was presented. Other old charges on Clear Channel are well aired by Eric Boelert, "Radio's Titan Hits the Skids," *Salon*, Aug. 7, 2002, one of many stories *Salon* ran on Clear Channel over the years (some can be found at www.salon.com/ent/clear_channel). Clear Channel's aggressiveness helped fuel Congressional pressure on the FCC not to expand the scope of media ownership. By 2008 Clear Channel's financial problems were receiving as much attention as its coverage biases. By 2009, cash flow was reaching a "crisis stage" (Geraldine Fabrikant, "Radio Giant Faces Crisis in Cash Flow," *New York Times*, April 30, 2009), and financial projections for the rest of 2009 seemed little more promising.

88 The creed can be found on the Clear Channel web site, www.clearchannel.com, under "about us."

89 Christine Y. Chen, "Not the Bad Boys of Radio," *Fortune,* March 3, 2003. Criticism of Clear Channel intensified during the run up to the Iraq War when its radio stations organized pro-war rallies. War opponents regarded Clear Channel as a privately owned medium for Bush administration propaganda—in addition to being a conduit for its advertisers' propaganda.

However, this criticism was mild compared with that which media critics heaped on the administration and the Pentagon, which restricted most war zone reporters to being embedded in units, did not answer direct questions in Washington press conferences, and engaged in PR campaigns that were dubious both in factuality and efficacy. February 5 2009, an Associated Press wire release claimed that the Pentagon had 27,000 people doing PR work and spent nearly $5 billion a year on it. AP's original report has been removed, but it was picked up by dozens of sites from *Wired* to *Russia Today* (easily found by Google), where it is still up.

90 Richard Pérez-Peña, "Big News in Washington, but Far Fewer Cover It," *New York Times,* Dec. 17, 2008. Traditional print newspapers now have far fewer people covering Washington news, but this reduction is almost offset by reporters from small or specialty news sources. As print newspapers reduce their investigative reporting staff, the public interest concern is whether newcomers have the talent, experience, and resources to tackle an unpopular story. If fewer people can dig into the backwaters of government to hold it accountable to the public, is the public interest threatened? An example is the concern of death penalty opponents that many fewer cases of wrongful conviction will be uncovered. Tim Arango, "Death Row Foes See Newsroom Cuts as Blow," *New York Times,* May 20, 2009.

91 Melody Petersen, "A Respected Face, but Is It News or an Ad?" *New York Times,* May 7, 2003. Brown and Cronkite are only two of many news celebrities who have been enticed to lend credence to commercial claims, blurring the line between a public service career in journalism and a celebrity career in attracting personal attention.

92 Leonard Downie, Jr. and Robert G. Kaiser, *The News About the News,* Vintage Books division of Random House, New York, 2002, p. 243. Many news companies weakened their news coverage if they saw more promising profit opportunities elsewhere. Even the vaunted old British news service, Reuters, expanded too much as a media conglomerate; then went into a down spiral ("Reuters to Cut 3000 Jobs After Big Loss," *New York Times,* February 19, 2003). Traditional news gathering, as faulty as it often was, is being replaced by on-line sources. The news is "free" to users, but business models and journalistic ethics are struggling to catch up. Several sites invite citizen journalists. There's always the prospect that an individual's video from a phone camera will be posted for world attention, for example, the crash landing of US Air Flight 1549 in the bay off LaGuardia field in January 2009. On the other hand can one distinguish what is real and representative from phantom site rumor campaigns and Photoshopped images?

93 Larry Tye, *The Father of Spin: Edward L. Bernays and the Birth of Public Relations,* Owl Books (Henry Holt), New York, 1998. Bernays wrote several books himself, among them, *Crystallizing Public Opinion* (1923) and *Propaganda* (1928), both by Liveright, New York. Born in Vienna, Bernays was the nephew of Sigmund Freud, who disliked Bernays' use of psychology for commercial manipulation. Bernays came to describe his work as the "engineering of consent." Although almost unknown, he originated such Americana as "bacon and eggs" for breakfast in the 1920s. He fostered cigarette smoking during WWI, and later with women; but in the 1960s began engineering the unpopularity of smoking. He anonymously instigated many practices that Americans think arose spontaneously, which is exactly what he wanted. In the 1930s, Hitler's minister of propaganda, Goebbels, referenced *Crystallizing Public Opinion* in developing Nazi

propaganda, and briefly consulted with Ivy Lee, another early PR pioneer. A complex man, Bernays considered himself a political liberal working with the ACLU, but for instance helped portray the Guatemalan revolution of 1954 as necessary to prevent a Soviet beachhead when actually United Fruit Company paid him to help it retain its Guatemalan plantations. (See also second paragraph of footnote 43, Chapter 1.)

94 Randy Dotinga, "Advertisers Tap Brain Science," first noted at *Wired News*, which was found at www.wired.com/news/medtech/0,1286,67597,00.html, and can still be found at several internet sites. Neuroscientists regard this idea as hype far ahead of the present state of knowledge, but it is great media bait, so stories about it are easy to find. Googling "neuromarketing" adds to insight about commercial vs. scientific culture. Sites range from euphoric enticements to future careers in neuromarketing to ethical outrage that a neural research lab would be used to conduct such experiments for commercial intent.

95 Mark Hertsgaard, *On Bended Knee,* Schocken Books, New York, 1989, p. 6.

96 The code of ethics, statement of professional values, and professional standards advisories of the Public Relations Society of America can be found from www.prsa.org/aboutUs/ethics/

97 Peter O'Malley, "In Praise of Secrecy," All About Public Relations web site, http://aboutpublicrelations.net/ucomalleya.htm.

98 In 1991, MediaLink, a PR firm that distributed about half of the 4000 VNRs released that year, surveyed 92 newsrooms, and all 92 had run VNRs, according to John Stauber and Sheldon Rampton, *Toxic Sludge is Good for You*, Common Courage Press, Monroe, ME, 1995, p. 185. In 2006, The Center for Media and Democracy reported another study tracking 36 VNRs out of thousands that had been distributed; 77 TV stations reaching about half the US population had used one of these 36 in a newscast without revealing that it was not their own reporting. A summary of that report can be accessed at www.prwatch.org/fakenews/execsummary. MediaLink's ethical guidelines for VNR users are at: www.medialink.com/about/docs/MDLK%20Code_Ethics%20031504.pdf.

99 John Stauber and Sheldon Rampton, *Toxic Sludge is Good for You*, Common Courage Press, Monroe, ME, 1995, p. 117. Chapter 7 describes methods to fabricate grassroots campaigns in some detail. The authors describe the early rise of the "Religious Right" as largely created by PR. Rampton and Stauber are now on the staff of the Center for Media and Democracy's Sourcewatch at www.sourcewatch.org, a wiki-type information repository revealing sponsors and funding by public relations clients for various campaigns and spending. From the site one can access how legislators voted, who is finding Astroturf groups, and so on – sort a political version of snopes.com, which is better known.

100 Peter Eisler, *USA Today,* May 1, 2008. The Pentagon's site aimed at an Iraqi audience is at www.mawtani.com/ar/ Even in 2009 it looked like it was still under construction. By April 2009 the Pentagon was promising to discontinue such activity.

101 David Barstow, "Behind TV Analysts, Pentagon's Hidden Hand," *New York Times*, April 20, 2008. Media critical web sites later noted that very few news operations of any kind; print, TV, radio, or web; had followed up on the initial exposé by the *New York Times*, but media reliance on the generals had dropped off.

102 David Barstow and Robin Stein, "Under Bush; A New Age of Pre-Packaged Television News," *New York Times,* Mar. 13, 2005. For a summary of standard, everyday media deceptions, see the "Ten Lists of Ten Guidelines" on p. 129 of Carl Hausman, *Lies We Live By*, Routledge, New York, 2000.

103 Dave Astor, "Armstrong Williams Column Axed by TMS," *Editor & Publisher,* Jan. 7, 2004. Quotes from Williams made it clear that he regarded his contract with the Department of Education as "selling a product," not informing, and really saw no conflict in the arrangement.

104 Dave Astor, "*Business Week's* Javers Hints that More Paid Pundit Stories May be Coming," *Editor & Publisher* (online), Jan 18, 2006. By the early 20th century, stories of commentators paid to advance either commercial or political viewpoints had become so common that little shock effect remained.

105 Harry G. Frankfurt, *On Bullshit,* Princeton U. Press, Princeton, NJ, 2005. The conclusion about bullshit is based on Prof. Frankfurt's analysis of this phenomenon. The term bullshit may be a unique American idiom, but the practice and its intent are not. In Prof. Frankfurt's words, "The fact about himself that the bullshitter hides, on the other hand, is that the truth values of his statements are of no central interest to him; what we are not to understand is that his intention is neither to report the truth or to conceal it." That is, in the bullshitter's eagerness to persuade or impress someone, veracity of any information presented is incidental and unimportant.

106 This dire warning is from Anthony Pratkanis and Elliott Aronson, *Age of Propaganda*, revised ed., Henry Holt, New York, 2001. These professors of psychology studied propaganda methods extensively, noting how easily Americans are attracted to unsubstantiated, but colorful statements and symbolic actions, citing as low points of 1990s news coverage, "All Monica; All the Time" during the latter Clinton administration, the O.J. Simpson trial, and the Florida election coverage in 2000. As for people preferring entertainment to hard news, all one has to do is check the relative popularity of the offerings on You Tube.

107 See the announcement of Toyota's Annual Environmental Report at www.toyota.com/dyncon/2008/may/agenda.html?siteid=news_may08h_3. In 2009 Toyota exhibited a vehicle with a body containing many composites made from grown organic matter, not metals or petrochemical polymers. This is not a new dream. Henry Ford touted a car body made of a plastic derived from soybeans in 1942. During World War II, Illinois made its state license plates from a soybean derivative. Unfortunately, when on farm trucks, hogs tended to eat them, so there may be a few unanticipated wrinkles to iron out.

Chapter 5: Creating Vigorous Learning Enterprises

1 For example Christopher Flavin presents a serious proposal to convert the United States to alternative forms of energy generation in *Low Carbon Energy: A Roadmap, Worldwatch Report* 178, 2008. While a reasonable stand-alone proposal, it doesn't factor in multitudes of other problems, like water shortages, food shortages, conversion of existing buildings and vehicles, toxic releases, and on and on. Enthusiastic entrepreneurs are busy concocting all kinds of approaches to alternative energy, but their enthusiasm – necessary if they are to succeed – may blind them to "I forgots" in their plans that they have to discover the hard way.

2 Ronald Wright, *Short History of Progress*, House of Anansi Press, Toronto, 2004. "Progress trap" is a phrase Wright used to describe the predicament of many societies, ancient and modern, when they overran their resources too late to easily retrench and take a different direction.

3 The disciplines are briefly defined at www.solonline.org/organizational_overview/ Senge's seminal book on organizational learning is *The Fifth Discipline*, Doubleday, New York, 1990. In 1997 he founded the Society for Organizational Learning (SOL), which promotes deep personal and organizational change in basic thinking and beliefs about how things work. Since then, SOL has generated a series of programs and publications on organizational learning, which can be found on its site: www.solonline.org.

4 Figures on carats per ton were from a web page at Mining Watch Canada now taken down, but similar estimates are available from many sources. For example, *Encyclopedia of the Nations'* section on South African Mining reported that in 2000, DeBeers' yield was 0.44 carats per ton of ore, found at www.nationsencyclopedia.com/Africa/South-Africa-MINING.html

5 Diamond industry initiatives to address issues threatening to make it a social pariah are at http://diamondfacts.org/ So far, most reforms address only issues like the conflicts in Sierra Leone that led to its diamonds being called "blood diamonds." Industry leaders are signing on to the Kimberly Process Certification System, backed by the United Nations. A related campaign seeks to persuade jewelry retailers to abide by a "Golden Rules" standard for gold and diamond sourcing: www.nodirtygold.org.

6 Robert W. Hall, "Culture of Accountability: Ventana Medical Systems," *Target*, Issue 6, 2007. Although the Roche Group purchased Ventana in 2008, it continues to function as a relatively autonomous unit. Ventana developed the mission statement and sub-goals referred to when it was an independent company. Although guidance of Ventana remains about the same, being part of a big parent company raises questions about long-term governance. Can Ventana pursue the same mission, adjusting its goals as an ongoing vigorous learning organization if governance is exercised from a distance? Could it become part of a larger-scope vigorous learning organization in Roche? In fast-advancing bioscience, operating "synergy" between the organizations is more important to performance than deep financial resources to fund more investment.

7 Jim Huntzinger, "Why Standard Work is Not Standard: Training Within Industries Provides an Answer," *Target,* Issue 4, 2006. If you are unfamiliar with TWI a quick review is online at www.twisummit.com, which refers to books and training programs on the subject.

8 Robert W. Hall, "Culture of Accountability: Ventana Medical Systems," *Target,* Issue 6, 2007, op.cit. Similar practices to reinforce the culture daily can be seen within Autoliv and other companies that have created a lean thinking culture, not just implemented lean techniques.

9 The above-the-line custom at Ventana originated from Partners in Leadership, LLC (www.ozprinciple.com). ABOVE THE LINE®, BELOW THE LINE®, and STEPS TO ACCOUNTABILITY® are its registered trademarks.

10 A listing of various codes of ethics and principles can be found at the ITT center's site: http://ethics.iit.edu/codes/index.html. For an example of an all-industry code, see the one for the global apparel industry at www.goodmoney.com/directry_codes.htm.

11 Elwood E. Rice, LL.D., *A Tribute to Business Character,* published by Rice Leaders of the World Association, New York, 1929. In the 1920s, Rice led a prestigious association with a headquarters in New York City. Today the only internet reference to it found is at: www.archive.org/details/riceleadersofwor00rice.

12 James Fallows, *More Like Us: Making America Great Again,* Houghton-Mifflin, Boston, 1989. Following standard free market logic, Fallows contended that Americans trying to imitate Japan risked falling into Confucian stagnation – that Japanese harmony is less likely to produce rapid innovation than market chaos. Furthermore professional certifications should be subordinate to job markets when selecting a workforce. Perhaps this idea is descended from Adam Smith, who contended that most tradesmen of his day were less skilled than plowmen because once they learned the skills, they performed them repetitively without having to judge effects of weather, and so on. Whether that was a good assessment in 1776 is dubious, and it was long before we had to depend on surgeons, airline pilots, and even auto mechanics and plumbers that must use computer diagnostics and comprehend complex regulatory codes in order to do the work. This book argues that today's world of work has moved beyond such obsolete arguments. Something better than either market incentives or the fleeting inspiration of professional codes is needed.

13 William M. Sullivan, *Work and Integrity,* HarperCollins, New York, 1995. The first chapter summarizes many views on professionalism in the mid-1990s, before the period of major corporate scandals.

14 The definition is an extended version of the *Oxford English Dictionary* definition.

15 M. Scott Myers, *Every Employee a Manager,* Third Edition, University Associates, Inc., San Diego, 1991 (first written in 1981). Myers proposed that every employee should be considered a manager rather than a market commodity. At the time few managers could fully embrace this idea. Non-acceptance of it littered the history of work in the 20th century: the fading of Allen Mogensen's Work Simplification; the opposition to TWI during World War II; the endless management-union clashes. Owners and managers boxed in by fiduciary duty traditions remain blind to it still. The notion of an all-professional workforce is beyond Myer's proposal, so it is a

concept even more foreign to business-as-usual. However, if a vigorous learning organization must be a full-stakeholder entity to make progress, why not dump the past and go for it?

16 Dilbert, resigned to incompetence and backstabbing, is the title character in Scott Adams' comic strip. The author visiting a company's offices has often counted the Dilbert cartoons posted, on the conjecture that trust in management is inversely proportional to the number of Dilbert cartoons posted per cubicle.

17 Joanne B. Ciulla, *The Working Life: The Promise and Betrayal of Modern Work,* Three Rivers Press (Random House), New York, 2000, p. 164.

18 Michael Marmot, *The Status Syndrome,* Times Books (Henry Holt) New York, 2004, p. 122. Marmot cites his own work with J. Siegrist as evidence that the primary indicators of stress related to work is the imbalance between responsibility and control, and the imbalance between effort and rewards. That is, being in the position of goat always blamed for something without being able to take corrective action, and having no recognition if one does, creates a great deal of stress. See also: Richard Wilkinson, *The Impact of Inequality,* The New Press, New York, 2005. (See footnote 101 in Chapter 1). Related to this is research on the diets and cardiovascular systems of mice by Zofia Zukowska and colleagues at Georgetown University Medical Center: Stressed mice presented with a rich diet gained more weight than unstressed mice and exhibited the belly-fat typical of many humans in modern societies. Picking up on the implications of this, the media publicized their studies. A summary of the research is "Scientists Discover the Key to Manipulating Fat; Pathway Also Explains Stress-Induced Weight Gain," *Science Daily*, July 2, 2007, which was found at: www.sciencedaily.com/releases/2007/07/070702084321.htm

19 The Northrop-Grumman Apprentice School at Newport-News, VA is probably the best-known American apprentice program. It has a four-year college-level program and mission resembling that of the former General Motors Institute, now Kettering University. A more typical list of apprentice programs is from California Apprenticeship Coordinators Association: www.calapprenticeship.org/Programs.htm One can see that that youth might consider several of these skills passé, and seek something that is seemingly less dirty and which has a more high-tech or entertainment spin to it.

20 Harry Petrakis, *The Founder's Touch: The Life of Paul Galvin of Motorola,* Motorola Univ. Press, Schaumburg, IL, 1991. Several stories of fires from Petrakis agree with Bill Lear's accounts—heard personally from Lear, who was known not to let a fact interfere with a good story. Paul Galvin founded Motorola to produce early automotive radios.

21 Richard Rashke, *Stormy Genius: The Life of Aviation's Maverick Bill Lear,* Houghton-Mifflin, New York, 1985. A popular brief account of the irascible Lear is by Dan Close, "Love Him or Hate Him, Bill Lear Was a Creator," originally in *The Wichita Eagle,* April 29, 1985, which was found online at www.wingsoverkansas.com/history/article.asp?id=103 Probably Lear's best-known quip about project management was, "You put up half the money, and you can make half the decisions."

22 A biologically based computer is called the International Genetically Engineered Machine (iGES), and the database of BioBrick™ DNA fragments is MIT's Registry of Standard Biological Parts. This is an open competition among mostly academic institutions. One can learn more about it at The BioBricks Foundation: http://bbf.openwetware.org.

23 For example Roche, the Swiss pharmaceutical company, explains its policy is to share information on patented genes or other items at www.roche.com/sci-genepatenting.pdf. Roche presents some cogent arguments. How the policy works in practice is not known, but a Google search of Roche and gene patents reveals a trail of disputes over patents related to genetic research, so it is obvious that the issues are still being sorted out.

24 The graduation figures and much else can be found at the U.S. Census Bureau site: www.census.gov/population/www/socdemo/education/sipp2004w2.html. (See Table 5A)

25 Servant leadership has a lengthy, if quiet history. As a concept associated with business it began with Robert K. Greenleaf, *Servant Leadership*, The Greenleaf Center, Indianapolis, IN, 1977. The Greenleaf Center was established to promote servant leadership. The best-known promoter of servant leadership today is Larry Spears of The Spears Center. The Scanlon Leadership Network also promotes servant leadership as one of several aspects of Scanlon Leadership, which is much more than a pay plan. See: www.scanlonleader.org/ Another business pioneer of servant leadership philosophy was William J. O'Brien, former CEO of Hanover Insurance. He summarized it in "Character and the Corporation," available from the Society for Organizational Learning, Cambridge, MA. O'Brien also coined the term "lean" in business long before it become popular in manufacturing. Servant leadership is inculcated in military academies, but not by that name. It's rarely inculcated in business schools.

Jim Collins' Level 5 leaders in his popular book *Good to Great* (HarperBusiness, New York, 2001) exhibited traits of Servant Leadership. While *Good to Great* is better known to business readers than servant leadership, Collins doesn't describe Level 5 leaders using that phrase.

26 Wendy Zellner, "What Was Don Carty Thinking?" *Business Week,* April 24, 2003. Zellner's commentary summarizes a story widely reported in the business press at the time. To restore trust with employees, much less union leaders, the parent AMR board had to fire Carty.

27 Robert W. Hall, "Tokyo Seksui," *Target*, Second Issue 2008. Sekisui is the largest of several Japanese companies that manufacture steel frame houses to precise specification in factories. Like most other large Japanese companies today, it found that youth entering the company are much less inclined than their fathers to stay a lifetime. To stay a career, they have to know that they fit and that they will both be challenged and satisfied by its environment. The old system of promotion largely by seniority is passé; people now advance on merit, although merit includes expert teaming with other employees. Under lifetime employment, senior leaders could bring people along slowly. Now they must develop them much quicker, spending more time evaluating their strengths, weaknesses, and advising how they can improve. However, the complexity of Sekisui's work also demands creating only "A-teams." The increased intensity of mentoring and evaluating personal performance has driven senior leaders to attend regular meetings to improve it, coaching each other in how to develop people better and better. They mentor the newest ones (first 1 or 2 years) almost daily, taking advantage of "teaching moments."

28 At Sun Hydraulics site (www.sunhydraulics.com/cmsnet/aboutus.aspx?lang_id=1) one can see a current overview of Sun Hydraulics' non-hierarchical policies. By culture it uses no job titles inside the company, but has to post some employees' primary external responsibilities so that outsiders know whom to contact. Employees have areas on which they concentrate, but few can say, "That isn't my responsibility." The company's technical expertise is ultra close tolerance machining for ultra-tough hydraulics applications. Probably the best-known story describing Sun

Hydraulics' culture is that within a factory the only person with a title has the part-time responsibility of watering the greenery, so that nametag reads "Plant Manager." Harvard Business School published a series of cases on the company in the 1980s.

29 PortionPac Chemical Company began as an environmentally conscious company in 1964, and much later learned that lean thinking would help them conserve resources. Products are biodegradable, and shipments under each new customer contract typically drop by half within a few months as a customer's cleaning personnel are trained in how to conserve usage. See www.portionpaccorp.com/

30 Robert W. Hall, "Eliminating the Budget: Park Nicollet Health Services," *Target*, Issue 5, 2007. Park Nicolett is one of the more successful cases of "Beyond Budgeting," but many other companies are doing something similar. Without a budget to lean on for excuses, managers and supervisors have to think more strategically and operationally on spending decisions, and they have to assume greater leadership of those working for them. (See footnote 31 in Chapter 4.) Detailed budgets would be the wrong kind of control system in vigorous learning enterprises.

Chapter 6: Developing the Constitution for Vigorous Learning

1 The Hunger Project site is: www.thp.org. The description of how it operates is from the web site and from a presentation by Jill Lester, president. The Wikepedia entry on The Hunger Project cites a good deal of old criticism of the organization, primarily its association with Werner Erhard and his est theory, but Erhard is no longer on the board, and The Hunger Project has consistently been rated as one of the best-run charities with good operating effectiveness as a non-governmental organization. It prefers to engage in grassroots community development with local women as change agents.

2 The World Transhumanist Association's vision and values can be found at www.transhumanism.org. It has some similarities to Compression, but concentrates on technical enhancement of humans and human technology while making a few nods toward dealing with the challenges of Compression. The contention of this book is that development of human behavior to meet these challenges will also be significant.

3 Kurzweil, the inventor of optical character recognition systems, including the flatbed scanner, became a technology futurist. His thinking is on display at www.kurzweilai.net. Kurzweil projects that software will eventually exhibit intelligence exceeding that of humans; therefore take over much direction of the world. This crossover point is called "the Singularity," a phrase that originated with Vernor Vinge. Wikipedia describes it as the "technological singularity," since the term is also used to describe almost any modeled phenomenon in which an effect goes to either zero or infinity. Kurzweil also contends that technically augmenting human physiology can make us nearly immortal by enabling fields like disease prevention and nanotechnology to progress in some form indefinitely. (Is this another avenue of evolution toward higher free energy density?) Kurzweil's thinking does not lack critics, for instance Glenn Zorpette, "Waiting for the Rapture," in *IEEE Spectrum, June* 2008: http://spectrum.ieee.org/jun08/6311 (part of a special report on the topic). However, feats like pilotless aircraft, driverless cars, and constant monitoring of individuals' locations and transactions give us pause for what is happening.

4 George Lakoff, *The Political Mind,* Penguin Group, New York, 2008. This is the latest of many books by Lakoff, a neural linguist famous for advising political campaigns. He recommends lacing political speech with symbolism that people emotionally relate to because it will be interpreted emotionally in the context of whatever worldview its hearers already hold.

5 Paul Collier, *The Bottom Billion,* Oxford University Press, New York, 2008. This review of failing economies includes policies that may help improve quality of life in very poor economies.

6 Neo-Corporatism refers to societal arrangements that feature regular negotiations between private companies, labor, and the government. This works well in small regions where social groups are tightly organized, like Sweden, Finland, and Norway. Mondragón Cooperative Corporation is the biggest cooperative enterprise in the world in the Basque Country of Spain. It has a credit union that functions as a bank, has over 150 companies of various kinds, all of which are worker-owned, and sponsors extensive education including Mondragón University. Plenty of books and web sites describe Mondragón. Coping with the recent financial downturn has presented Mondragon with the same difficulties as investor-owned companies, but it seems to be

surviving because if workers understand the situation, they share the pain (from *The Economist*, March 26, 2009).

7 Inside Brown & Williamson, Wiegand became more and more at odds with senior managers over research on a less hazardous cigarette product until they no longer trusted him. He went public after being fired from Brown & Williamson, which compiled a huge dossier on him to discredit his integrity before he could give congressional testimony or talk with the press. In this case, the employer could not squelch the message as they usually do. Inside Enron, Watkins was an ignored barking dog, going public only after Enron's collapse.

8 C. Fred Alford, *Whistleblowers: Broken Lives and Organizational Power*, Cornell University Press, Ithaca, 2001, pp. 22–25. His book is a classic among books on this subject, and its subtitle is significant.

9 Integrity International at www.soeken.lawsonline.net/ offers legal and financial support to whistleblowers. The National Whistleblower Center (www.whistleblowers.org) offers legal advice and is politically active. A center just for government employee whistleblowers is Public Employees for Environmental Responsibility at www.peer.org/

10 Mauricio Delgado, "To Trust or Not to Trust: Ask Oxytocin," *Scientific American* (Mind Matters), July 15, 2008. Thomas Baumgartner and colleagues at the University of Zurich found that the amygdala region of the brain is positively influenced by oxytocin for two functions: learning fear and emotion, and learning reward responses and trust. The original work was published as Baumgartner, et al, "Oxytocin Shapes the Neural Circuitry of Trust and Trust Adaptation in Humans," *Neuron*, May 22, 2008.

11 Adam Smith, *An Inquiry into the Nature and Causes of The Wealth of Nations*, 1776, Book 1, Chapter 10. The observation on agronomic skill is in paragraph 1.10.79 in the text readable in full at www.econlib.org/LIBRARY/Smith/smWN.html.

12 In the 20th century agronomics evolved into agricultural science, which in turn splintered into sub-fields supporting technology-based industrial farming. The American diversified family farm faded, replaced by specialized operations for poultry, hogs, crops, and so on, often as contractors in agribusiness systems. However, the U.S. Department of Agriculture still keeps statistics according to the different factors of production: www.ers.usda.gov/Data/AgProductivity/ Meetings of the American Society of Agronomy are only partly on agronomy; meetings are held jointly with other societies covering fields such as geophysics, climate change, and biodiversity. See www.agronomy.org. And every state in the United States still has an "agricultural extension service."

However, evidence in the merits of "old style" integrated, diversified, crop-rotation farming is gathering, and The American Society of Agronomy is making an effort to integrate the newest biological technologies and practices. For example, it publicized the results of a study in Wisconsin showing that a more "organic" approach beat modern monocropping on several criteria of performance. See: John-Paul Chavas, Joshua Posner, and Janet Hedtcke, "Organic and Conventional Productions Systems in the Wisconsin Integrated Cropping Systems Trial: Economic and Risk Analysis 1993-2006," *Agronomy Journal*, v. 101, pp-228-295, published on line March 4, 2009.

Home Economics evokes *Oikonomia* by the Greek, Xenophon, the ancient origin of economics; roughly translated it means "rules and lore for managing a household, probably a sizeable estate." As a formal study at both the K-12 and at university levels, home economics began the United States in the late 19th century. Ellen Richards and other pioneers wanted to create a field of study primarily for women who then had little opportunity for higher education, emphasizing home and family as an important part of the world, and using scientific principles to improve the operation of households. In this respect the home economics movement was a counterpart to Scientific Management for industry, in gestation at the same time. Back when a great deal of work, like canning of vegetables now done in factories, was done at home, home economics was very influential. The best programs featured nutrition, sanitation, child development, study of textile fibers, and other topics useful for functioning outside today's market economy. (Answers.com has a good run down on the history of home economics.)

In the latter 20th century, as the rural population migrated to cities and suburbs, home economics faded, displaced by mass production and mass markets. As career opportunities opened for women in fields once exclusively for men, home economics came to be seen as trapping female talent in yesteryear. See: "What Was Home Economics?" Cornell University Division of Rare & Manuscript Collections, 2001, at http://rmc.library.cornell.edu/homeEc/masterlabel.html.

13 "Market theory of value" is a more popular phrase for what economists more generally call a subjective theory of value, including marginal utility for what one more or one less unit of anything may fetch as a price from a buyer, used for setting prices. The value that either a buyer or seller may place on something may be zero, or even negative, depending upon the time and circumstance of a transaction. Quantifying subjective value underlies the devising of all kinds of economic models of reality.

14 The labor theory of value did not originate from Karl Marx as is often alleged. David Ricardo proposed it, but probably did not originate it, and Adam Smith "talked all around it."

15 Because of fuzzy category definitions, occupation and industry comparisons using national statistics is fuzzy. To suggest much, differences have to be overwhelming, and there are many caveats. For example the Bureau of Labor Statistics (www.bls.gov/oes_nat.htm#b00-0000) reports three times as many CEOs as purchasing managers. About a million people work in law-related occupations. Over a million work as accountants or auditors. Each of these is more than double the *combined* headcount of 448,000 in farming, fishing, and forestry. (Many people living on a farm don't work it, and many of those working a farm don't live on it). About 484,000 people are financial managers, and they have a lot of support staff: 357,000 loan officers alone. In total about 8 million people work financial services. Volume of shares traded on the NYSE alone ballooned from 3.1 billion shares in 1970 to 597.7 billion shares in 2006; the trillions of dollars in derivatives and similar instruments traded did not exist in 1970 (Table 1179, U.S. Census Bureau). In 2008, about 14 million people worked in manufacturing (but far from all actually make anything); and 11 million more worked in food service (not agriculture). Financially related services account for 7.8% of GDP, professional and technical services, 7.0%; manufacturing 6.9%; health care 6.9%; and agriculture 0.9 % (from Annual Industry Accounts, U.S. Bureau of Economic Analysis). The figure for health care is below the 16% of GDP usually bandied in discussions on national health care policy; adding in insurance and medically related services balloons the numbers.

16 While these assumptions are used to simplify exchange models, few economists are so cold as to assume that real people always maximize their self-interest. Philosophically anyway, the

subjective theory of value allows people to give things away at an exchange price of zero. The more ideological proponents of a market theory of value often cite Adam Smith's *Wealth of Nations* (1776) without reading it in entirety, and neglect Smith's earlier work, *The Theory of the Moral Sentiments* (1759), which can be read on line at: www.adamsmith.org/smith/tms-intro.htm

17 Martha Stout, *The Sociopath Next Door,* Broadway Books (Random House), New York, 2005. Stout defines a sociopath as a person unable to emotionally feel compassion for others, distinguishing right from wrong only at an intellectual level; therefore ruthlessly manipulating others for self-interest. Few economists fully subscribe to economic man assumptions except as convenient to simplify modeling, but when modeling, forget the nature of the assumptions.

18 The seminal work on behavioral economics (which also led to artificial intelligence in computing) began with Herbert Simon and others at Carnegie-Mellon in the 1960s. Many others continued. Robert Axelrod, for instance, extended the original Prisoners' Dilemma to discover patterns of cooperating and competing that lead to win/win or win/lose. Assumptions became less simplistic; for instance, that information isn't equally distributed and isn't cost-free. By 2002, behavioral economics had entered mainstream economic modeling, and Daniel Kahneman and Vernon Smith won a Nobel Prize for many contributions to it.

19 Much financial theory has been based on the efficient market hypothesis; that securities always trade at a fair market value if many people are in a market, so no investor can outperform that market over the long run. Enthusiasts have stretched the implications of this theory ever since Eugene Fama developed it (published as "Efficient Capital Markets: A Review of Theory and Empirical Work," *Journal of Finance*, May 1970).

The efficient market hypothesis remains controversial because it has been invoked to justify many financial market innovations, including complex derivative trading instruments and ever-faster computerized trading, now described by variety of names: program trading, computer trading, algorithmic trading (or just "algo"), and high-frequency trading (HFT). Proponents claim that each of these increases market liquidity or market efficiency, and anything doing that must be beneficial.

Computers have executed capital market trades for 25 years. Time between trades is now down to milliseconds. Technicians (quant jocks) riding trends others never see thus capture margins on the market mechanism itself, not from human revaluation of any underlying assets. And traders using HFT can inject new information about a company, for instance, at lightning speed to start riding a revaluation trend "almost before it starts." About 75% of all trades on the NYSE are now HFT. Critics fear that this increased market volatility inflated bigger financial bubbles. Others allege that it's more like charging a fee for liquidity, as with debit card clearing systems, rather than from exchanging human valuations of assets. Proving any allegation is very difficult, but in any case a tiny fraction skimmed off huge financial flows (trading churn) adds up to billions of dollars, so that the sizes of the bonuses made by traders draw criticism. See for instance, Charles Duhigg, "Stock Traders Find Speed Pays, In Milliseconds," *New York Times*, July 23, 2009.

NYSE is now building a huge data center in New Jersey that will hike the percentage of HST trading from 70-75% to maybe 90% (Scott Patterson and Serena Ng, "NYSE's Fast-Trade Hub Rises Up in New Jersey," *Wall Street Journal*, July 30, 2009). The financial industry is not in agreement that this is good. For a flavor of the debate, see Jon Stokes, *Ars Technica*, Aug. 2, 2009, "Computer Trading Worries Grow as NYSE Builds New Datacenter," at: http://arstechnica.com/tech-policy/news/2009/08/nyse-builds-computer-trading-mothership-worries-abound.ars

HST reopens ancient concerns whether making money just on the exchange of money is in the best interests of society. Does trading at a speed faster than real humans can actually revaluate assets constitute a market? If so, trading of what; between whom? Design engineers whose computers exchange design iterations faster than their "masters" can follow are communicating with another human through an agreed medium. But HFT is more like entering software in jousts against competing software, and has even been termed a form of "robot competition." Of course, from the view of Compression the critique of all this is that guidance from capital markets was too abstract and far removed from physical reality before HST began to make it even more abstract and far removed.

From the view of lean principles, quality principles, and systems theory, faster feedback and correction is an improvement in a process. But if the faster feedback is not really a correction, but only a reaction to a change not understood, the system can goes into the status well known in quality as "overcontrol." That is, errors are amplified, and if nothing dampens this, the system will go out of control.

20 Robert Costanza, et al, "The Value of the World's Ecosystem Services and Natural Capital," *Nature*, May 15, 1997. Most environmentalists soon give up trying to explain nature without entering the metal box of business executives that is called "money," first trying to translate ecology into terms business thinkers understand, then trying to coax them out of it.

21 The World Intellectual Property Organization explains the valuation and legal issues in intellectual property are at www.wipo.int/ (hard to load). It's well known that any instrument of intellectual property is worth something only if its owner can legally (or otherwise) enforce it. A patent lawyer's review of intellectual property is the second half of Robert Plotkin, *The Genie in the Machine*, Stanford Law Books, Stanford, CA, 2009. Critics of excessive intellectual property claims are increasing, for example Neil Natanel, *Copyright's Paradox*, Oxford University Press, UK, 2008, who concentrates more on copyrights infringing on free speech than in retarding learning rates. And James Boyle, *The Public Domain*, Yale University Press, 2008, and on-line at the author's site: http://james-boyle.com. Boyle critiques intellectual property law as unreasonably restricting exchanges of ideas and freedom of expression.

U.S. Patent 6556992 is actually on "Method and System for Rating Patents and Other Intangible Assets."

One of the most noted intellectual property controversies is Monsanto's genetically modified seed. Farmers sign agreements not to replant seed from their own planting, but to buy it from Monsanto. This violates longstanding agricultural practice throughout the world. Alleged strong-arming of farmers who violate this agreement is the basis of most counter-suits against Monsanto (and Monsanto also sued DuPont, which accused Monsanto of being litigation happy.) Throughout the world enforcement of the patents stirs as much opposition as fear of unintended genetic contamination of the environment. Opponents fear that if seed can only be obtained from Monsanto, BASF, Bayer, Dow, DuPont, and Syngenta, they will have a lock on all agriculture. So far, Monsanto has not introduced Terminator Technology (crops with seed that will not germinate, which makes replanting by farmers impossible). A dated, but comprehensive review of this in language less heated than most is: Haley Stein, "Intellectual Property and Genetically Modified Seeds: The United States, Trade, and the Developing World," *Northwestern Journal of Technology and Intellectual Property*, Spring 2005.

On May 8, 2009 the American Academy of Environmental Medicine issued a call for a moratorium on genetically engineered crops and full studies on their effects on human health and

the environment. The statement was based on a number of studies linking GM food to health problems in animals. Following the precautionary principle in both public health and in environmental protection, the Academy recommended that the sellers of GM seed or food be required to prove it safe, rather than that other parties be required to prove it not safe. (Statement can be found at: www.aaemonline.org/gmopost.html) In Europe scientific groups took that position as early as 1999, so that in the last decade genetically modified crops have been on a downhill slide in Europe much like that of nuclear power in the United States in the 1980s. If the burden of legal proof actually shifts almost wholly to the seller, the value of intellectual property would probably depreciate, and much of that value is in biological patents. It's very hard to prove that any level of something above zero is safe.

22 Eric D. Beinhocker, *The Origin of Wealth*, Harvard Business School Press, Boston, 2006.

23 From the CorporateRegister.com/crra/ site one can see the CSR report winners for 2008, but must register on the site to download winning reports. Vodafone was the 2008 winner, and one can navigate to its 2008 report from the Vodafone site, www.vodafone.com/ Vodafone was also the 2007 winner and that report, 43 pages long, with only a few pages of financials, was certified by Deloitte & Touche. In both reports, responding to calls for extensive study RF exposure resulting from long-term cell phone use as a potential cause of brain cancer, Vodaphone noted that scientific evidence of this was inconclusive, but it is monitoring health concerns with cell phones. Readers interested in cell phone radiation risks will find alarming media reports, but peer-reviewed research studies are not as easy to locate, a situation typical of many other slowly accumulating hazards – if there is a serious hazard. (Dr. Vini Khurana's paper that drew a great deal of media attention to this was found at www.brain-surgery.net.au/SurgNeurol_RV.pdf)

Readers may be interested in Wal-Mart's CSR, which is a sustainability report found at: http://walmartstores.com/Sustainability/7951.aspx

Another approach to corporate social responsibility is B-Corporations, which are dedicated to balancing the interests of all stakeholders, including the environment. This approach seems to be a hybrid organization that corporations will morph into in order to deal with Compression. See: www.bcorporation.net/

24 Sekisui CSR reports can be seen at www.sekisuichemical.com/csr/report/index.html.

25 "Just Good Business," *The Economist*, Jan. 17, 2008, Special Reports Section.

26 This discussion does not belabor the buildup to the big financial bubble and its aftermath. It was not hard to see coming (I pulled most retirement funds out of stock during the dot.com madness.) For example, by 2007 household mortgages had ballooned 65% just since 2003; household debt of $13.8 trillion had grown by 134 % since 1998; retirement assets of $17.6 trillion had grown 151% since 1998; and American debt, public and private, had grown by 5–10% per annum for the past seven years. By 2007 the United States' foreign trade deficit had risen to $731 billion (by the current account), and the $2.6 trillion in dollar reserves outside the United States ($1.1 trillion held by China and Japan) was almost double the cash float of the US Treasury, and much higher than the emergency funds of the Federal Reserve. When foreigners became wary of buying American debt, U.S. institutions could not make up the shortfall in liquidity. Real estate deals became harder to make and real estate values declined. To pop this bubble, all it took was some over-rated mortgage debt. Printing more money, if it is well applied,

may once again re-prime growth, but more crucial is the long-term issue of what we do with our physical economy.

After the global financial contraction of 2008-2009, institutions looked to Japanese methods to work out of its bubble that began in 1990. Among the options were 100-year, multigenerational mortgages and Real Estate Investment Trusts. By 2006, Japanese real estate values were turning around, but with global financial contraction in late 2008, Japanese housing started dropping, office vacancies rose, and this modest recovery was in doubt (www.japaneconomynews.com/category/real-estate/)

27 Vaclav Smil summarizes the situation in Japan at www.japanfocus.org/-Vaclav-Smil/2411. Both Smil and the Japan Institute for Energy and Economic Statistics note that in total, energy conservation by Japanese industry leveled off in the 1990s, while energy use increased in Japanese offices, households, and transportation. Japanese consumed more energy by accumulating more "things" that consume energy.

28 James Lovelock, *The Revenge of Gaia*, Basic Books, New York, 2006. Lovelock claims that ten experiments now support his Gaia theory that the biosphere is one interconnected system. In addition more and more physicists continue to create models and evidence showing that the whole universe is interconnected: e.g., David Bohm, *Wholeness and the Implicate Order*, Routledge, New York, 1980; Seth Lloyd, *Programming the Universe*, Alfred A. Knopf, New York, 2006; and B.G. Sidharth, *The Thermodynamic Universe*, World Scientific, Singapore, 2008. Lovelock's concept is descended from similar concepts decades earlier, notably Alfred Redfield in the 1930s. Curiously, Benjamin Franklin is credited with insight that ecology is an interconnected system (Steven Johnson, "Green Ben," *American History*, Aug. 2009).

In contrast with Lovelock, Peter Ward (*The Medea Hypothesis*, Princeton University Press, 2009) argues that over a longer time span, the earth does not intrinsically favor life. Life evolved as a huge, primeval biomass from a high CO_2 atmosphere, from which mammals and man emerged as oxygen levels increased. In about half a million years, life itself will decrease the CO_2 levels to a point where higher forms of life cannot be sustained. Holding down atmospheric CO_2 concentration is an "immediate" problem of the next 50-100 years. Ward is pessimistic that the human race can do that, so it is likely to extinguish itself; but if it does stave this off, it will be by "engineering" this big interconnected system on its own behalf. Ward holds that with a population of 6-9 billion humans, any return to some "pristine" ecology is hopeless. His *Medea Hypothesis* is controversial, of course.

This interconnectedness of processes is why vigorous learning organizations have to solve problems from a holistic view of total life-cycle processes, but in their own locality. The problem of e-coli 0157 contaminating produce (one process in Figure 6.4) illustrates the point. To preclude such incidents, food retailers apparently insist that growers isolate fields from any possibility of fecal matter getting on produce, but of course manure has long been a major source of fertilizer for crops. However, the causal chain of e-coli 0157 contamination is not well understood and may vary from place to place. This story is from Carolyn Lochhead, "Crops, Ponds Destroyed in Quest for Food Safety," *San Francisco Chronicle*, July 13, 2009.

29 Information on PCBs can be found at many credible internet sites via Google.

30 Jeff Dukes, "Bad Mileage: 98 Tons of Plants per Gallon," Press Release, University of Utah, Oct. 27, 2003, picked up by EurekaAlert! This never became a peer-reviewed paper, but Dukes' back-of-the-envelope calculation became a hit news as a news release; it was found at http://web.utah.edu/unews/releases/03/oct/gas.html.

31 Product yields from refining petroleum vary greatly around the world per a DOE site, www1.eere.energy.gov/vehiclesandfuels/facts/favorites/fcvt_fotw214.html. Refinery processes and settings vary considerably, depending on whether feedstock is "sweet" or "sour" crude, demand for products, number of variations or fuel formulas desired, and so on.

32 See www.epa.mercury. The amount of mercury being released into American air has diminished since 2000, but health concerns from mercury exposure continue to rise. Cement production, refining of various metals, batteries, and fluorescent lamps are all potential sources of mercury. Mercury is being "designed out of" batteries and fluorescent lamps, so now about 40% of mercury emissions originating in the United States comes from coal-fired generating plants. However, only about 25% of these emissions are deposited in the U.S. The rest enter the global atmospheric cycle to fall out and be deposited all over the earth's surface. Less than half of all depositions from the atmosphere in the United States originate in the U. S., and about half of all global mercury emissions are in Asia. Mercury as well as other atmospheric contamination is a global problem. (From EPA: www.epa.gov/mercury/about.htm)

Mercury exists in nature. We have long known that directly handling mercury is hazardous. Working with mercury caused old-time hatters to become goofy, as captured in the phrase, "mad as a hatter." But the hazardous mercury accumulating today is methylmercury, which forms after atmospheric mercury is deposited. Methylmercury is known to accumulate in the bodies of fish, notably tuna. That's why the EPA advises people, especially pregnant women, not to eat mercury-laden fish. Ever since the Minimata disaster in Japan in 1956 (from eating grossly contaminated fish) we have known that fetuses concentrate methylmercury from their mother, and that it has a greater effect on fetal neural development than on adults. A long trail of research since shows that in low concentrations, methylmercury has no detectable effect, while long exposure lets accumulate. Tuna, being bigger and living longer than most fish, thereby accumulate more methylmercury.

Research on methylmercury is ongoing. Methylmercury is a suspect in the increase in autism during the past 20 years. This is not definitive because other hypotheses on causes of autism are still being explored, but living closer to major sources of mercury releases does appear to correlate with occurrence of autism and other abnormalities. R. Palmer, S. Blanchard, and R. Wood; "Proximity to Point Sources of Environmental Mercury Release as a Predictor of Autism Prevalence," *Health Place*, Mar. 2009 (a positive correlation was found, and not for the first time).

And biological processes by which mercury deposition from the atmosphere is converted to methylmercury in the oceanic food chain are being discovered. (Krabbenhoft, et al; "Mercury Sources, Availability, and Biodistribution in the North Pacific Ocean: Insights from Data and Models," *Global Biogeochemical Cycles* [American Geophysical Union], May 2009.) The headline grabber from this study was a projection that at the current rate of mercury fallout from the sky, the biological concentration of methylmercury in the Pacific Ocean could increase by 50% by 2050.

33 Just one of many such sites is: www.greenhomebuilding.com/recyclematerials.htm. The official site for the well-known LEED building standards is the U.S. Green Building Council, www.usgbc.org/

34 "End-of-Life Vehicles Directive" Policy Department: Economic and Scientific Study, European Parliament, 2007. By a 2008 survey, only 10% of Germans would pay more for an environmentally superior vehicle (Just-Auto.Com). One conclusion from this is that a drastic change in the automotive industry business model will be necessary to shift the driving public toward substantially greater environmental sustainability making their transportation choices. Of course, auto companies fear doing this because it would take time for the vehicle buying public to accept any major change in concepts of ownership and responsibility.

35 "Ecological footprint" to describe sustainable areas originated with Williams Rees and Mathis Wackernagel, *Our Ecological Footprint*, New Society Publishers, Gabriola Island, BC, Canada, 1995. Ecological footprints for all human activity are estimated by a variety of methods, but most originated from Rees and Wackernagel, who have themselves estimated ecological footprints for industries, nations, and so on.

36 Odum calculates an "emdollar" by dividing any country's GNP by its total annual energy usage. No matter which currency is used, that only changes the scale of any energy measurement, so it "washes out" when an energy ratio is calculated. Perception of this is something like relating our bodies' perception of temperature to readings on a temperature scale. We can understand either the Centigrade or Fahrenheit scale; however, we probably associate personal sensation of temperature with numbers on the scale we grew up with.

37 Estimates by Jonathon G. Koomey, "Estimating Total Power Consumption by Servers in the U.S. and the World," Final Report Feb. 15, 2007 (Lawrence Berkeley National Laboratory and Stanford University). Report last found at http://enterprise.amd.com/Downloads/svrpwrusecompletefinal.pdf

38 Progress is being made on this, as reported in "Data Center Energy Report: Final Report," July 29, 2008, found at https://microsite.accenture.com/svlgreport/Documents/pdf/SVLG_Report.pdf. This report from a Google site, now taken down, summarized work by numerous data companies, not just Google, which alone has about half a million servers. Approaches include "virtualizing servers" for better untilization, faster software, and lower-energy hardware. The industry claims that it is on track to increase the total data stored while keeping the total electricity usage around 40 million KWhr/year, a 30 percent decrease from 2005. And Google is reported by LiveScience to be experimenting with high-altitude kites with wind generators to greatly reduce dependence on electricity from the grid (lifetime energy yield from the kites is unknown).

Another report on server energy is from Intel, Lauri Minas and Brad Ellison, "The Problem of Power Consumption in Servers," on line at: www.ddj.com/215800830. The authors also have a book that is referenced on this site. Many ideas to offset increased power consumption have been proposed, with many being implemented. In 2006, one could hardly find an industry report on this topic, but it appears to have taken off in 2008-9.

39 For example the Pulp and Paper Technical Association of Canada suggests that energy reductions of up to 80 percent can be had in some sub-processes for making paper by

benchmarking best practices of mills in the industry. However, most changes require major capital expense on equipment that is replaced only once every 10–20 years, so swap-out is slow. In addition paper mills uses several toxic chemicals in quantity. Paper mills have been considered "major polluters" in the past, but "only" about 5 percent of Canadian air contaminants and 6% of water contaminants were attributed to it in 2007 (per the toxic release inventory of Environment Canada; www.ec.gc.ca/pdb/npri/npri_data/e.cfm). Paper production is a multi-step chemical process; an overview of paper making and its environmental problems can be gleaned from an auditing guide found at: www.fao.org/docrep/005/V9933E/V9933E00.HTM (from the United Nations). Obviously an analysis by the methods of this book stretch industry experts, so they are too extensive to detail here. Less resource-intensive basic methods to make paper are not obvious. More obvious is greatly curtailing the use of paper; therefore its production. That would not be welcomed by investors in the paper industry because it would leave them with "stranded capital," idle capacity with no revenue to pay for it. To make a serious dent in this, paper, publishing, and printing industries would have to turn their "business model" – and their thinking – on its head.

The author attempted to learn how much paper computer printers use each year. Market studies of annual printer page volume exist, but were beyond the author's budget. Just that finding alone is an indicator of how difficult it is to shift from an expansionist marketing mindset to something more like Compression.

40 A review of The Joint Commission site (www.jointcommission.org) will convince anyone of the reach and complexity of health care accreditation.

41 MBDC (McDonough Braungart Design Chemistry) certification is at www.c2ccertified.com. The certification is formally for a product design, but actually evaluates the processes to produce that design.

42 Satish Nambisan and Mohanbir Sawhney, *The Global Brain*, Wharton School Publishing, Philadelphia, PA, 2007. To stimulate innovation, they propose Wiki web sites that allow users, and sometimes visitors, to add, delete, or edit the content. The content is presumed to reflect the wisdom of a large group, but of course, saboteurs sometimes invade. Peter Russell wrote a book by the same title much earlier (1982), and it is now in its third edition (2008). Of course, internet sites to discuss anything and everything have exploded, but to discuss what and for what purpose? Global brain proponents have in mind global dialog and sharing that improves insight and learning. One example is www.cognexus.org/. Development of tools to do this seems to be running ahead of our social and behavioral capacity to use them wisely.

43 "Consortia" operate by a semi-formula. Top management of each member company site has to be engaged, constituting the governance of it and sustaining the funding for it. Fees are only 1 to 3 thousand dollars per month for each company. The major commitment is learning time. Each consortium needs a dedicated facilitator committed to the betterment of member companies, not selling a service or technique to them. The operating performance of companies in consortia is known to be a cut above what it might have been were they not members. The HPM site is www.hpmconsortium.com.

44 You can learn more about Kalundborg at www.symbiosis.dk.