I Shoulda Had The Carp

Glenn Fishbine



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ABOUT THE AUTHOR

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About the Author

Glenn lives in Minnesota with his wife, three cats, an iguana, and a furniture-shredding parrot. He has thirty years of information technology experience. He has experience in capital formation, experience as a board member in public companies, including chairman, and is a published investment strategies author. He has traveled extensively (on other people's dimes) including Europe and Japan where he was a consultant to NEC Corporation. He has more than a dozen U.S. patents and recently published **The Investor's Guide to Nanotechnology and Micromachines** with John Wiley & Sons. He graduated in political science and economics at the University of New Mexico. He received his M.A. in political science from the University of Minnesota.

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On Nanotechnology – Weekly Essays

These essays were written as part of a weekly column for a Chicago based e-zine, eprairie.com. Sadly, my relationship with them came to an abrupt end, when they started charging readers to view the content, without compensating the authors.

There's Something Happening Here

"Stop children, what's that sound, everybody look what's going down" - Buffalo Springfield

Mayor Richard Daley formed the Mayor's Council of Technology Advisors in 1999. In the last year, this council has proposed that Chicago should become a regional nanotechnology hub. Meanwhile, the University of Wisconsin has created a Center for Nanotechnology, the University of Minnesota has created the Organization for Minnesota Nanotechnology Initiatives, the Institute for Nanotechnology quietly resides at the University of Illinois, Purdue University in Indiana has raised \$51 Million for the Birck Nanotechnology Center, and on and on and on. Clearly, something big is afoot.

Most people think of nanotechnology as something that got Wesley Crusher into trouble in a 1989 episode of "Star-Trek, the Next Generation." Few people realize that the U.S. government has spent almost \$2 billion trying to create nanotechnology, and that the global investment in nanotechnology is approaching \$6 billion—more than the cost of a fully equipped Nimitz class aircraft carrier en route to the coast of Iraq.

When governments start investing this kind of money into a technology, there is either a rich payoff at the end, or someone has their hand in a pork barrel of major proportion. Digging lightly into the U.S. government's investment in nanotechnology, we find that its \$700 million 2003 budget is managed by an organization called the Nanoscale Science,

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Engineering and Technology (NSET) subcommittee that is harbored within the National Science Foundation. This initiative is managed by Dr. Roco, who speaks with a distinct French accent, and closely resembles Jacques Valle's character in Spielberg's "Close Encounters of the Third Kind." Dr. Roco has recently reported that nanotechnology, whatever it is, will represent a 1 trillion dollar economic force employing 2 million workers in the United States by 2015.

If all of this is true, then perhaps it is time to start paying serious attention to nanotechnology, whatever it is. This is Three years ago, I had the dubious where I come in. pleasure of starting the writing phase on a book called "The Investor's Guide to Nanotechnology and Micromachines." At that time, I had no prior experience with nanotechnology beyond science fiction and an occasional glimpse of pictures of small things published in Scientific American. How I got this book project is something only Hercule Perot could divine, but let it suffice that I had to learn a few giga-words worth of nanotechnology jargon, philosophy, business, technology, and personalities. Throughout that process, I had to keep the words of Kurt Vonnegut in mind, "anyone who can't explain what they're doing to an 8 year old child is a charlatan." Thus, by the spring of 2002 I had the number one best selling nanotechnology book on the market, and by the spring of 2005, if sales continue, I'll have earned in excess of \$1/hour for my efforts.

On the other hand, this experience gave me insight and access to programs that in principle may represent 20% of the world's gross domestic product in a decade or so. In

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short, I became absolutely enthralled by the topic. Once a writer gets a bug up their heinie, he has to keep writing until "all the poisons that lurk in the mud hatch out."¹ Much to my joy, ePrairie has given me an opportunity to guide its readers through the often murky yet ever fascinating swamps of nanotechnology.



Thus, this is the first in a weekly series of columns dedicated to nanotechnology. My intent is to educate, infuriate, and pontificate. The focus of these columns will cycle in an orderly way from week to week. Starting next week, we will dive headlong into an introduction to

¹ With apologies to Robert Graves, "I Claudius"

nanotechnology—the first of several primers on what it is, and where it came from. The week after, we will take a look at current topics in nanotechnology—a guide to what's hot, what's not, and why or why not. The third week we will look at the business case for nanotechnology—companies to watch, stocks to avoid, and sectors of interest. The fourth week, we will look at some of the dreams of the nanotechnology community—fascinating claims and promises from immortality to a Ferrari in every garage. Then the cycle will repeat itself.

One thing is clear about nanotechnology. Whatever it is, there's going to be a lot more of it before we're finished. A recent review of technology economic impacts suggested that nanotechnology is not something new and wonderful, but rather a steady incremental development built on knowledge and research going back literally thousands of years. This study suggested that fully 40% in the growth in this country's Gross Domestic Product for the last 10 years attributed in could be directly developments to nanotechnology, albeit under different names.

Of one thing I am certain, each and every human being on this planet will benefit from these technologies.

Grey Goo

"For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled." --Richard Feynman

One of the more interesting concerns of nanotechnology is "grey goo." The term was invented by Eric Drexler to describe one of the dangerous issues that must be faced as nanotechnology capabilities evolve. Here's how it works.

- 1. Pretend that nanotechnology truly exists to the point where we can fabricate machines of arbitrary complexity using individual atoms or molecules.
- 2. Pretend that these machines have sufficient complexity and computational means that they can make copies of themselves using whatever happens to be lying within their reach.
- 3. Pretend that their fabrication systems are such that they can make a copy of themselves about once an hour.
- 4. Pretend that one of these machines decides to do nothing except make copies of itself.

THEN we take this



And turn it into this in about 1 week.



It's a bit worse than the Borg. The idea is that everything gets converted into grey goo: you, me, trees, chickens, and everything. This would not be good news. It would totally ruin my retirement plans.

By comparison, let's think a bit about my favorite bacterium, e. coli. This bacterium lives in your stomach and mine, and is about 10 micrometers in width, and can make a copy of itself in about 20 minutes. If just *one* e. coli decided to replicate itself uncontrollably, it could perform the same feat as our hypothetical nanomachine in about a day and a half.



Because of this concern, there are those in the nanotechnology community who have proposed legislation that would make it illegal to create a nanomachine with the ability to make a copy of itself. One wonders if we should advocate similar legislation for bacteria. I am, for some reason, reminded of Indiana House Bill #246 submitted in 1897 which would have made the legal value of \prod (pi) = 3.2

The interesting issue here is that e. coli long since made the genetic decision to make as many copies of itself as fast as possible forever and ever and ever. Just counting the bacteria that live inside humans, there are about 3.9×10^{23} (39,000,000,000,000,000,000) bacteria that have made that same genetic decision. If we move into the rest of the world, the number of bacteria that have made similar decisions is estimated to be 5 X 10^{30} . So how come these bacteria haven't converted the planet into sludge? Well, there are two leading answers. The first is that bacteria dine on each other, so since everyone is having lunch at the same time, no single bacteria has an opportunity to grow at an unrestricted rate without becoming lunch for another bacteria. The grey goo model suggests in this case, that since evolution hasn't created our runaway nanomachine, there are no natural predators to stop it, so it will convert the planet into copies of itself in about a week.

The second one is that, fundamentally, the universe is a hostile place, and no matter what your intentions, be they lofty or bacterial, the universe just doesn't provide you with all the parts you need to make things on demand. In fact, if you're in the mood to make a lot of copies of yourself, the raw materials in your neighborhood are going to get consumed rather quickly, which is going to slow down your rate of replication. Similarly, if you happen to need some rare substance in your replication process, such as tantalum, you're not going to find very much of it floating around waiting to be consumed.

Thus, while grey goo is certainly an interesting idea and legislation will be pending to see to it that we don't make it outside of Iraq, there are likely to be some significant natural laws that should bring the threat level down to a manageable level. On the other hand, we need not worry too much, for the nanotechnology community has proposed that along with grey goo, we should also fabricate blue goo. Blue goo would be the nanocops of this new age, nanomachines that have the express purpose of hunting down and destroying grey goo.

The one caveat to all of this is that the military potential of the various kinds of goo will certainly result in some level of funding over the next few decades. In fact, a larger version of goo technology has already been funded by DARPA under the name "smart dust." Perhaps it isn't such a bad idea to legislate the value of \prod ...

How Small is Small?

"Seen from the moon we are all the same size." -Eduard Douwer Dekker

This week continues with a basic primer to concepts in nanotechnology. To discuss nanotechnology is sometimes akin to discussing the origins of one's belief in God. There are ardent evangelists that will take any of the numerous nano-theology debate. sides to the For some. nanotechnology is just the continuation of one's ongoing dedication to science & discovery. One shining example is Richard Smalley who completed his post-doctoral work at the University of Chicago in 1976. Two decades later, he shared the 1996 Nobel Prize for chemistry for the discovery of fullerenes (a form of highly structured carbon). This was the first Nobel Prize granted for a discovery clearly within the realm of nanotechnology. One would think that this that nanotechnology is а relatively recent means development in the annals of science. One would be dead wrong.

The word *nano* is derived from the Greek word *nannos*, which roughly translated means "little old man" or "dwarf." In today's English usage, nano is a technical term for measurement meaning 1 billionth of something. It is usually compounded with the word *meter* and as a *nanometer*, is a measure of distance of 1 billionth of a meter—approximately the distance occupied by 5 to 10 atoms stacked in a straight line. The word *technology* has a common meaning, also derived from Greek, which can be generally defined as *the application of scientific method to*

commercial objectives. So *nanotechnology* very generally means of the manipulation of exceptionally small things, approximately at the atomic or molecular scale, towards some commercial objective. In a nutshell, nanotechnology is the manipulation of very small things to make a profit.

Sumerian texts from 6 millennia ago document mankind's first venture with assembly of small things to make a profit. Carefully preserved cuneiform tablets recount how early technologists performed the transformation of glucose $(C_6H_{12}O_6)$ into ethanol (CH_3-CH_2-OH) . These early technologists, also known as brewers, created the magical concoction called *beer* by employing a primitive molecular assembly process using a molecular assembly device called Today, the annual global consumption of this veast. molecularly engineered product is approximately 34,333,000,000 gallons, which represents a significant percentage of the world's GDP.

While the Sumerian's may not have known exactly *what* they were doing, they set the stage for global demand of nanotechnology-derived products. For millennia, brewers and vintners quietly plied their trade assembling molecules one loving atom at a time without a care in the world about how nature had granted them the ability to create bulk products from the mass assembly of individual molecules.

It wasn't until 1959 that Richard Feynman, who later would share a Nobel Prize for his work in quantum electrodynamics, got around to suggesting that it was not only possible, but also desirable to think about assembling commercially viable products, one atom at a time. Most nanotechnologists claim that Feynman's 1959 "There's Plenty of Room at the Bottom," speech created the foundation for what would become nanotechnology in its various incarnations. While Feynman was perhaps 6,000 years late in seeking commercial opportunity with nanotechnology, his significant contribution was to make the quest for atomic assembly of products respectable. In short, any credentialed scientist could now claim to be working in a direction suggested by Feynman, and not be denied tenure for being a crackpot.

Science and technology tend to take a generation to achieve success with new paradigms. Thus, it comes as no surprise that it took nearly a quarter century before the realities caught up with Feynman's conjectures. In 1985, three significant events occurred:

- 1. Richard Smalley, et al, discovered fullerenes.
- 2. Eric Drexler published the seminal book "Engines of Creation."
- 3. IBM published a photograph of xenon atoms, which had been moved into a pattern that spelled out the letters "IBM."



From a marketing point of view we now had, respectively:

- 1. Acceptance by the international community of something novel that had nanometer scale structure.
- 2. A popular book talking about what nanotechnology could do for you and your kin.
- 3. A rather remarkable photograph showing that atoms could be moved one at a time.

Thus, while science may derive from generations of dedicated attention to detail and the growth of ideas pyramided on the ideas of others, for nanotechnology, the birth in the public's eye came in one moment in time, in 1985. From that time forward, there would be no lack of scripts for science fiction episodes, and no dearth of funding for those seeking to build the inscrutable.

In four weeks, we'll see exactly what is so important about a fullerene and why a former University of Chicago post-doc achieved acclaim for finding something so small.

The Atomic Shopping Cart

"Children need money. As they grow older they need more money. They need money for essentially the same reasons that adults need money. They need to buy stuff..."

Donald C. Medeiros

In a time of global terrorism, conflicts in the Middle East, a growing budget shortfall, what kind of insanity would compel you to spend \$700 million on the National Nanotechnology Initiative (NNI)? You'd either have to be nuts, or a Republican. Or perhaps, like a child, you have bad dreams, and only a \$700 million lollipop will let you sleep soundly at night.

It was a dark and stormy night in the summer of 1999. Twenty-three years before, in 1976, the U.S. Congress had established the Office of Science and Technology Policy (OSTP) with a broad mandate to advise the President and others within the Executive Office, on the impacts of science and technology on domestic and international affairs. In the summer of 1999, the OSTP had just presented a report to Congress that said, "The rest of the world is spending more on nanotechnology than we are" and "we will lose the technical high ground, again, just like we did with televisions, automobiles, and memory chips." It's not that any of the members of Congress had a clue as to just what nanotechnology was, but they all knew that the Japanese were spending \$400 million per year on nanotechnology, and if we didn't start now, the future of the world's economy would be in the hands of peoples who have yet to immigrate to this country. Of course, looking back, we discover that the Japanese were lumping nanotechnology and biotechnology into the same pot, so in actual fact, they were spending $1/10^{\text{th}}$ of what was claimed on nanotechnology. And of course, the global economic meltdown was just beginning, which made the rest of the world re-think their technology investment... but that's just history at this point. Congress spoke, and the NNI was born.



Once a federal feeding frenzy starts, all manner of things can happen. The least likely is that spending will decline. After all, a Federal Bureaucracy has a life of its own that by default is subject to cost overruns, increases in infrastructure costs, and at some level, the actual execution of whatever goals and objectives are promoted from "the highest levels." So what kinds of programs is the federal government buying with our nanotechnology dollars through the National Nanotechnology Initiative? There are, according to NNI reports, five program areas where activity is warranted:

1. Fundamental Research - Provides sustained support to individual investigators and small groups doing fundamental, innovative research

- 2. Grand Challenges for research on major, long-term objectives
- Centers and Networks of Excellence for interdisciplinary research, networking, industry partnerships
- 4. Research Infrastructure metrology, instrumentation, modeling/simulation, user facilities
- 5. Societal Implications and Workforce Education and Training for a new generation of skilled workers; the impact of nanotechnology on society (legal, ethical, social, economic)

And in what proportions is the NNI spending this money? The NNI breaks it down by seven rather indistinct spending areas.

45%
20%
14%
9%
6%
6%
0%

Funny how the 5 programs don't match the 7 spending categories, but then it's not *my* data. I'm also amused by the actual NNI definition for investment in item 7 (the one that really counts). The NNI suggests that it's not "0%" as I report, but rather, "distributed", which is government speak for, "we don't spend money here but definitely attend

conferences and would appreciate it if you'd talk to your local congressman or senator."

When you dig through the budgets in some detail, what you discover is that 1/3 of the money goes to the national laboratory system and 2/3 of the money goes to universities. A lot of the money, I mean a *lot* of the money goes into building infrastructure, which means, buildings. Of course, history proves that it is impossible to perform novel and break-through research without a new building from which to perform the novel and break-through research.

One of the nice things about the NNI is that it isn't large enough, yet, to have the infrastructure necessary to actually disburse very much of its own money. Thus, it relies heavily on other government agencies to do its spending. In fact, it spreads the wealth through:

- 1. Department of Agriculture (USDA)
- 2. Department of Commerce (DOC)
- 3. Department of Defense (DOD)
- 4. Department of Energy (DOE)
- 5. Department of Justice (DOJ)
- 6. Department of State (DOS)
- 7. Department of Transportation (DOT)
- 8. Department of Treasury (DOTreas)
- 9. Environmental Protection Agency (EPA)
- 10. Food and Drug Administration (FDA)
- 11. Intelligence Community (IC various)
- 12. National Aeronautics and Space Administration (NASA)

- 13. National Institute of Standards and Technology (NIST)
- 14. National Institutes of Health (NIH)
- 15. National Science Foundation (NSF)
- 16. Nuclear Regulatory Commission (NRC)

Most of these agencies distribute the money through research grants called SBIR or STTR programs, which are small amounts of money granted in \$50,000 to \$600,000 increments to small companies that perform research specified by the funding agencies. Thus, while the NNI represents a single pot of money, the distribution of the money is handled under the policies and practices of 16 different federal agencies. Needless to say, when one asks each of these agencies what nanotechnology is, you get a slightly different answer. But we'll come back to *this* topic in four weeks.

Next time, we're going to take a look at a small company that routinely uses nanotechnology as part of its business model—A small obscure company that goes by the name, INTEL.

I Didn't Know It Was Loaded

"Companies tend to look for success in the bottom line." -Anne C. Weisberg

When one searches the Thomas Register for companies that make integrated circuits, the number of companies that are in the Midwest is a fraction of a percent of the whole. What can be found is a small sprinkling of "fabless" companies that *design* semiconductors, but don't actually *make* them. Of course, very few small companies have the capital to invest in the multi-billion dollar manufacturing facilities that have football field sized production spaces so clean that that the only dust to be found is no larger than 300 nanometers in size.

It was not always so...

In July of 1968 a small company started with the purpose of developing a memory device based on silicon rather than the then prevalent magnetic memory.



Woven magnetic core memory bits

At the time, silicon memory cost almost 100 times more than the hand woven magnetic cores that constituted the memory elements of computers of this era. Facing various investment hurdles, and potential competition from other companies, the founders changed course and took the brazen path of producing the world's first microprocessor, the Intel 4004, which contained 2,300 transistors in the space of a postage stamp, cost an earth shattering \$200 per chip, and executed instructions at the rate of 1 every 1/60,000th of a second. (It would take more than 250,000 of these chips to match the performance of a typical processor in today's home PC.) Faced with financial success, the company went down the path of stuffing ever more functionality into their microprocessor family creating generation after generation of microprocessor.

Three years before the founding of Intel, Gordon Moore, then at Fairchild Semiconductor, who would later be one of Intel's founders, wrote in a paper for *Electronics* that suggested that it seemed as if the industry was doubling the density of components every year. He suggested that if this trend continued, the present density of 50 components per circuit might reach 65,000 components per circuit by 1975. Somewhere along the way, this observation and speculation became "Moore's Law" and the operational standard for the semiconductor industry. Today, it seems as if "Moore's Law" is *the* law as far as the electronics industry is concerned.



There are two other interesting things that happen as "Moore's Law" continues down its economic course. First, the cost of the factories that build these devices increases by a factor of 2 every year or so. Second, the size of the features used in building these devices is currently in the 130-nanometer range, and shrinking. Intel is investing a few billion dollars in the next generation factory, which will build features as small as 65 nanometers, which means features will be brought to market that are on the order of 300 atoms wide.

Assuming that this trend continues, there is a wall to be found. At some point in the not too distant future, the smallest feature size is about the same size as the smallest hunk of matter—the atom. When, and if, the feature size is the size of an atom, this is going to be a rather imposing physical problem, which limits how long "Moore's Law" can hold. Pessimists give it 5 years. Optimists forecast the end to "Moore's Law" not later than 2017. Anyway you look at it; there is a limit to how small you can make things out of atoms.

On the other hand, if you're a nanotechnologist and really don't care about computers that much, there is something rather interesting that Intel has been doing for the last 30 odd years. By constantly shrinking the size of components in their products, Intel has finally broken the hallowed 100nanometer barrier and will be routinely manufacturing components in the clear realm of nanotechnology by the end of this year. This makes Intel the world's largest nanotechnology company.

What I like most about Intel is that they don't think of themselves as a nanotechnology company. Intel's chairman, Andrew Grove states "The two areas that our business focuses on, computing and communications, are the backbone of the digital infrastructure, and our products are the building blocks that makeup this infrastructure." Did anyone see the word "nano" in there? I didn't. Yet Intel has public plans to produce transistors as small as 20 nanometers by 2007.

The key point of this is that nanotechnology, for those who enjoy market success, is just another hurdle on their path to market success. Like overcoming unions, shipping strikes, and foreign competition, nanotechnology is just another one of those things that gets in the way that has to be managed and cudgeled until it bleeds profit.

In four weeks, we'll take a look at a different company that positively drips "nano" albeit without profits. Next week, we're going to enter the dreamland world of nanopossibilities.

You've Gotta be Kidding!

"Wonderful invention, the phonograph. Keeps a man alive long after he's dead." - Stephen Orlac

How much money would you pay to live forever? \$100? \$1,000? \$100,000,000? Keeping in mind that forever is a long time; you could certainly arrange some kind of longterm loan, since you'd have plenty of time to make the payments.

Historically, only religions have the lock on immortality. Thus guided by divine inspiration and a codicil transcribed directly from God, most religions profess the rebirth of consciousness after the body is disposed of. Well, guess what? There are some nanotechnologists who claim that in a few decades, death will be a choice rather than a requirement.

ואויבר או מאשריר אמר שמיפוז אובאר ויברו באואה ואויכר אלאמיא אפורלאסר איזרט ראיאר איז אישר ליא המצרי לייברה אייה איים אולבר אילבת בצוצה איל אישאינייני אאיני באיני בליש בבבירף ונאון אאיני שאמצ אירטיל בנאר היונאי איניא אין אייאיאיאיניו אוני איניא איינא צמורים אינאריים דרך נדך איניאום אראנה לוא עלדא באפאבריאב וידיער אפצר בנאיטאין הלכח אשר היבוללהתצמין ואחיך לאאש ווכוויך אשר נכיאת בציטור אתרבאת עלבא היאברי אבריל אברי אביין אין אישניי לאולואצאיה זיאו אותי לוא הניוי ואונכנרנוא שאינוייניר אפירוצה ובניאון אבר פינושויף לאייויב מיחדה לשריח אפירוצה באניר ויין של פוברר ברייייניה לשריח שמיעורה באניר ויין של וברר 13 AVANS איא אין אראל אראל איין איין איין איין אינראר הכבעירה בארב זי mariature 1.048 איי איי אנויניי לנה שינוא אישיוי אר אופא איי אפער אופע אבר או אל השער היאר באברות השאראי ביות על אל בה לאלי הבאין 510000

Let's see how we can come to this rather heretical Last week, we noted that Intel will be conclusion. manufacturing devices by 2007 with feature sizes about 20 nanometers across. A red blood cell is on the order of 10,000 nanometers across. In 2 dimensions we could stack about 250,000 components in the same space as a red blood cell. If the trends continue as far as 2017, which may be the end-point of "Moore's Law" we could be looking at a manufactured device the size of a red blood cell with 256,000,000 components. If we add the third dimension, could 65,536,000,000,000,000 that translate into components. Somewhere along the way, we're talking about

the raw technical capability to produce a rather sophisticated robot small enough to wander around through your body doing whatever it has been programmed to do. If we make the robot 1/10,000th the volume of a red blood cell, we're still talking about 655,360,000 components, which is arguably perhaps enough to embody this machine with the ability to think, move, and do whatever we have programmed it to do. If such a device can be built, if we have the slightest clue how to make it do things, we could, in principle, program it to go inside any cell in your body and reverse all the causes of aging simply by rebuilding the cell to a younger version of itself. If we do that to every cell in your body, and keep doing this on a regular basis, you could live forever, provided you drive safely, stay out of the sights of Al-Qaeda, and don't live in an earthquake or flood zone.

The real question is, how practical is this speculation? Well, that's the true life or death question. Those who believe in "Moore's Law" point out that it has been an accurate predictor of relevant technology for almost 40 years. It only has to hold up another decade or so before the raw technology is available. On the other hand, there are a few items missing from having raw capability and having the actual machine:

- 1. We don't know how to build an autonomous robot of any real complexity. Our best technology today can create a robot that will vacuum your rug rather poorly, sometimes.
- 2. We don't know how to write software that would manage an autonomous robot, even if we could build it.

- 3. If we had the robot, and knew how to program it, we don't know enough about biology to tell the robot what to do once it gets there.
- 4. Even if we can manufacture components at the size required, we don't know how to deliver power to the robot, nor do we have any idea how to control its motion, or its actions once it gets to its place of work.

The proponents of nanotechnology say, "don't worry, technology is evolving on a logarithmic scale so these issues will be solved with unprecedented speed." Many different technology progress curves demonstrate how things are happening at an ever-faster pace.



Source: Ray Kurzweil

One thing to keep in mind, when speculating about the future, is to keep a close eye on *which* trends you are using to do your forecast. I'm not suggesting that any particular trend is a good or bad forecast of things to come, but there are a few examples I like to keep in mind before preparing my investment portfolio for the really long haul.

First, technology forecasts do not routinely come true. A 1965 study of the speed of human travel showed that between 1800 and 1963, humans were traveling faster and faster on a logarithmic curve, and if this trend continued, humans would be traveling just under the speed of light sometime towards the end of the 20th century. I guess we missed that curve.

Second, in the 1980s, I lugged around a Kapro portable computer that used Wordstar for a word processor. I remember that it took about 1 minute to boot up this ancient application to the point where I could type my first word of wisdom. I wonder, with all the proven technology advances of the last quarter century, why does it still take about 1 minute to boot up my current laptop & word processor to the point where I can type my first word of wisdom?

Buckminster Fullerenes

"Humanity is acquiring all the right technology for all the wrong reasons." --R. Buckminster Fuller

This week continues with a basic primer to concepts in nanotechnology. Four weeks ago, I promised to discuss some of the work of Richard Smalley who completed his post-doctoral work at the University of Chicago in 1976 and shared the 1996 Nobel Prize for chemistry. During an eleven-day period in 1985 Smalley's team discovered a seventh form of carbon. Now most of us think of carbon as a rather mundane pile of black ash that is the major component of soot. Most of us, at least once in our lifetime buy or receive an incredibly expensive form of carbon known as a diamond. The other kinds of carbon rarely rise to the level of consciousness, unless you're really into chemistry. What Smalley's group discovered is clusters of carbon that were made of precisely 60 carbon atoms and other clusters with precisely 70 carbon atoms. In the case of 60 carbon atoms, C_{60} , the structure appeared to be a "truncated icosahedron" cage", in exactly the same shape as a European football or the geodetic dome designed by architect R. Buckminster Fuller for the 1967 Montreal World Exhibition. The researchers named this structure of carbon а buckminsterfullerene, which others promptly renamed to buckyball to avoid excessive tongue twisting.



It's rather clear that not many people are going to get terribly excited thinking about a hunk of carbon that is about 7 angstroms in diameter; in fact, Dr. Curl, who gave the acceptance speech for the 1996 Nobel ceremony noted "At this moment there is no commercial product based upon fullerenes." For the better part of 15 years after their discovery, buckmister... buckyminister... buckyballs were just an interesting and esoteric area of study. Along the path of research into this strange form of carbon, in 1991 an NEC researcher named Sumio Iijima found a variation of fullerenes that was an arbitrarily long tube of carbon. Naturally, this became known as a buckytube.



For some period of time, researchers would pay outrageous sums of money to get their hands on some of this esoteric stuff, usually buying from university laboratories where graduate students would carefully monitor custom built devices that rather haphazardly produced minute and unpredictable quantities of this valuable soot. Over time, production techniques stabilized and demand started growing to the point that during 2002, production capabilities reached approximately 2.5 tons per day generating over \$12 million in sales. While \$12 million in sales is rather petty when one considers the value of gyros consumed along Halstead, but
there are some rather interesting possibilities that emerge when you discover what you can do with carbon in this form.

Perhaps the most useless possibility is that if you get a collection of carbon nanotubes in a pile and take their picture with a flash camera, the pile will burst into flames. At about \$300 per gram, this is not a terribly cost effective way of starting a fire on a camping trip, although I wouldn't be surprised to see a few grams in a mil-spec MRE sometime in the future.

The more interesting possibilities range from creating the very small to the very large. At the smallest scale, a nanotube can operate like a semiconductor, which means you can make an electronic device with a diameter of about 0.4 nanometers. If this laboratory capability can be commercialized, this points to the possibility of building computers about 100,000 times smaller than those available today. This would make a Pentium IV at about .002 square millimeters, which is about the size of single plant cell.

At the middle of the range, where you can touch and feel, several companies, most prominently Samsung, have built prototype flat panel displays using nanotubes as electron emitters that are as thin as an LCD yet as bright as a normal CRT. Several different companies are hoping to commercialize this capability to penetrate the established multi-billion dollar display market.

At the other extreme of the range, there are a number of different groups that have proposed creating 70,000kilometer long strands of nanotubes, lowering them from geosynchronous orbit, and using OTIS elevator technology to lift people and machines from the surface of the earth into orbit for a few dollars per pound. They do have a ways to go, however, since the longest nanotube on record is a few centimeters in length.

Meanwhile fullerenes have been proposed for use in delivering drugs for a variety of illnesses, ultra compact military radio jammers, high-density energy storage for electric cars, incredibly strong drill bits, and they have even been used to help date the age of a comet strike on the earth some 250 million years ago.

As for Smalley, he's the chairman of the board of a small company called Carbon Nanotechnologies, Inc. based out of Houston, the not windy city, where you can purchase a small variety of nanotubes, by the gram.

Dr. Smalley died in 2005 several years after this was written. A great loss for nanotechnology.

Nano Nano

"Why do they call it rush hour when nothing moves?" --Robin Williams

Four weeks ago, I gave a rather dry introduction to the National Nanotechnology Initiative. Based on the feedback I received, a tremendous number of you were incredibly thrilled to know that the Department of Agriculture was involved in nanotechnology. My phone hardly stopped ringing. I thought it would be worthwhile to spend a few more words on this topic.

The Department of Agriculture is focused on the production and the quality of the nation's food supply. It is part of their mission to ensure that each and every American has access to an abundant variety of food products, and the means to counter the effects of excessive indulgence in those food products. In managing food, the department follows the herd mentality in much the same way that a century ago, herds of cattle routinely boarded trains en route to the North & Sheffield Commons slaughterhouse. Simply put, whatever nanotechnology is, everyone wants a piece of it.

The NNI has attempted to come to grips with a definition of nanotechnology, which reminds me of the definition of organic chemistry. Originally, organic chemistry was supposed to concern itself with those chemicals and chemical processes that were somehow involved with the processes of living organisms. As it matured in the middle 19th century, organic chemistry lost its attachment to living organisms and redefined itself as the chemistry of carbon and its compounds. Essentially, reality interfered with the original ideas. Nanotechnology has matured to the point where its fundamental meanings have similarly evolved.

N. Taniguchi first used the term "nanotechnology" in 1974. He defined it as "production technology to get the extra high accuracy and ultra fine dimensions, i.e. the preciseness and fineness on the order of 1 nm..." Such precision proved to be politically unacceptable in the game of grantsmanship. It's simply too small to be funded.

An Ohio native, Thomas Kuhn, sets the stage for what happened next. Kuhn, who is a renowned philosopher of science, is most noted for his book, "The Structure of Scientific Revolutions." He suggested that typical scientists are not objective and independent thinkers. Rather, they are conservative individuals who accept what they have been taught and apply their knowledge to solving the problems that their theories dictate. He went on to suggest that the advancement of science can only occur as one generation of younger scientists replaces older generations who have the courtesy to retire or die. If we remember our hero Richard Feynman, in 1959 he suggested that manipulating matter at the atomic scale was both possible and useful. By Kuhn's definitions, Feynman created a new paradigm, yet it took the die-off of a generation of scientists before Feynman's concepts achieved serious recognition. After a new generation of scientists achieved success in implementing Feynman's core concepts, according to Kuhn's model, the current crop of scientists is by definition, a bunch of conservative individuals who accept what they have been taught. In short, nanotechnology has acquired the following of the herd, which of course makes the Department of Agriculture politically correct in pursuing nanotechnology research.



The problem with the herd mentality is the Kuhnian idea that scientists solve the problems that their theories dictate. Thus, while the NNI may clearly dictate what nanotechnology is supposed to be, as the money courses through the veins of various federal agencies, the dominant local paradigms give a distinct hometown flavor to what nanotechnology becomes. Thus, for example:

- 1. DOD thinks nanotechnology will equip the foot soldier of the future with uniforms and gear that can heal them.
- 2. DOE thinks nanotechnology will build better solar cells and batteries.
- 3. NIH thinks nanotechnology will build better labon-a-chip devices.
- 4. The Department of the Treasury thinks nanotechnology will make counterfeit proof currency.
- 5. The intelligence community thinks nanotechnology will make insect sized mobile surveillance vehicles.

The list goes on and on. When you take a look at the various agency nanotechnology physical size of expenditures, the targeted outcomes span 9 orders of magnitude from 10^{-9} to 10^{-0} meters and the smallest feature sizes span 5 orders of magnitude from 10^{-9} to 10^{-4} meters. acceptable According to the NNI. the range of nanotechnology is supposed to be anything smaller than 10^{-7} meters. If you remember Kuhn, of course this makes a lot of The sloppier the definition, the more funding is sense available. The neat thing about government process is if you're off by a factor of 1,000 or 1,000,000, it can easily get lost in a footnote to a footnote in the federal deficit ledger.

One of the leading venture capital firms interested in nanotechnology, Ardesta of Ann Arbor, Michigan, struggled with this issue before finally realizing that, from the investor's point of view, they really didn't care what nanotechnology is supposed to be. They completely sidestep the problem by simply stating "Ardesta has established a leadership position in the emerging field of Small Tech," to which I say "bravo!" One of their subsidiary companies is a small magazine called "Small Times" which tries to bring a MEMS, microsystems business perspective to and Thus, as far as money is concerned, nanotechnology. nanotechnology can be defined as anything too small to see without a microscope that has at least one investor attached. Q.E.D.

Scanning for Dollars

"Follow the Money" --Deep Throat

Chicago really isn't such a bad place. While I am definitely not a resident, nor would I ever be one, there really are some good things about the area beyond the quality foods and museums. If only there were trees and mountains.....

For those of us interested in nanotechnology, Chicago actually has an active nanotechnology community and several companies hoping to emerge as significant players in the coming age of small tech. To provide a list of companies is an author's way of getting an update of who's alive and who's not, and who's new. Thus, I have provided a short list of companies in the Illinois area, not to be inclusive, but to incite others that I may not know about to write to me in horror about my mindless and unfair omission of their name. Keep in mind, a good statement of horror may find itself the topic of a future column. The company's I've chosen to mention are:

- 1. Atom Works
- 2. Imago
- 3. Motorola
- 4. Nanosphere, Inc
- 5. Nanophase
- 6. NLake Technology Partners

This week, I have chosen to pick on Northbrook Illinois' very own Nanosphere, Inc. as an example of the issues that

face an emerging company in the nanotechnology space. I apologize in advance to the management, employees, and shareholders of this company for any improper or incorrect statements made here. I should advise them that libel suits will be undefended and you can have all of my worldly goods if you litigate, including my debt, cat, and parrot.



Glenn's litigation defense team

Nanosphere, in the world of nanotech, is big-time. Not so much that the company has tremendous revenue success, but rather, that it has had significant venture-capital success. In early 2003, the company closed a 3^{rd} round of VC money worth about \$15 million. In the world of startup companies, this is pretty good. In the world of nanotech startups, this is fantastic!

What makes Nanosphere interesting is that Nanosphere isn't really a nanotechnology company. In reality, it's a genomics company. This is not a crime. Genomics is concerned with deciphering the genetic code in DNA. DNA is a molecule. DNA is about 2.2 nanometers in diameter, which brings it clearly within the NNI's definition of nanotechnology. What Nanosphere has is the ability to create gold nanoparticles, which are designed to attach themselves to certain DNA sequences. If they are present in a sample of DNA, they signal their presence by changing color.



DNA without Gold



10 nm gold particles attached to DNA

This in turn can be used to determine portions of the genetic code in a controlled and rapid manner. The result, or at least, Nanophere's hoped for result, is that the company will become a significant player in the existing \$750 million market for molecular testing technologies.

What makes Nanosphere an exemplar for nanotechnology companies is that the founders of the company managed to ride the wave of early nanotech funding and leverage their research into a truly valuable opportunity in the biotechnology arena. Now whether or not they are a nanotechnology company or a biotech company is a topic for pundits to debate, but I plan to participate in their IPO whatever they call themselves at that time.

One of the key differences between Nanosphere and other nanotechnology startup companies is what I call the failure history of management. In the case of a new technology, the primary founders come out of an academic environment and aside from managing sophomores and small research projects; they tend to lack some of the fundamental business skills and tend to choke when someone asks them what their EBITDA forecasts look like. Such companies are usually destined to the dust heap of history. HOWEVER, people who survive the early stage experience and move forward to the *next* opportunity have been bloodied to the point where EBITDA has a priority equal to, or in excess of the gee-wiz factors associated with a new technology. Such people tend to found companies with a much higher success rate. Genomics has had a multi-generational series of successes and failures, and although the average genomics stock may be at 5% of its IPO price, there is a broad base of experienced managers coming out of Genomics that have a reasonable hope of making real companies succeed. Nanotechnology companies are still in the first generation of A new nanotechnology startup management training. usually has a set of managers who haven't been bloodied yet. Thus, when one comes across a company like Nanosphere which has 2nd generation management, there is cause for hope.

Of course, be sure not to be confused with the Nanosphere, Inc. based in Florida that merged with Nanocoat to become Nanotherapeutics. That would be a story in caution, albeit a nicer investing climate.

Soul of a New Machine

Cats are intended to teach us that not everything in nature has a function. -Unknown

In 1981 Tracey Kidder was awarded the Pulitzer Prize for the **Soul of a New Machine**, which chronicled the development of the 32-bit version of the now defunct Data General Eclipse family of minicomputers. Kidder's remarkable story was of a small group of individuals who worked outside the envelope of known technology to create something the computing world had never seen. Kidder was helped by the power of the personalities that converted concept into hardware.

There is buried behind the dikes of the Netherlands, not just better chocolate, but a small personable group of researchers at the Technische Universiteit Delft—a small group of researchers who have the Kidderian challenge of creating a quantum computer. To understand what they are trying to do in creating a quantum computer, we first have to understand the world in which quantum effects occur. Generally, these are effects that occur at the scale of individual atoms or electrons, which happen to occupy a space somewhat less than a nanometer, most of the time, which makes it fair game for this column. There are some strange quantum effects in bose-einstein condensates that can be measured in centimeters, but we're not going to touch on those this week. I was trying to explain quantum computing to my daughter the other day, and as her eyes entered that blissful "sure dad" glaze, I finally realized that the only way to explain quantum computing is by threatening the life of a cat. Not *her* cat, but Schrödinger's cat. This of course leads to, who the hell is Schrödinger and why am I trying to kill his cat? Well it turns out that Erwin Rudolf Josef Alexander Schrödinger was one of the founders of quantum physics. He was so successful at developing quantum physics that he was later quoted as saying about quantum physics, "I don't like it and I'm sorry I ever had anything to do with it." There is a reason he said this, and it has to do with his cat.

Picture if you will a cat in a box. It's a warm box, so our cat is napping. At the top of the box is a small vial of cyanide gas, ready to be released into the box if it receives an electrical signal to do so. The signal will be provided by a shielded radiation detector in another box that contains exactly one atom of a radioactive substance that may or may not decay. If it decays, the detector will trigger the signal to dump the cyanide and kill the cat. If it doesn't—no signal napping cat. The problem is this: by the rules of quantum physics, the single atom's decay is not defined until you look. Thus, until you open the box to see if the cat is dead or alive, it is both dead AND alive at the same time.

experimenter Geiger tube discharges opens box single state mixture superposition decoherence observation "irreversible act measurement of amplification"

The laws of quantum physics demand that a quantum state is unknown until observed. So, until we look, pussy is both simultaneously alive and dead. When we open the door to look, however, it's either napping or stiff as a board. Don't try this at home without PhD supervision.



The cat in this model represents a quantum bit in a quantum computer. A quantum bit will, when we measure it, be either a zero or a one, like a normal computer bit, but until we measure it, it will be both a zero *and* a one. Don't argue with me, it's the way the world works. What makes matters worse is that the Dutch team has managed to build small circuits with several quantum bits that really truly do what Schrödinger said they would do.

Now, what you can do with a quantum computer is really not certain yet. There are however, some hints. One of the standard measures of computer efficiency is factoring large numbers. Let's say, for example you want to find all the prime factors of a 300 digit numbers, say:

20395687835640197740576586692903457728019399 3314348263094772646453283062722701277632936616 0631440881733123728826771238795387094001583065 6733832827915449969836607190676644003707421711 7805690872792848149112022286332144876183376326 5120835748216479339929612499173198362193042742 80243803104015000563790122

Using a conventional computer executing one trillion instructions per second would take about 150,000 years to calculate all of the prime numbers, when multiplied by each other, equal that number. Using a quantum computer executing one trillion instructions per second would take about 1 second. There is clearly some advantage.

The other question that one might ask is "when can we have a quantum computer?" Well, the best estimate I heard

over drinks from one of the Delft boys was, "not in my lifetime." I guess Kidder will have to write about the soul of another machine.



Dead Greek Scattered Through the Midwest

"My own suspicion is that the universe is not only queerer than we suppose, but queerer than we **can** suppose." -J.B.S. Haldane

Democritus of Abdera lacked most of the rudiments of modern civilization—toilet paper, Walkmans, and CNN. He lived about 2,500 years ago during the golden age of Greek scholarship. A pupil of Leucippus of Melitus, he extended his teacher's thinking about atoms formulating the idea of the eternal, unchanging, indestructible atom. Lacking the empirical method (something that would languish for another two millennia), he nonetheless managed to describe the idea that matter could be reduced to fundamental bits of stuff, which could be recombined in a myriad of ways to create all that we could touch.

Later scholars would come up with even more bizarre theories of atoms that ultimately resulted in the ability to create nuclear power plants and weapons of inconceivable destructive potential. Yet, for all the inferred knowledge about the fundamental nature of matter, it wasn't until the mid 1980s that it became possible to actually think about seeing and moving individual atoms, one at a time. In 1982, two IBM researchers, Binning and Rohrer invented a microscope that could image electrically conductive surfaces at the atomic scale (less that 0.2 nanometers) for which they shared half of the Nobel Prize for physics in 1986. A different team of IBM and Stanford researchers including Binning, Quate & Gerber is now credited with developing the first generation of what we now call Atomic Force Microscopes (AFM), which are so freaking bizarre, they can take pictures of individual atoms in just about any environment including vacuum, air, and liquid. The resolution can be so fine that an AFM can take pictures, not only of individual atoms, but also of the quantum effects of interacting electrons.



Building a Quantum Corral one atom at a time, showing the quantum "ghost" particle created at the center.

An AFM is a versatile device that can also create images of much larger objects such as this image of tobacco mosaic viruses.



Just to make matters worse, an AFM can not only take a picture, it can pick up individual atoms, one at a time, and move them to a pre-selected position. As a result of this versatility, the AFM has become the mainstream research tool for serious nanotechnology researchers.

AFMs can be found in virtually every serious nanotech lab on the planet, including NWU, University of Chicago, University of Wisconsin and on and on. In fact, there are two regional manufacturers of AFMs—a Minneapolis company called Hysitron, and the other, Novascan in the wilds of Ames, Iowa. Both of these are rather young companies that are a bit shy, by several years, of general interest from any but the wealthiest of investors. On the

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other hand, they serve a growing niche market, which globally has about a dozen competitors at this time.

Now I'd love to explain exactly how an AFM works, but having studied the math involved, I really don't know. I kind of gave up when I came across the part of the explanation where it said, "it is obvious to the most casual idiot that the following is true:"

$$\mathbf{A}_{o}(\boldsymbol{\omega}_{o}'/\boldsymbol{\omega}_{o}) = \frac{A_{o}(\boldsymbol{\omega}_{o}'/\boldsymbol{\omega}_{o})}{\sqrt{1+\boldsymbol{Q}^{2}(\frac{\boldsymbol{\omega}_{D}}{\boldsymbol{\omega}_{o}}-\frac{\boldsymbol{\omega}_{o}}{\boldsymbol{\omega}_{D}})^{2}}}$$

I must be an applied rather than casual idiot, but what basically happens with an AFM is you drag an ultra-tiny sharp stick across the surface of what you want to take a picture of and take careful measurements of how much you bump or drag as you go. As the pictures above show, it really works.

Now the most interesting thing about AFMs is not just that every nanotech researcher worth their salt wants one, but that our dear friends at IBM have an active plan to put AFMs in the hands of just about every technogeek on the planet. IBM's millipede project is attempting to use massive arrays of AFMs to create portable memory devices about the size of a postage stamp containing a few gigabytes of your favorite music, videos, or whatever. They actually have working prototypes although consumer products are still a few years out, yet, you may soon find that your Walkman playback is based on the nanotechnologist's favorite toy, the AFM.

Space, the Final Frontier

As an adolescent I aspired to lasting fame, I craved factual certainty, and I thirsted for a meaningful vision of human life so I became a scientist. This is like becoming an archbishop so you can meet girls. -M. Cartmill

I really must admit that it has never been my intent to slander the U.S. Department of Agriculture. Yet, having mentioned them in two previous columns, I must admit the response has been a bit frightening. I discovered that eprairie readership is far more than a local or regional phenomenon when I found myself invited to Stockholm this fall—not to receive the coveted Nobel Prize, but to be a speaker at a small conference discussing the philosophy of nanotechnology research, no expenses paid.

One of my consistent themes in discussing nanotechnology is to harp on the wide gap between Starting with the National perception and reality. Nanotechnology Initiative, I've attempted to show that as programs filter down the food chain, they tend to be displaced mightily from their original intent. This happens on a regional scale as well. One of the fundamental tenants of a new field of research is to develop the infrastructure that supports the field. Usually, the infrastructure is presumed to be based on a cadre of educated and motivated researchers sharing a common vision of what constitutes appropriate research. One of the premier advocates of reality in science can be found in a rather obscure publication from Chicago

Heights published bimonthly by the Society for Basic Irreproducible Research. This journal the Journal of Irreproducible Results (JIR) highlights some of the most fundamental problems in basic science and research. It is a must read for anyone seriously thinking of investing in, or participating in nanotechnology. Sometimes, infrastructure is just concrete.

A few miles from Chicago Heights, at Northwestern University, the Institute for Nanotechnology is cutting its teeth in a 30 million dollar new building. Two specific programs are housed here, the Nanoscale Science and Engineering Center, and the Center for Transportation Nanotechnology. The latter one caught my eye quite early on. NWU is a highly prestigious university, so much so that 30 odd years ago, I applied to, and was accepted, albeit without any form of student aid. Being somewhat destitute at the time, I set my sights on other campuses, yet always had a yearning to be more closely affiliated with NWU. Over time, I came to realize that everything I learned through my arduous graduate program was either irrelevant or obsolete by the time I was handed my parchment. So now I can righteously ask, higher education long in my past, exactly what the hell is *Transportation Nanotechnology*?

In a roundabout way, let's check out the basic NWU nanotechnology infrastructure. A 44,000 square foot building costing \$33 million, 1/3 funded by the Feds. A rather normal university approach, if you build a lab, they will come.



But back to transportation nanotechnology... I have an image of little nanotaxis carrying molecules from follicle to follicle. In actuality, the NWU center exists "to advance the education and research frontiers of nanotechnology as applied to the transportation sector." The center has active research in the following areas:

- 1. Nanomaterials by Design: High Power Density -Materials for Advanced Power train Systems
- 2. Polymer-Inorganic and Organic Nanocomposites
- 3. Engine Power train Nanosensors and NanoTribology
- 4. Transportation Nanoparticle sensors
- 5. Nanostructured Fuel Cells
- 6. Social/Commercial Barriers in Nanotechnology

Well, I guess it *is* transportation. What bothers me though is that the center's contact has the title "director of marketing." Since when does a university research center have a director of marketing? Clearly, something is being sold.

Now I'm not suggesting that there isn't dramatic value in applying nanotechnology to transportation issues, in fact, one theoretical paper suggested that if we could somehow attach billions of tiny flapping wings to our bodies, we could fly through the air like a bird without anything more than our nanosuit and battery pack. THAT would be interesting transportation. I'm not suggesting that NWU's researchers are anything but world-class. In fact, if you look at the publications that have come out of the center's staff, you quickly discover that some of the best and brightest are present and active at the center.

But nanotechnology for transportation? JIR will hear about this, I promise.

Preaching to the Converted

There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact. -Mark Twain

One of the more interesting aspects of the nanotechnology industry is the degree to which the industry sells to itself. Since consumer products tend to be out in the future somewhere, with a few notable exceptions, nanotech startups face a severe problem finding customers for products and technologies that are true nanotech. One way around this is to provide technology products and services for people who This is a process that I call industrial do research. cannibalism-basically, feeding yourself to yourself. It's a difficult strategy because only a small percentage of nanotech companies can sell to other nanotech companies. If they all did that, they would all quickly run out of money. It simply defies the laws of economics to have a thriving industry that sells exclusively to itself. However, it is a strategy.

In fact, in the great northern wilds of Madison, Wisconsin, there is a company that does exactly that. Imago Scientific Instruments Corporation sits in a small industrial park a little over a mile from downtown Madison. Imago plans to "become the world leader in providing 3dimensional imaging and analysis capabilities to nanotechnology industries." With \$12 million of venture capital, the most recent round received in September of last year, Imago has a firm financial commitment from one of the leading small-tech venture capital firms—Draper Fisher Jurvetson. What is interesting is how a small Wisconsin startup has achieved funding from traditional Silicon Valley capital sources.

Perhaps it's the products, er, the product. Imago has a "Three Dimensional Atom Probe Microscope." Clearly, no home should be without one.



The key question, however, is exactly what is it that excites VCs enough to pump \$12 million into the development of a *microscope*? For that answer, we have to figure out what exactly a 3D microscope is, does.

Recall that a few columns ago, I gave a brief introduction to the Atomic Force Microscope (AFM)? This is a device that can deliver a picture of a surface at a scale of micrometers down to the individual atoms themselves. The thing I forgot to mention about the AFM is that it can only take a picture of a relatively flat surface. What Imago's microscope can do is take a picture of the three dimensional structure of something.



What that means is you can get a sense of not only what's on top, but also, what's inside. If you're trying to come up with a material, such as a ceramic for an automotive engine, one of the things you learn early on is that impurities at the atomic scale can often spell the difference between materials that shatter and materials that bounce. This can mean the difference between an automobile engine with a life expectancy of 100,000 miles and one with an expectancy of 1,000,000. Knowing how various materials are put together in three dimensions can prove to be an extremely valuable tool when it comes to making "nanostructured materials," materials that are built with processes that control the composition structure down to the molecular or atomic level.

Nanostructured materials are not exactly new. One of the theories about the sinking of the Titanic is that the steel which was used to fabricate the hull was crystallized in such a way that when the hull hit the fatal ice-burg, rather than bending the way steel is supposed to bend, it shattered like glass. Later fabrication processes for steel and many other materials have focused on the production of ever-finer distributions of material to achieve greater hardness and durability. In this quest for ever greater durability, materials science has entered the realm of creating ever finer material structures to the point where it would make a lot of sense for a material's scientist to have one of Imago's microscopes.

One of the nice things about Imago's venture family is that they have brought in some reasonably good senior management to nurture the company's initial growth phases. Provided the market for the product (product family?) exists, this will be an interesting company to watch in the future.

TANSTAAFL

There is no free lunch -Milton Friedman

U.S. Patent # 6,362,718 was granted on March 26, 2002. In the Field of Invention Section, the patent states that it is "... capable of producing electrical power without an external application of input power...." I want one. Think of what you could do with it. Compete with utility companies, recharge the batteries in your electric shaver without ever having to plug it in, sell electricity to your neighbors; the possibilities are endless. Sadly, it won't work in spite of its exalted patent status. It's just another perpetual motion machine, which we all know, violates the 2nd law of Thermodynamics and is also prohibited by statute. One thing about laws of physics, no leader or legislature can vote a law of physics up or down. You needn't train peace officers on enforcing these laws. They simply can't be broken. Maybe.

In 1827 the English botanist Robert Brown noticed that pollen grains suspended in water jiggled about under the lens of the microscope. Others noticing the same phenomenon named it Brownian motion in honor of its discoverer.

The phenomenon remained unexplained until Albert Einstein in 1905 decided to take a shot at a solution, which contributed to his receipt of the Nobel Prize for physics in 1926. What Einstein suggested was that the motion was due to the invisible water molecules hitting the visible particles and moving them a bit. Since the particles are hit continuously from all sides, they move in a random fashion. For a long time, life was good with this explanation. Until Feynman got his hands on the problem. Feynman suggested that we could build a device that took advantage of Brownian motion.



He suggested that we could build a tiny device that consists of a vane (on the right) and a ratcheted wheel (on the left) attached by an axel from which we could suspend something, perhaps a flea. Due to the bombardment of gas molecules on the vane on the right, the vane oscillates and jiggles. Since the wheel at the other end of the axle only turns one way because of the ratchet, motion in one direction will cause the axle to turn while motion in the other direction will not. Thus the wheel will turn slowly and may even be able to lift some weight, although some millionth of the weight of a flea. The system has no loss of energy, yet, performs work. This is a violation of the 2nd law of thermodynamics for which no patent exists. Feynman

pointed out that since this was a violation of the 2^{nd} law, then it simply couldn't work.

Unfortunately, several successful attempts have been made to actually make a Brownian Ratchet, and, they worked. The key question is, do we now have the basis to create a perpetual motion machine? Have we found the key to free energy for all time—the ultimate free lunch?

WellIII, no. There is a ratchet remember? At the scale where this happens, the ratchet too is getting bumped around as much as the vane, and every time the ratchet slams down, it dumps the free lunch back into the gas...net net, no perpetual motion and no free lunch.

On the other hand, Brownian motors exist, and work, although they do consume energy as they go. This would seem to be the end of the tale at this point, but it's not. It turns out that if you start looking at the mechanisms by which DNA makes copies of itself, or the way proteins are folded as they are created, there is pretty convincing data to suggest that nature has engineered Brownian ratchets to assist in these fundamental biological processes. Thus while a Brownian ratchet is not the means to a free energy lunch, they may be core to the creation of all the foods that go *into* your lunch.

Nacient Rice

A little and a little, collected together, become a great deal; the heap in the barn consists of single grains, and drop and drop makes an inundation.

-Saadi

The scope of nanotechnology is far greater than the borders of the Midwest, or even the United States. In part, this is because fundamental research is an endeavor of humankind, not just those with access to SBIR grants. In part, this is because governments hate to be left behind. In part, this is because a lot of people think there's a lot of money to be made in nanotechnology. Of all the factors that go into the global focus on nanotechnology, the one that makes the most economic sense is greed. To further greed, it is often a good idea to have a clear focus on merchandising, which is the means by which the seller brings awareness of the product to the buyer. While e-commerce may be growing as a consumer purchasing choice, most people still want to touch and feel before buying. Thus they go to market. With the growth of the city in ancient times, the market became the meeting place for buyer and seller. The origin of the market from the ancient lean-to of stick and hide has evolved to the malls and marts that dominate our consumerism in present day. While most markets have evolved into general product showcases, there are a few that still cater to a select audience in search of select products.

One of the more interesting specialty markets of present day is the Merchandise Mart in Chicago with its emphasis on showing and selling clothing. Fabric producers from around the world regularly congregate here like the smelt runs of the

Midwest Rivers, or the grunion of the California coastal waters. In the various seasons of the lady's hemline, new styles and fabrics routinely find themselves offered at wholesale to the domestic retailers of clothing. Long past are the days where fabrics are made locally, with many now coming from distant nations like India, Malaysia, and China. Here buyers and sellers introduce the latest in clothing and fabric with an eye to creating the latest in seductive styles and fashions. One new fabric, at Dockers everywhere, is the "stain defender" produced just for those like me who can't keep a good lunch out of their lap. Produced by a Burlington Industries acquisition called NanoTex, this is the most visible consumer nanotechnology product in the world today. A successful battle has been waged and won in creating coatings for fibers such as cotton that resist the cloth's temptation to absorb liquids, and thereby save me from repeated public embarrassments.

Whilst this is a uniquely made-in-U.S.A. technology, one shouldn't forget that the majority of all fabrics are manufactured outside of the country. Thus, in understanding the global impacts of nanotechnology in spill management, it makes sense to discover what other countries are doing in nanotech, especially, our dear friends in China, who make so many of our consumer products these days.

One of the first things you discover in your research is that most Chinese speak and write in Chinese. I mention this only because I know far too many people who don't know that. One of the other things about the Chinese is they write using a character set that defies the common profile of learning requirements many of us and our children endured in high-school. Thanks to the World Wide Web you quickly find that it is possible to perform research in Chinese using automated translation tools that give you the gist of a publication. Of course, words like *nanotechnology* don't translate too well, and come back in the transliterated English as "nacient rice." In researching nacient rice, one discovers that China profound robust has а and nanotechnology research community. Chinese nanotechnologists have excelled in not just the pure research domain, but have also recently produced one of the most remarkable achievements of the future clothing industry-a carbon nanotube rope measuring 20 centimeters in length, large enough to pick up with your finger. This remarkable achievement lead by H. W. Zhu at Tsinghua University in Beijing, will undoubtedly lead to bulk fabrication of nanomaterials, and ultimately nano-fabrics that not only repel pizza, but also dramatically increase the strength of fabrics exceeding steel by a factor of 50 or more.



Such a fabric has other interesting characteristics that may wind their way into the consumer space. It turns out that if you apply a voltage to a carbon nanotube, the tube can be made to lengthen and contract, a tiny amount. As it expands or contracts, its reflective color changes. This suggests in the perfect fabric world, a stain resistant invincible fabric that with the touch of a button (or rheostat) becomes the color of the moment. No longer will consumers have closets full of clothes to fit the mood. Now, one suit suits for all fashions, always new in appearance, and changing appearance as needed. Similarly, no more need for paunch retaining girdles, for no excess love handles would ever have the strength to split a nanofiber skirt down the seams.

Now this doesn't mean that we'll see new fabrics at the Merchandise Mart for the fall fashion show, but it does mean that the fabric industry is on the verge of one of those horrible Kuhnian paradigm shifts, where everything we know is wrong, and what will be is beyond our current imagination.

A girl's best friend

Those in the cheaper seats clap. The rest of you rattle your jewelry. -John Lennon

My favorite kind of company is the one that barely exists yet prevails against all odds. It is a rare and wonderful day when David takes on Goliath and whacks him in the forehead with a stone. Perhaps that is why I have this preternatural obsession with nanotechnology. This week, we have a tale of David & Goliath in the nanoworld. To understand this tale of triumph of mite versus mountain, let's discover a bit more about carbon than most people ever wanted to know.

Carbon is formed as one of the last stages in the death of a star that is about to go supernova. After exhausting its supply of hydrogen, a star will fuse helium for perhaps a million years producing carbon as a byproduct. If the temperature at the stellar core exceeds about 500 million degrees, the carbon will fuse for perhaps a thousand years more. The resulting neon and oxygen may fuse for a year producing silicon, which may in turn fuse for a day producing iron. At the end of the day when the silicon runs out, the iron stubbornly refuses to fuse at which time it's show time as the fusion process runs to a screeching halt and the fuel depleted star simultaneously collapses and blows apart.


A supernova spews its guts

Some of the unburned carbon gets strewn through the universe during the explosion ultimately ending up on the fingers of young ladies in the more popular form of carbon called a diamond. What makes a diamond special is not the fact that it's carbon, nor that it costs a small fortune to properly equip your spouse with diamonds. What makes a diamond truly special is the way the carbon atoms bond together. Each carbon atom bonds with 4 other carbon atoms in a structure that creates the most durable and hardest substance found in nature this side of a neutron star. As a result, diamonds, in spite of their price, are highly prized in the tooling industry as the durable tips to the broad assortment of cutting tools—which brings us up to speed for our David & Goliath story.

It has long been the quest of the tooling industry to find a means of fabricating diamonds in cheap and plentiful ways. Since diamonds are most commonly found on the crust of neutron stars, in the core of large Jupiter like planets, and a thousand miles beneath the surface of the earth, this has been a frustrating quest at best. However, there has been some progress in taking diamonds and splatting them onto the surface of things to harden them significantly. Such splatting is formally called Diamond Like Coatings (DLC). It involves a variety of processes that either embed tiny diamonds on a surface, or that actually grow diamonds on a surface, usually at a thickness of a few to several hundred nanometers. However it is done, the surface becomes coated with those special bits of carbon with proven hardness and durability improving the wear characteristics from a few percent to a few thousand percent.

David, in this story, is a small Chicago company, not even a storefront actually, Syndia Corporation, founded by an entrepreneur and a faculty member from Northwestern. The patent portfolio of this company is the business of this company, and buried in the portfolio is a patent describing a method for producing a DLC. Now, for those of us who shave, I'm certain that few of you know that Gillette's latest generation of razor blade has a Diamond Like nanoscale Coating on each and every blade. This makes Gillette a nanotechnology company. It also happens, that in 2002 a court ruled that Gillette infringed on patents owned by Syndia in Gillette's production of razor blades. Infringed to the initial tune of about \$10 million and counting. What Syndia patented, and what Gillette faced in court, was the ability to take a standard razor, and coat it with a thin film of diamonds thereby dramatically improving the wear characteristics of the blade and reducing the amount of blood replenishment required by the standard beardless hominid.



SEM of a razor

While the rest of the world was Mach3ing our faces clean of stubble, Gillette was fabricating DLCs by the ton while a small NWU spin-off was quietly suing the socks off of Goliath.

Whatever the final appellate course of the Syndia-Gillette controversy, what is interesting is that DLCs exist, and there is clearly a path to creating one of the nanotechnologist's dreams—the diamondoid. In the ideal nanomachine world, a nanomachine would be created out of pure diamond-stuff, thereby creating a machine of unprecedented stability and strength, considering its size of course. Thus, while the diamondoid may not yet be on our immediate horizon, the touch of nanotechnology is found whenever a lady strokes the clean-shaven face of her guy.

Gap-toothed in nanoland

The tooth fairy teaches children that they can sell body parts for money. -David Richerby

Nanotechnology, it is said, will ultimately evolve to the point where it touches every aspect of commerce and technology. While many pundits claim that the day is coming, some claim that it is already here. I often error on the side of conservatism, but there is one case that I think deserves consideration in determining the degree to which nanotechnology can impact us all. In fact, there's a Midwest company that has managed to put nanotechnology on the lips of us all....

Sometimes, when a company deserves to live, it dies. Sometimes, when a company deserves to die, it lives. In 1902, there was a company in the Midwest that deserved to In the lost city of Two Harbors, Minnesota, 5 die. entrepreneurs purchased a mine in hopes of making sandpaper and grinding wheels. Being somewhat out of touch with reality, they gleefully mined a mineral called anorthorsite thinking it was a different mineral called corundum. When applied to sandpaper and grinding wheels anorthorsite proved totally inadequate as a sanding and grinding material, compared to the corundum that they thought they were mining. The market spoke, and they closed their mine, moved to Duluth and with the support of an angel investor purchased corundum and manufactured sandpaper and grinding wheels that worked. The company

should have died, but they lived to the point where they currently generate in excess of \$15 billion/year in revenue. The company is 3M.

Let's take the way-back machine for a slight diversion to a different time and place. In the 6th century, the Arabian Empire conquered much of Spain bringing a new age of enlightenment to a people that was otherwise in the doldrums of the dark ages. For almost 6 centuries, Arab control of Spain ran through the gambit of stable peace and repeated civil wars. Abulcasis was one of the children of Arabian immigrants who inhabited the southern coast of Spain in the 11th Century. He entered what at the time was the rather black art of dentistry, and transformed it into a nearly modern science. Amongst his many dental achievements were advanced development of extraction, scaling, the design of scrapers and most important for this story, the binding and filling of teeth with a bone substitute.

So how do you mix one innovative Arab with one should have failed multi-national conglomerate and come up with nanotechnology? Well, have you ever been to a dentist? Each of us has a clear memory of the sound of a drill, the scratching of fingernails on a blackboard vibrating our skull into that special state of torture that we voluntarily endure as part of our dental hygiene. What most of us forget as our lips flub around trying to find our molars and our fingernails unclench from the chair, is that there is that moment after the command to "rinse and spit" where the dentist checks with his assistant to match the color of your teeth with a little color chart. If the dentist is using a 3M product, he selects the appropriate shade and then finds a little vial of "3MTM ESPETM FiltekTM Supreme Universal Restorative" goo, which he will then apply to the drill point to reshape your tooth into a natural shape and appearance, converting this:



Into this:

Abulcasis would be ecstatic to see his life's work accomplished with so little effort. This miracle of modern dentistry is due to the result of a century of building ever finer sandpapers to the point where 3M's tooth goo uses a mixture of 20 to 70 nanometer particles to create an ultrahard wear resistant nano-composite that with a flash of ultraviolet light forms a bone-like material that bonds to the tooth.



Tooth goo nanoparticles

With approximately 70% nanoparticles by volume, modern dentistry now has nearly tooth hard and tooth durable tools to shape almost any tooth into a cosmetically appealing and functional shape.

Thus nanotechnology has reached the big time in another indirect way, from another company that really doesn't call itself a nanotechnology company, routinely doing nanotechnology.

On Nanotechnology – Other Essays

These essays were written on request of the editors of various nanotechnology websites. Like the epriarie.com essays above, they were written to enhance the credibility of nanotechnology and the state-o-de-art image of the editors.

Investing in Science Fiction

Science-fiction balances you on the cliff. Fantasy shoves you off. Ray Bradbury

Crichton's latest book, **Prey**, was a best seller a month before its official publication. I remember tracking it on Amazon in early November 2002. Crichton's unpublished book was number 19 on the Amazon hit parade. My book was languishing at around 15,348. Crichton got a \$30 million dollar advance. I got audited by the IRS for claiming my computer as a business deduction for writing my book.

There is no question that nanotechnology excites millions of people as an alternative future. Similarly dinosaurs have been fascinating millions for decades. I remember reading that when **Jurassic Park** opened at the box office, the profits from the first weekend were equivalent to the total paleontological research funding for the last few decades. Now that the dinosaurs have died off, twice, paleontologists initially reported significant increases in their budgets, due to the impact of Hollywood. However, in these leaner economic times, funding levels have flattened or started to decline. Sadly, most paleontologists never ever get to produce a salable product.

For the next few years, if Crichton's PR campaign holds, the terror of run-away nanobots will garner an increase in public attention. Certainly, the companies with NANO in their name will be joined by other companies changing their name to nano-something. I would expect, if the craze holds, to find a new startup named Xymos in much the same way the Bubba Gump Shrimp Company exploited an earlier popular theme.

Now what this means is that any fund manager worth his salt is going to add the word "nanotechnology" to his portfolio. This isn't to suggest that nanotechnology investment will increase. It is to suggest that interest in investing in nanotechnology will increase.

The situation will improve dramatically if Jerry Falwell demands immediate government bans on nanotechnology research. Negative P.R. is almost as good as positive P.R.

Science Fiction has always been good for programs that stand on the fine line between science and fiction. Nanotechnology has lofty visions for a future utopia, while the commercial side focuses on corrosion resistant paint and spill resistant blue jeans. On the other hand, science fiction tends to bring the most brilliant young minds to think about difficult problems, and sometimes, those minds make career choices that foster a new generation of development and progress.

Earlier this year, a Small Times reviewer verbally chastised me for misrepresenting what nanotechnology is. I had made the horrible mistake of not believing that nanotechnology refers to technologies smaller than 100 nanometers. I had suggested that from an investor's point of view, as long as the technology was invisible without a microscope, it must be nanotechnology. Similarly the Forbes Nanotech report routinely chastises companies for claiming to be nanotechnology companies when in actual fact; their technology is hundreds or even thousands of times too large to be real nanotechnology.

From an investor's point of view, it's not what's *real* that counts; it's what people *think is real* that counts. As long as investors rely on the popular media to shape and develop opinions about nanotechnology, then the smart rule for a nanotechnology company is to follow the money. Ultimately, the physics of matter will determine what is possible or not as nanotechnology evolves. In the meantime, public opinion is a useful and valuable tool in shaping funding decisions for the future.

My hat goes off to Crichton and every copycat author who exploits the fringe of science to create science fiction. Their work will ultimately benefit all who strive to develop and commercialize what turns out to be a complex and difficult technology.

Every nascent nanotechnologist should remember, however, that every investment bubble eventually breaks. A recent survey of biotech startup IPOs showed that the average stock price over the last 2 years had declined to 5-10% of the IPO price. This shows the fickle nature of market forces in funding new companies. On the other hand, most of these companies did receive the resources to develop core technologies and products that will ultimately lead them to some measure of success. With luck, nanotechnology will reap similar investment rewards. With even better luck, their post IPO positions won't be so dismal in later years.

Are we there yet?

Only buy something that you'd be perfectly happy to hold if the market shut down for 10 years. Warren Buffett

Nanotechnology deals with the creation of valuable commodities fabricated one atom at a time. The ultimate dream of nanotechnology is to create legions of inexpensive self-replicating microscopic machines that can be directed to fabricate or modify virtually *anything* using ambient materials. Building a house from a pile of sand, or reconstructing every cell in the human body to ensure eternal youth are among the dreams of nanotechnology. However, present products seem more focused on stain resistant fabrics, corrosion resistant paints, and a host of fascinating, yet unproven possibilities.

Two years ago, I signed a contract with John Wiley & Sons (a prestigious publishing company) to write *The Investor's Guide to Nanotechnology & Micromachines*. Wiley gleefully handed me over to one of their editors who would guide me through the process. He started defining how he expected me to review stocks as a group, small-cap, mid-cap, the ones most interesting to investors, and derive a model for ranking companies into various investment categories, development stages, with a vigorous treatment of their.... My laughter broke up his monologue. "What's wrong?" he asked. It took me a while to stop choking with laughter. "Well, "I said, "the big companies are IBM and INTEL, and no one's going to pick them because of their nanotechnology R&D. The mid-caps don't exist, and the 4 small-caps will probably be dead by the time the book is published—and I hesitate to discuss the private companies and the non-profits with no public stock to trade"

He said, "But we have a contract for you to write a book! Who's the audience?"

"Well," I said, "I don't do your marketing, but surely, you could target the accredited investors? There's a coupla million of them."

He paused a bit and said, "We don't target accredited investors."

With that auspicious start, we went down the path of writing an investor's guide to a nascent industry that had virtually no investors and few companies, yet in 9 months we gave birth to a credible guide to an industry with nearly 1,000 players on the threshold of becoming believable. Having earned in excess of \$0.60/hour for the effort, I now stake claim to being one of the planet's experts on nanotechnology investment, such as it is.

In the ensuing two years, everything has changed, and nothing has changed. The number of investible nanotechnology companies on the verge of death has grown 20-fold from the 4 lonely spirits I tracked at the beginning. The number of dancing-bear companies has dropped to close to zero—and by all that's holy, there are several reputable venture capital firms actively placing money with truly promising startups. On the other hand, if you want to personally invest, there's still IBM and Intel, and well, maybe Sumitomo and Samsung, each investing some fraction of a percent of their R&D into nanotechnology. The government is still *the* major investor in the "industry." And the over-the-counter stocks? Well a few IPOs have come and gone—think pink sheets, or a few companies on NASDAQ struggling to redefine themselves.

With approximately \$2 billion into the global investment in nanotechnology, the number one profit maker is Harper Collins, which recently released Michael Crichton's *Prey*. The number two profit makers, as Josh Wolfe of Lux Capital keeps reminding us, are the nanotechnology conference organizers. If enough of you buy my book, I'll become the number three profit center behind Harper Collins and nanotechnology conference organizers, albeit by a factor of 1,000 less in performance. But for the savvy investor, their time has yet to come. If you meet the SEC qualifications to be an accredited investor, you *can* invest in a number of specialized investment funds managed by quality funds managers helping some good companies get off the ground.

The time for global awareness of nanotechnology is clearly upon us. Governments are expanding the infrastructure necessary to make nanotechnology, however you define it, a viable and emerging economic force perhaps in much the same way governments made fusion reactors a viable and *ever* emerging economic force. Private investment now rivals, almost, government investment. So is this the time to invest? If you put your money into the right funds, you will make money. But if you want to pick the right company, you may have to wait a few years to see if Wiley commissions a 2^{nd} edition of my book.

Nano Startup Success Factors

Whenever there is a hard job to be done I assign it to a lazy man; he is sure to find an easy way of doing it. Walter Chrysler

P.T. Barnum said there was one born every minute. He was right. I am the chairman of the board of a small startup company, which relied on the good intentions and gullibility of hundreds of well intentioned, reasonably intelligent, and unwary investors. Fortunately, I wasn't affiliated with the company until after their investments were made. My task was to figure out how to manage the company from the edge of the pit of despair into a company that had meaningful sales and positive cash flow. I learned to hate inertia along the way. The jury is still out for this company, but I think they'll make it. I might even try to claim credit for all the hard work that others did to pull the company out of the swamp.

There is nothing like failure to draw one's focus to the conditions required for success. In building a successful nanotechnology startup, there are common rules that apply, whether the company wants to be the buckyball king of the world, or the croissant king of the world. The number one factor that will make or break a company is the management team.

A management team is a collection of people with different skills who share a common focus, a team oriented

approach, and a drive for success no matter what. For a startup company, the skills that must be present are:

- 1. Leadership
- 2. Technology
- 3. Marketing
- 4. Sales
- 5. Finance
- 6. Experience

Somewhere along the way, the company needs enough money to pay for all of this. The typical startup company doesn't have people who can truly fit the bill in each and every category. The typical startup company is the founder, Joe, his wife, their best friend Mary, her husband, and either a rich uncle or an SBIR grant manager. By the time the company files its articles of incorporation, the seeds of death are usually planted. Startups tend to start with people who know each other well enough to take risks together. There's a dreamer in the group with some leadership skills, who can pull together the first team. If they are lucky, the initial management team will have 1 or 2 survivors through the first round of angel funding. Most likely, none of the original management team will survive the IPO.

The reasons are simple. Who you know tends to not be who you need. The first investor who pops for the deal will have assessed the management team and will already know, who lives, and who dies. The entrepreneur has been carefully cached into a neat little cubbyhole that has a selfdestruct timer with options. The investor knows that for this company to succeed, the investor is going to have to take a management roll at some point, or find someone who can. Meanwhile, the management team has the task of creating future investment value so some other investor can buy into a more sophisticated story.

Now the real key to success is to find the team you need, even if it consists of strangers, and *then* file the articles of incorporation. If you have the right team, the team will have the experience to train you and perhaps help you continue your roll in the organization as it hits the **Inc Magazine** fastest growing company list.

of the One major problems а nanotechnology entrepreneur has is that there is a total lack of experienced nanotechnology entrepreneurs who've been there, done that. If we think about biotech engineering startups, the one-time darling of the investment community, the boom bust cycle hired, trained, and laid off, a vast number of people who were given on the job training on how *not* to do a biotech startup company. With this pool of failures, and a few successes, biotech created a pool of skilled people from which a biotech entrepreneur can recruit. Nanotechnology is simply too immature to have created this pool. Nanotechnology needs a few meltdowns to create the critical mass that generates trained and skilled people who know what they did wrong last time.

The number one factor that will spell the difference between success and failure is a quality management team from the beginning. A quality management team can survive almost any startup problem, lack of cash, failed technology, competition, misjudged market space, or any of the myriad of other things that can and will go wrong. When the investor looks at the company, they already know that the story, however good it is, is going to change completely at least once every 6 months. Their interest is very keen on the people. Are these people the kind of people who will regroup and charge forward no matter what obstacles get in the way? If their buckytube idea turns out to be inappropriate for their market, are these the kind of people that will drop their buckytube obsession and find some other way to bring a product to market?

If the answer is yes, then the entrepreneur and the investor see eye to eye. After all, the final objective is simply this make money.

How to spend \$100 Billion on Nanotechnology

Physics isn't a religion. If it were, we'd have a much easier time raising money. Leon Lederman

When my brother got his PhD in plasma physics, I asked him, "So how much physics do you know?" In a manner that only brothers can do, he looked down on me and said, "Well, I know most physics up to about 1940. I know some of the quantum physics up to about 1960. And I know a lot about plasma physics up to last year." With these words, he attempted to enter the fusion physics job market just about the time the U.S. government cut fusion research to the bone. He hasn't played with plasma since.

After 30 years of federal funding at about \$500 million/year the U.S. government decided it had other priorities than cheap energy from seawater. With a global investment approaching \$30 billion, the problem of building a commercial fusion reactor still limps along with a prototype horizon somewhere between 5 and 20 years in the future. Putting the sun in a bottle is difficult.

What if we had \$100 billion to invest in nanotechnology? How far could we go, how fast? In constant dollars, this kind of investment is comparable to what was spent on the global fusion research program.

There would be several keys to the success or failure of this kind of investment:

- 1. What would our goal be?
- 2. How well do we understand the problem?
- 3. Who would manage the program?
- 4. Who would actually do the work?

Unlike the fusion program, the goals of nanotechnology are vague. There is no single sentence that summarizes nanotechnology's goals. Thus, our goal becomes the first funding problem. We stand before the Republican congress, hat in hand and say, "We want \$100 billion dollars to develop nanotechnology." The honorable Senator Skeptic from the state of mind says, "And when you're done spending that money, what will we have?" Well.... Uh....small valuable stuff that does many things. This is one committee hearing that even CSPAN would avoid.

Do we understand the problem? Well, not knowing the physics of magnetic containment of high-density plasmas didn't deter two generations of physicists, so not knowing the physics and engineering of nanotechnology shouldn't stop us. But are we investing in specific technologies such as computers, paints, robots, medicine, or are we investing in the general concept of creating disruptive technologies with broad implications across the board? Consider the politics of intentionally disrupting a major portion of the work force using Federal money. The honorable Senator Skeptic asks,"so you want our committee to fund you so you can unemploy 50% of the work force over 35 years of age? The AFLCIO would sooner work with Al-Qaida than let that funding bill pass.

So who will manage this program? It's not out of line to expect a major Federal procurement program to spend this kind of money. The F-22 Raptor fighter, a single engineering project, will ultimately cost around \$200 billion. Of course, as program sizes increase, the size of the bureaucracy increases, as does the size of the oversight process, which ultimately leads to cost overruns and program delays. Thus. \$100 billion dollar program our is automatically investigated by the GAO as a \$150 billion dollar problem. And who runs this program? Letting the Federal government manage the program would be a proven way to snatch defeat from the jaws of victory. We could try civilian contractors such as Lockheed Martin, who routinely manage large programs for the government. Of course, they will perform according to contract, with an eye on potential "disruptive technologies." They just might end up in a monopoly position defended by the Microsoft legal team.

Granted that there is a managed program with clear goals and adequate yet incomplete understanding, who executes this program? This leads to, who is competent to execute the program? The number of nanotechnology degree programs can be counted on one's fingers. The number of these programs that include entrepreneurship and business training is, well, none. Thus, the global pool of experts capable of executing the program consists mostly of those of us who have crossed over into nanotechnology from other fields. Which makes one ask, if we were successful in our other disciplines, what motivated us to focus on nanotechnology? Perhaps we hand the money to Drexler; after all, this is his fault to begin with. So how do we spend \$100 billion on nanotechnology? We don't. Nanotechnology is too small, too ill defined and too new to meet the thresholds necessary for major investment. Maybe in a few years....

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Moon Rocks

Editor: a person employed on a newspaper whose business it is to separate the wheat from the chaff, and to see that the chaff is printed. Elbert Hubbard

Many years ago, I tried to assign a new project to an engineering manager. He looked at the specifications that I'd given him and said, "If we only had moon rocks." I stared at him with a puzzled expression. "Moon rocks, that's what we need," he grumbled. I asked, "Moon rocks?" He looked at me, and said, "Yes, moon rocks. You see, you want me to do some *moon rock* engineering." I asked, "What's that?" He glared at me with that serious expression that comes from too many myopic hours spent solving nonlinear differential equations and pronounced, "Well, the specification says we're going to take an optical system that has a 30-inch focal length and compress it into a space of about 1 inch. I think I can do that, but I need some moon rocks to do the engineering—" I finally got his point. If someone asks you to do the impossible, you might as well start by asking for the impossible in return.

This fall, I finished the final touches on a book entitled *The Investor's Guide to Micromachines and Nanotechnology*. I'm not sure if it was a labor of love or one of those punishments that comes from watching too many Star Trek episodes. When I started writing the book, I had an intense fascination with the coming age of nanotechnology. The deeper I got into the subject material, the more moon rocks I found. If only we had a working

atomic assembler... If only we had carbon nanotubes 1 cm in length... If only we had some diamonoids... The only ifs started to get to me so that I would wake up in the middle of the night in a cold sweat, dreaming about micro-robots and nano-manipulators and other capabilities that might never exist. I almost abandoned the book project to search for a new topic that had some reality. Notwithstanding the NNI's half billion dollar investment. I was torn between the almost religious fever of nanotechnology's proponents, and the rather boring surface physicists stuck in the dank dust free labs of Intel, IBM, and CERN. In truth, there is a lot of nanotechnology on the brink of breakthrough. There is also a lot of nanotechnology that is merely on the brink. By the time I finished the book and sent it off to my publisher, I had become a somewhat jaded realist on the scope and potential of an emerging technology. Some parts are real. Some parts will be real, as soon as that truckload of moon rocks arrives.

What I hope to do in this column is to provoke some serious debate over what we can, should, and will do, as the investment in nanotechnology continues to expand. Oh, it will expand. There are plenty of people who purchase moon rocks every day. P. T. Barnum once suggested that there was one born every minute. There are also some very serious, very professional, and very meaningful professionals who are making incredible discoveries and inventions, without the aid of moon rocks.

Nanotechnology will reshape our world, as it has for the last 30 years. Seventy percent of the growth in the GDP is based on the physics associated with quantum and nanotechnologies. These are not technologies waiting to happen. These are mature technologies that are branching in new and dramatic directions. It is my hope, as I add to these columns in the future, that I will entertain, educate, and enrage, in a manner that provokes thoughtful and serious development of one of the top three candidates for the #1 technology of the 21st century. Nanotechnology might rank only a few small steps behind Genomics and Nintendo.

In each of these columns, I hope to show two sides of a selected nanotechnology. One side is the hype. The other side is the value. With luck, there will be ruffled feathers and furious debate. In the next column, I will explore some of the finer tidbits of nano-lore. The virtues of carbon and the considerations that will keep space elevators from ever leaving the ground.

Roping the Stars

We cannot swing up on a rope that is attached only to our own belt. William Ernest Hocking

As I stated in the first column, it is my hope to entertain, educate, and enrage in a manner that leads to thoughtful and productive discussions. Picture if you will, a rope stretching from the surface of the earth, 22,000 miles straight up into geosynchronous orbit. Engineering analysis suggests that if such a rope can exist, you could climb it. In fact, there have been a number of serious studies that have outlined the mechanics and physics of such a device. These studies have even indicated that a rope braided out of carbon nanotubes would have sufficient strength to make such a rope actually physically possible. The concept has the generic name "space elevator."

The dynamics of a space elevator are relatively simple. You bolt one end of a rope at a location on the equator (Ecuador comes to mind), and the other end passes through a location in space 22,000 miles overhead (plus additional distance for counterweights). This permits you to have a stationary object, or tower, that stretches from the surface of the earth to orbit at 22,000 miles. Along the way, you would pass through the inner Van Allan Belt and reach the fringes of the outer Van Allan Belt, so you would have to wear your lead underwear for the trip. You would also hope that the carbon fibers would have self-healing capabilities every time they encountered an oncoming 10 MEV particle. Lastly, you

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would pray that elevator music has finally evolved into an endurable state of being. These minor issues aside, one calculation I saw indicated that the rope that reaches the required distance, just to sustain itself (i.e. no payload) based on continuous strands of carbon nanotubes, would weigh about 34 million pounds. Using the current Payload Assist Module (PAM-A: 4,400 pound payload) getting that bulk of carbon fibers into geosynchronous orbit would take about 7,700 space shuttle launches. At a rate of 10 launches per year, this could be done in about 700 years at a cost of perhaps 924 billion dollars (assuming no inflation). Redeeming frequent flyer miles would reduce the cost somewhat. Obviously some intermediate technology is required just to get the rope (or even part of the rope) in place. Equally obviously, it is not going to be a crash priority for the Bush administration.

While the cooler heads are thinking about heavy lift vehicles and non-geosynchronous staging areas, there is the minor problem of coming up with aligned carbon nanotubes of sufficient length to braid into a rope longer than, say 1 millimeter. At least we know how to put something into geosynchronous orbit. Now let's think about those nasty little carbon nanotubes. Well the state of the art isn't too good right now. There may be a few labs kicking around that have created a few fibers as long as a millimeter. Of course, getting a weaver's bundle together by picking out the long ones using an atomic force microscope is a sorting activity that can take, on a good day, an hour per fiber. The fact is, however, that unlike hemp, carbon nanotubes would rather slide against each other rather than stick together, so there is an implicit requirement that any space cables should be fabricated out of single strands about 3,872,000,000 times longer than those that have been previously fabricated. The alternative is a self-unraveling rope, which wouldn't stay together long enough to be of any value. Not to worry, we are not going to start shuttle launch operations any time soon.

So, where might we focus our R&D efforts on carbon nanotubes? Well, I happen to like IBM. They have a nearterm product focus. In April 2001, they published a report describing how to make arrays of carbon nanotube based transistors. *Arrays*, not just one—in other words, bulk processing. Now the downside is that the arrays weren't any smaller than those produced with conventional lithography techniques, and the performance of the transistors didn't set any speed or amplification records. But, it did demonstrate that a concerted affordable effort using a nanomaterial could result in a practical and usable technology. Only one-step away from being a product! It only missed the cost-effective element.

On Life

Sometimes, just being alive has its own moments. Many of these stories evolved out of a recognition that even the simplest of things has the most profound meanings in life. Like my favorite cat...

First Runner Up

From this day to the ending of the world, But we in it shall be remember'd; We few, we happy few, we band of brothers; For he to-day that sheds his blood with me Shall be my brother; be he ne'er so vile, This day shall gentle his condition: And gentlemen in England now a-bed Shall think themselves accursed they were not here. And hold their manhoods cheap whiles any speaks That fought with us upon Saint Crispin's day. - some English author

Sometimes, I wonder what would have happened if Henry V's generals had been rational. The next scene would have been the scene where Henry's generals stand before the troops and say something like:

I have some good news and some bad news... The bad news is, the king is dead. The good news is, you can all go home.

The history of the world is written by the winning side. As far back as Thucydidies, who chronicled the oft quoted **History of the Peloponnesian War,** the winner has determined the truth of historical fact. On the other hand, most of us have never heard of Thucydidies and a recent survey of defeated candidates for the office of Mayor of Minneapolis shows that most people couldn't pronounce *Thucydidies* if their lives depended on it. Let it suffice that a long time ago, in Greece, there was a major war lasting a generation between two city-states over who was going to be the tax collector of the region. It was a very famous war, at the time, if you were there. Lots of people got killed. Lots more lived. There were lots of very famous heroes. *From this day to the ending of the world, they shall be remember'd.* Maybe.

As I was rifling through a cupboard the other day, I came across a certificate of sorts. The certificate declares that my daughter's cat was judged best of show in some competitive cat competition some 6 years ago. I remember looking at this certificate, declaring that in the opinion of a team of expert judges, this cat was better than any other cat presented before the judges on that day. I looked from the certificate to the brown stain where this best of show creature had puked her lunch on my white rug, and wondered, just precisely, what it means to be best of anything? Could those judges, in their calm deliberation, envision that this most famous cat for a day would ultimately cost me thousands of dollars in vet, cleaning and other expenses? That she would often wake me up at 4 in the morning, demanding that I join the hunt with her for imaginary mice? Perhaps the judges had this in mind when they judged her best of show. Best cat, for that day...Queen for a day. Perhaps it was a well earned prize, and her stomach calmly digested fur balls while under examination. Now, half a decade later, I doubt if she would be best of show except perhaps at a fur-ball heaving competition. Yet, as I think about that certificate, with a typical sense of pride, I looked at her and said, "my you were special, once." Once. And then what happened?

This got me to thinking about my resume. I went through it with a sense of pride noting all the accomplishments and wonderful things that I've done in 30 years of professional involvement in the world. Invented, wrote, directed, founded-Lots of good stuff-A veritable powerhouse of accomplishment and high honor. Except, I also remembered this meeting I had when I was an executive at a small company. I was sitting across from the CEO and the vice president of marketing. The CEO was chewing the ass off of the marketing guy. Last year, he had increased sales by 50%, but was now complaining about how sales were in a down swing and the company needed to respond to the declining market with new products and new capabilities. My job was to create the new products and new capabilities. I had just explained that the lead time for the new things was on the order of 18 months before we could bring them to market. The CEO turned to the marketing guy and said, "There is a rule in sales. It's not sufficient to describe your successes in the past. We have long since spent that money. The rule is, this, what have you done for me lately? If you can't get the sales numbers up to where they have to be, I'll have to find someone who can." I sat there in wonder. The marketing guy had been through several stages of hell with me through premature product introductions, customers who had unrealistic expectations, customer support problems that had driven two field service technicians literally to their graves, and had managed, somehow to get contracts signed, RFPs won, and checks delivered to the company coffers. His resume was chock full of accomplishment, in the past. His time of being a hero, *remember'd*, was past. Now he had

a simple choice, walk the plank yet again and find some new customers, or be cast aside like week old Chinese food too long in the fridge for human consumption. *No greater love hath he, than he who dies for his company.*

As I stood in the middle of the rug, looking at this oval brown stain in a previously pristine rug, best of show, record sales, suddenly took on a new perspective. Perhaps the issue is not in the accomplishment, but in the recognition of the accomplishment... in the means by which we judge ourselves and others. If we were truly rational people, would we hang our hides out in gale force winds to see if it was truly the storm of the century? Would we really want to read a New York Times best seller and ignore number 102 on the list? By what means do we judge ourselves and others to be successful, happy, great, or even satisfied.

Back in the early '70s, when Microsoft was a fledgling company, there is a story that one of the programmers working for Bill Gates quit one day. As he walked out the door, in a rather informal exit interview, he shouted at Bill, "You're an unscrupulous asshole!!! Someday, someone's going to sue your ass!" Truer words were never said. This programmer probably regrets being no longer associated with the top 3 richest individuals on the planet. I'm sure today, he would gladly be number 4 with the problems of hiring the complete staff of several Seattle law firms to defend his honor and earning potential before some federal judge. Certainly, he's out there, somewhere, doing some fantastic software for some fantastic company that ranks in the fortune 1000 list. Or maybe, just maybe, he's doing what my first boss did when he found himself on the street after running a successful company into the ground, guiding tourists on canoe rides in Baja California becoming one with nature and breakfasting each morning with the scrambled eggs of endangered sea turtles.

As I stood there, looking at that oval stain, gift from the best of show, I wondered, since we know that the heroes of old ultimately vanish in the mists of time, what happens to their lieutenants and their sergeants and all those little people who stand in muddy trenches wondering who the hell Saint Crispin is, and why they'll be remembered for eternity for loosing a few shafts of arrows at some muddy Frenchmen who can't move horses through some bog? To understand this, I thought it might be good to first discover just who Saint Crispin was. Perhaps, an understanding of the Saint used by Henry V to rally his troops before battle would give me a better understanding of what it is that drives people to exceed, even if they don't quite end up in best of show. Certainly, Crispin meets the criteria of Sainthood through the annals of Catholic history-beheaded by the Romans in 286 AD. Each Saint appears to be noted for some special trait, some memorable accomplishment other than martyrdom and This is the essence perhaps of the inspirational piety. message that Henry gave to his troops. Saint Crispin, patron Saint of cobblers. glove makers, lace makers. lace workers. leather workers. saddle makers. saddlers. shoemakers, tanners, and weavers. OK, Henry, I've got it. We're gonna stand, outnumbered 20 to 1, before the French, to be placed in memory alongside the patron saint of people who make doileys. When we return to England, at least we'll get discounts on shoes. I'd face down any 20 people

hell bent on chopping me to bits for discounted leather products. Anyone would.

I went back to contemplating my oval stain again. There surely is a place for those who are *remember'd* through history. Surely some future playwright will craft the story of Bill Gates, who faced down government anti-trust attorneys to bring humanity into the information age. There will be controversy for centuries over the pivotal transcripts and stories told about the great man and his contribution to society, and history. On the other hand, if you discount the money part, who would actually want to be Bill Gates? Accomplishment and motivation perhaps are the benchmarks of success, and perhaps we judge this by battles won, fortunes made, trophies collected. But what about those of us who never won the big game, who sold the stock at a loss, who dropped out of school, or were fired because we hadn't excelled lately? Are we any less the models of life for our failure to own, marshal, and be quoted? As I looked at that stain, I thought of my daughter, now a sophomore in high school. In her class of 900 students, she hangs happily in the middle far removed from the top student, and equally far removed from the bottom student. What legacy shall I pass on to her about accomplishment, glory, honor and how history shall remember her? Certainly, she is interested in winning. For some strange reason, everyone wants to be first, best, fastest, richest. There is some ingrained joy in getting that blue ribbon and beamingly staring down those who didn't quite run fast enough. Yesterday, her high school band came in 2nd in a competition, and once again, her ego was bruised by their collective failure to be the best at
something that she has worked so hard for every day for many long months. Is she now a failure for not having heeded the call of her king to face down some bog slogging enemy?

Perhaps so. Perhaps, in the final analysis, most of our 6 billion co-inhabitants of this planet are not ready to face that blue ribbon, and we are destined for that trash heap of anonymity and obscurity. Perhaps victory and fame shall elude most of us, almost all of us, we band of brothers. As the French slogged through the mud towards their English foes, surely they had some reason to push forward into the face of death to achieve something other than 2nd place. Yet, there is historical precedent for how to deal with the fact that you lost and someone else won. The Japanese have a word for this, seppuku. This is the time honored tradition of facing down your enemy and granting complete victory over you, by virtue of clearing yourself completely from this planet. Something, by the way, you don't try at home without adult The ultimate problem facing the victor is supervision. cleaning up the mess left behind. So first place comes in two parts, the rewards, and the mess.

Thinking again on the rewards of success I remembered this time, long ago, when the business editor of a local newspaper wrote an article about me. I was portrayed as one of the region's hottest up-and-coming entrepreneurs. Somewhere in the article, he made an estimate of my net worth based on records of stock ownership and the current market price for the stock. His information was faulty and he gave me a net worth 10 times what it was at the time, and 300 times what it ultimately came out to be. There I was reading with joy, this moment of victory in my life, until I read that paragraph. There was enough paper money there to advise anyone with an evil heart, that kidnapping my children was a task well worth the exercise. I talked it over with my wife and we discussed, getting an unlisted phone number, hiring a security guard for the kids, adding alarm systems for the house, placing the kids in private school—all manner of possible ramifications from a moment of overinflated public fame. For the first time in my life, I realized that to get the blue ribbon was not necessarily the prize that I'd always dreamed of. With fame and fortune, real or imagined, also come duty and responsibility and risk. Perhaps the risk comes with the territory, but think of it this way, Bill Gates can hire the security guard, have a 40 acre home with fences, dogs, electronic surveillance and have his children home schooled by Yale scholars. I couldn't. In fact, the only thing I could afford at that time was to get an unlisted phone number. Fortunately, my paranoia was never rewarded with an evil act against my family, but for a month I lived in fear of what might have happened.

I think on that day, I realized that sometimes, it's actually better to be somewhere just behind the winning team. If you win the gold, someone covets your gold. If you win the silver, someone covets your sliver. If you win the bronze, well, hell, who wants the bronze other than scrap dealers? And, if you are simply the 1st runner up, you don't even get your name in the paper. On the other hand, being 1st runner up isn't a bad position to be in. There is certainly a sense of accomplishment, a sense of anonymity, and even if you can't display the gold, you can certainly purchase a reasonable replica to show off to close friends.

So staring at that oval stain on the rug, I realized that the cat, best of show for a day, Queen of her house, had given me many things more than a blue ribbon and a certificate. Just the simple fact of her being, the interspecies affection between pet and pet was a simple gift unrecorded and unremembered through eternity. Whilst best of show never threw up on a judge, no judge ever had their lap invaded by this cat when the world seemed cold and distant. They never saw her purr or had her argue with you over whether or not salmon was on her menu for the day. And she, what does she know of ribbons and certificates, she can't even read for God's sake! It's a good certificate, something to show when conversation grows lax. But it says nothing of the real world, where now, I must pull out a pail and a sponge and clean up the gift from best of show. We band of brothers who never get the gold; almost all of us, we happy not so few

Native Dietary Dreams

The key is to learn the basics so cooking isn't a chore. It's really very easy to cook. And with a glass of wine at the end of the day, putting together simple tastes in your kitchen is such a wonderful thing. - Julia Childs

The other day, I was having a conversation with my boss. She comes from a long line of German Catholics. In her office was her executive secretary. Somehow, we got into this long-winded discussion of ancestry. The executive secretary, as it turns out, had ancestors that came to this country on the Mayflower. It seems as if those who traveled on the Mayflower have some special place in the annals of Americana, being able to trace their ancestry back to that hallowed time when a bunch of renegades decided to colonize the Americas in search of religious freedom under the auspices of King James of England.

I sat in the office listening to the extended family linkages binding this executive secretary to the first recorded consumption of wild turkey & eagle (which allegedly tastes like mutton) by Europeans. A brief review of the dietary habits of the time shows that ham, corn on the cob, popcorn, sweet potatoes, cranberry sauce, and pumpkin pie were missing from the first thanksgiving. In retrospect, this is probably no surprise since thanksgiving wasn't really considered a holiday until President Lincoln, in a fit of civil war funk, declared the day a national holiday in 1863 during the darkest year of the war-between-the-states. By Lincoln's time, pumpkin pie was certainly on the list of dietary additions to the traditional American diet of the time, provided that you were living in one of the states of the union or confederacy.

My ancestors, as it turns out, were neither celebrating Thanksgiving, nor dining on the finest of foods, having recently been decimated by smallpox and scratching a living by growing pinto beans and herding alpaca llamas through the wilderness in search of water supplies uncontaminated by the ritual upstream pollution of neighboring tribes. While the children of Plymouth Rock religiously shot muskets at each other in a effort to unite the union and set the slaves free, my ancestors were merrily weaving baskets, crushing pinto beans into paste, and trying to not adorn the trophy belts of the vicious neighboring Yaqui Indians who ran half naked through the desert in search of scalps, ears, and peyote cactus.

Once in an effort to determine my ancestry, my father drove us through the ancestral homeland. I have a memory of small dusty huts nestled almost invisibly against a dusty landscape where mountains had long since been eroded into small hills, and abandoned Spanish missions dotted the landscape as if to proclaim the failure of Christian conversion in the wide deserts of northern Mexico. We drove through small villages where asphalt was road dream of future generations, watched simple people gaze from the shadows of porches, and wondered if the hubcaps would be missing if we actually found a stop sign and slowed the vehicle. It was perhaps a less promising view of history than having had ancestors dining on eagle and oats, but these were *my* ancestors who had signed no Mayflower compact, and had faced no political intrigue since the fall of Teotihuacan, the great pre-Columbian empire that built pyramids to rival the monuments of the Egyptians.

Sitting in that office listening to the Wagnerian exploits of my boss, and the extended family history of her executive secretary, I realized that ancestral roots seemed to be core to the identity of many people. I thought about this as they rambled and remembered that the other side of my family was less native to the world occupied by the ancestors of the Mayflower. They had had entered this country on forged passports in an effort to escape the pogroms of the Czar and in their forgeries had lost all sense of any ritualistic history of who they were or from whence they came. They had not faced down the turkey & dumpling of modern times, but perhaps had dined on simpler fair, the cheese and porridge and pickled herring that came in 50 gallon barrels from the North Sea.

From a dietary point of view, I couldn't quite relate to the ancestry of the Mayflower. Something seemed quite amiss that a band of religious fanatics, destined to obliterate an indigenous culture stretching back thousands of years, was now honored, respected and had somehow imposed it's dietary standards on 240 million people. Perhaps there were festival days in my ancestor's lineage, where people would gather around the largest mud hut in the dessert, and celebrate some annual event, perhaps, failing to starve yet again, or failing to be enshrined on the belt of some mad semi-juvenile warrior a few hills away. I wondered, amidst the discussion of German cuisine and Mayflower cuisine, would my ancestors have recognized these wonders of modern agricultural greatness? Would they have had enough teeth even, to chew?

In many respects, I view myself as perfectly acclimated to my culture. I will celebrate Christmas with a tree and presents. I will eat outrageous quantities of turkey on the appointed day, and perish the thought that I would ever turn down a big Mac super sized with all the trimmings. In a sense, I think of myself as bonded to the internationalism of modern mercantilism. With broad internationalism as my watchword, I can scarf down sushi or mini frosted wheats indifferently. Yet sometimes I wonder, do I have cultural roots, and if I did, would it make me a better human being?

I watched as my boss and her executive secretary cherished their ancestry and commiserated over the difficult times they faced maintaining their cultural heritage. It's so hard to get the recognition one deserves for having ancestors on the Mayflower—so difficult to get proper hasenpfeffer anymore. Why even turkeys today don't taste the way they used to, being pre soaked in buttery marinades with little plastic "I'm cooked" timers stuck in their torsos. I looked at them in some kind of jealous awe, wanting to shout, "Hey, at least your ancestors had teeth and didn't have to suck their nutrients from paste wrapped in dried corn husks."

Greatness and ancestry—the essence of cultural identity and greatness. I remember the foreplay of Alex Halley's **Roots** when he shocked the world by bringing a sense of identity to a society of ex-slaves. Some claimed that with his work, he brought a heritage and identity to 1 in 5 Americans who had been stripped of their identity by generations of brutality and oppression. Thinking like an academic, it matters little that he faked half the material and stole the other half. The key thing that he demonstrated is that identity for many people does not rest with the accomplishments of a life time, but also, and perhaps necessarily, with the actions and deeds of parents, grandparents, and those who came before. There exists perhaps, some genetic element of humanity, which requires ancestor worship to establish that every morning, we can get out of bed, eat our porridge, and face the day. The memories of ancestors guide us on our appointed tasks, and give us the courage to face down the infidel and claim our territory, our rights, and our homeland.

Our homeland. If I were to investigate properly, I would discover that my homeland extends from the northern part of Sonora, Mexico into the southern part of Arizona. With enough genetic markers in play, I could probably reach the level of recognition required by the Bureau of Indian affairs to be declared a native American Indian, entitled to my own territory and nationality, and permitted, even, to open my own casino only a few hundred miles south of Phoenix. Armed thus, I could assert my cultural heritage by fleecing millions of dollars from people who try to avoid the law of averages and in time, build a community of like-minded cultural aficionados living in cultural antiquity. I could restore myself to my native roots and live in a mud hut, drink polluted water, and suck down pinto bean paste on dried cornhusks. This heritage is something that is mine for the reclaiming. Of course, I'd hardly be so stupid. I'd purchase condos in New York, beach-front property in Kauai, and a

small villa on the cliffs of Majorca. Of course, once each year, I'd return to my ancestral home to confirm the casino management and determine what kind of tribal owner's draw would be required in my annual pursuit of tribal roots.

Yet, perhaps, there is something to be said for the boss who can't get a good stewed rabbit or the executive secretary who can't stand the way turkey is prepared before freezing. Perhaps there's more to the quality of the ancestral losses, than the fact of the loss itself. For myself, I can't claim that I would like to return to the era of smashed beans, desert snake, and fried cactus. Perhaps that's a cultural deficiency of mine. If I choose the alternative ancestral tree, I really don't have much interest in oat porridge and picked herring either. There are those, of course, who would claim that I do a disservice to my ancestors, do not respect the efforts they made to place me where I am today. That without my cultural heritage, I am adrift in a sea of uncertainty, without culture, motive, or morals. Perhaps they are right. Sometimes I feel that not knowing my ancestors or failing to respect their hard work has placed me in some kind of special hell reserved for those without firm roots. Usually, I think of this whenever someone who is Jewish sends me a Christmas card. I wonder what kind of cultural turmoil do they face having a 4,000 year-old history that culminates in corned beef & cabbage and Dr. Brown's soda?

Of course cultural heritage is also religious heritage. The Jewish ancestry that is also my heritage often claims to be the first monotheistic religion, provided you discount the sun worship of the discredited Aknahton of Egyptian times. The Catholic boss merely claims her Catholic heritage in her search for stewed rabbit, and the executive secretary claims her rights as an early protestant when she whines about the turkey marinade. Could I too claim religious freedom in asserting my cultural heritage? Doubtful. My ancestors had a bad habit of tossing maidens off a cliff to assuage their angry gods. It is doubtful that I would be granted full freedom to practice my cultural beliefs more than once. In time perhaps, as I have been deprived of my ancestral freedoms, our world will evolve to the point where any religious sacrifice of rabbit and turkey will be deemed equally distasteful in the eyes of the global community. Perhaps, in the end, the vegetarians will rule with an iron fist preaching that yeast and cabbage are the ultimate manifestation of God and the cultural roots of humanity.... That is, until some revolutionary declares that yeast has the evolutionary potential to become sentient.

So I am adrift without culture in a world that demands cultural heritage, assertion of national identity, and questing for the ancestral images that bring us each, in our separate way, to our vision of home. For me, I'll skip the hasenpfeffer and beans for now. Rootless, it is my time to celebrate variety without claiming identity, time to plan dinner with sushi, dumplings and haggis.

Perfect People – Perfect Teeth

Whenever I'm caught between two evils, I take the one I've never tried. -- Mae West All women are born evil. Some just realize their potential later in life than others. -- Chad A. Gamble

I have a friend who is perfect. At least, that's what she tells me. She has the perfect marriage, the perfect family, the perfect body, the perfect job, and the perfect balance of life. She accomplishes tasks on time, on budget, and there is no one on this planet that can measure up to her standards of perfection. In a sense, it is a shame that a perfect person lives in such an imperfect world. I on the other hand, am full of imperfections, which perhaps accounts for why I am her friend. I provide a benchmark against which she can explore the primal balance between good and evil.

Culturally, we can trace the battle of good vs. evil to the Garden of Eden. Here the evil serpent first battled the good God in dominating the minds of the simple people, Adam and Eve. In biting the forbidden apple in the garden, Adam and Eve were duped and thereby learned to be ashamed, which became the first incidence of evil. Shame. What an interesting entrée to the definition of evil. Whilst they were otherwise traipsing around the Garden of Eden, munching on guava, papaya, and apricots, they suddenly discovered after untold eons of being the garden's stewards, that they were naked. Suddenly, being aware of the inherent evil in being they scrambled naked. around for appropriate

undergarments. What has always bothered me about this story is that nothing changes for this blissful couple, except for their awareness. When they become aware that they are naked, when they become aware that nakedness is evil, suddenly they have to take action. Prior to that point, there is no evil.

This has always made me wonder if, in the natural world, without awareness there might be no place for the existence of good or evil. The issue only arises if we become duped by the serpent and thereby suddenly become aware of evil around us, starting of course, with ourselves. When I take a shower each morning, and look at my uncovered loins, I try to understand what inherent evil there is in Mr. Happy. From the point of view of washing at least, it's just another one of those strange body parts that doesn't rinse as easily. Of course, there's some implicit requirement that after I leave the shower, I have to cover my crotch. If I think of this merely as a protective measure, keeping me from freezing Mr. Happy into a midriff icicle, perhaps the multiple layers of thermal insulation make sense. On the other hand, of the many times in my life where parts of my body were freezing, I can cite cold nose, cold toes, cold ears, cold hands, but not once did Mr. Happy feel the bite of winter.

Perhaps then, the evil resides in some other aspect. If not the thermal properties, perhaps there is something of a more sinister nature in the midriff. When I think of the public nature of evil, one common theme is that to slay one's neighbor is generally considered a sign of bad character. That made me wonder if there is latent homicide potential in my most evil of body parts. As an experiment one day, I attempted to grip various tools of violence with Mr. Happy, a hammer, a knife, and a 12-gauge shotgun. I was forlornly left with the conviction that, try as I might, I was unable to use this appendage in support of the most violent of acts. The thought of engaging in mortal combat gripping a battleaxe with Mr. Happy, made me convinced that the only means I had to slay my foes was to drive them into hysterical fits of laughter from which they might fail to recover.

Therefore, the logic of Adam hiding Mr. Happy with a fig leaf in the Garden of Eden continues to escape me. Exactly what kind of evil are we talking about that Adam and Eve had to conceal having been granted the ability to know evil? Could it be that the ability to engage in sex is the evil to be concealed? At this time, immediately ano serpent (a.s. vs. b.s. - before serpent) it's not clear if Adam & Eve had yet figured out what to do with their respective body parts. In fact, it is doubtful that they had time to discover the missionary position, most time being spent on fashioning fig leaves and string bikinis. So it is likely that they had no time to perform the "evil deed" prior to God's observation that they were style conscious and sorely lacking access to or credit at the Garden's Macys. So it could only be in anticipation of evil acts, that they were cast forth from the garden, prior to actually committing any acts of sexual violence.

Thus, I come back to the earlier assertion that the world, in the absence of awareness, has no intrinsic good or evil. In fact it would seem that good and evil exists mostly in the anticipation of acts, rather than in the acts themselves. On the other hand, if I tried to live my life as if there was no good or evil, and if I did whatever came to mind, in a short period of time I would probably be branded as some kind of pathological personality, and incarcerated for securing my position on the bus by executing some little old blue-haired lady who happened to be occupying the seat that I'd chosen for myself. Man in the wild that I might be, Uzi in hand, I'm certain that I would gladly pop an old lady between the eyes to secure my rightful place in the world of city bussing. Society of course, would have no course but to brand me as evil, incarcerate me, and spend \$20 million accelerating my removal from this world. But, since Genesis teaches us that evil occurs in the *anticipation*, long before I ice the old lady, if I am rational, can't I just go to the D.A. and say, "I've got a deal for you. Give me \$5 million, and I won't pop an old lady on the bus, I'll save you \$15 million, and I'll stay out of your way for the rest of my life." I guess that won't work either.

The question of course is, would I casually secure my seat on the bus through violent means if I were unaware that there was such a thing as good and evil? Our society seems to believe that for every action I take, there is a choice leading to that action—a constant balancing act of choosing between doing good and doing evil. It's almost as if I must be in constant battle with myself, saying, "is it right to blow away a blue haired matron to secure a seat on the bus, or should I stand here, in perpetuation of eternal good and hang from the slimy gripping bars?" I have never actually had to confront myself balanced between such choices. My brain seems to not function in the manner it is supposed to function. The thought disturbs me, because I tend to regard the blue haired lady more as an immovable boulder in *my* Garden, too heavy to roll, than a moral dilemma which balances me between right and wrong. On the other hand, it disturbs me to think that there may be others on that bus who wishing to get off at the next stop, struggle with the choice between bustling past me with a curt "excuse me" vs. firing a few rounds in my general direction to clear their path. Perhaps this is why I ride the bus so rarely.

If my perfect friend is correct, my dilemma at having no dilemma is merely a clear sign of my total lack of moral character. Ah yes, moral character. I try to think back on His beloved Eve has just handed him the poor Adam. forbidden apple. He's taken a bite. He's smiling, he's happy, and then the big cheese comes down and says, "Hey buddy, you're outta here!" Adam's going, "huh? I did what? She did what?" The serpent's wandering around, presumably on legs at this point going, "gotcha!" Now this may be a clear sign of my moral turpitude, but at a time like that, don't you think that you'd say to God, "You expect me to be suspicious of everything she feeds me? Like 'Eve, where did you get this food, the 7-11 or the serpent?' Hey, she only cost me a rib. I've got spares. We can make another one. Banish her, I'll be fine. You can have my fig leaf as a memento. Can I go back to the garden now? And to avoid any future misunderstandings, would you please move that tree?"

Since I clearly am having a problem figuring out what evil is, maybe I should consider what good is instead. After all, I have a perfect friend with perfect teeth with perfect morals. Such a friend is obviously, a Godsend. So back I go into Genesis, to find out when it was that Adam & Eve were good. Well, Genesis is a bit less revealing about the actions of Adam & Eve when they were good folks. They ran around naked, apparently tending the garden, not really doing much of anything. If they had simply sat in the sun all day, munching on pears and bananas, we wouldn't have a story of creation. In fact, none of us would be here to contemplate good and evil. Instead, there would be a perpetually young couple trying to avoid eating apples, unaware of the sin of Pampers, perhaps advanced to the stage of the pan flute, and preparing to tame fire. In this idyllic Garden of Eden, by what deeds would we know their goodness? Adam and Eve are not healing cripples, bringing sight to the blind, or feeding the starving. There are no food shelves to be stocked, no pollution, no traffic, and most miraculous of all, no lawyers. The happy couple is found most of the time lounging on infinite expanses of a sandy beach that gently slopes into sharkless, perpetually calm, wave free water. Keeping in mind the 35% of all Americans are afraid to die because they believe that heaven would be boring, we can get a sense of the true essence of this realm of perpetual goodness and tranquility. Perhaps perfection of goodness is found in the total lack of action, to wit, good is boring.

Well, if that's the case, then perhaps the epitome of good can be found in billion-year-old granite. Immobile, unmoving, harmless sheets of ancient magma may represent the ultimate goodness. My perfect friend, for example, might be good not by what it is she does, but rather by virtue of the fact of how little she does. Like immobile basalt, perhaps her virtue lies in her total inability to move in any direction. Now if I were to ask this perfect person, "is she good because she does nothing?" she would certainly find that a ridiculous assertion. Her goodness, to her, resides in all the good things she does, none of which resemble in the slightest the attributes of a field of rocks. Further, it is not the *anticipation* of doing good that counts; it is the *act* of doing good that counts. To be good, she has to sing in church, pray in church, educate her children in the ways of the church, give 10% of everything she owns to the church, work in the community with those less fortunate, and drive around town at or below the posted speed limit. My, what a contrast from evil. With evil, all you have to do is *think*, and you've sinned. With good, good intentions are hardly sufficient. You have to *do* something.

So what I have with goodness is a contradiction. The ultimate good, as taught in Genesis, is a rather bland state of being. The ultimate good, as taught by the perfect friend, is in the never ending frenzy of finding worthy causes, and taking actions that make changes for the better. I have only lingering doubts what it means to be bad. Nevertheless, I'm somewhat confused over what it takes to be good. Perhaps I need to sit quietly, like granite, and wait until that vital moment when I get a calling to help that blue haired old lady off the bus.

Wax On, Wax off

But since I, after having been admonished by this Holy Office entirely to abandon the false opinion that the Sun was the centre of the universe and immoveable, and that the Earth was not the centre of the same and that it moved, ... I have been judged vehemently suspected of heresy, that is, of having held and believed that the Sun is the centre of the universe and immoveable, and that the Earth is not the centre of the same, and that it does move.

- Confession of Galileo Gallilei before the Tribunal of the Supreme Inquisition, June 22, 1633

Ever since I was a small boy, I wanted to be abducted by aliens. I think the urge came from a strong desire to see the world from a high vantage coupled with a strong desire to gag every time I confronted the food at the school cafeteria. I think I figured that the food couldn't be any worse, and if they ever let me out of the holding pen, I could be reasonably well behaved and a good tourist. I remember walking out into the backyard at night with a flashlight and wearing down the batteries sending out flashes of Morse code in the pattern ...

Needless to say, I never got a free tour of the solar system or the lesser magellanic cloud in spite of my best efforts. However, I did go through a lot of batteries.

Unlike others I later encountered, I never went to extremes to achieve my goal of being wafted away from the planet. For some reason, I managed to avoid wrapping tin foil around my skull (to protect myself from eloptic radiation), nor did I run yards of fine copper wire through my underwear (to equalize the flow of synergetic particle beams). In fact, by the time I became an adolescent I gave up the basics of the dream and even, in more recent days, completely neglected to put the SETI screen saver on my home PC. I was recently saddened to read that the various UFO cults seem to be dying off for lack of any tangible results beyond crop circles and a never-ending influx of nocturnal lights over Mexico City, undoubtedly enhanced by the air quality of the city and the effects of carbon monoxide on the brain and camcorder electronics. Sadly many of the mysteries of the world seem to be ignored as time marches forward. As a civilization, we know too damned much. We know how DNA replicates, we know how atoms work, and we know how the planets are formed.... Well, almost.

Yesterday, I was reading an article in a magazine about how Jupiter's moons may *not* be a very good model of our solar system. Oh, the positive signs are all there... the moons of Jupiter orbit in the same plane as the planetary spin just like the planets orbit the sun.... The moons' orbits seem to match... and even the direction of rotation is counterclockwise when viewed from the pole. However, the mass distribution is wrong. I was considering the concept of mass distribution when my eyes came back to a particular word in the article... *Counterclockwise*? I wonder if the planets and moons are aware that it is better to go counterclockwise than clockwise? What an amazing concept to consider. To think, there must have been a time in our history where there were clocks that made *clockwise* and *counterclockwise* emerge from nothingness. Yet, 5 billion years before the first clock, the planets already knew which direction to choose.

I decided it was important to understand the cosmological meaning of clockwise, so I went in search of the origin of this obscure yet fundamental concept. I immediately discovered that toilets flush clockwise in the Northern and counterclockwise in Hemisphere the Southern Hemisphere. For some reason, this is an important lesson in most high-school science curricula. I spent about 20 minutes flushing to see if this was true. Living in the Northern Hemisphere, I saw it flush clockwise and never once saw it flush counterclockwise. I don't know anyone south of the equator that I could have called to ask if they could flush at the same time to see if we could simultaneously observe this mystery. Careful (gloved) investigation with my hand was unable to find any particular irregularity at the bottom of the bowl that might force flushing in one direction or the other. However, noting which way the toilet water flushes is not the answer to which way is clockwise and which is not. To discover more, I did further research into the history of clockedness

It turns out that clockwise is probably an invention Northern Hemisphere peoples. If you go back in time to when people tried to determine the time-of-day by the sun, you can swiftly discover that if you jab a pointed stick into the ground, the shadow from the stick will follow a daily pattern from which you can determine what time it is. In the Northern Hemisphere, the shadow will go in a clockwise direction. In the Southern Hemisphere, the shadow will go in a counterclockwise direction. Near the equator, well, it depends on which season it is. This makes me suspect that there may be some aspect of aortal blood flow that drives blood to the brain differently north of the equator than south of the equator. Since we know that toilets flush differently north of the equator than south, certainly other fluids move in a similar manner. This difference in blood flow may alter the brain-making northern peoples more time aware than However, there may be southern peoples. another possibility. Keeping in mind that early-humans radiated out of Africa (counterclockwise toilets) it seems strange that early civilizations seem to have arisen only when they passed north of the equator (clockwise toilets). Of course, if you think about the geography of the situation, anyone who turned left (counterclockwise) would eventually hit the ocean. Anyone who went straight would eventually hit a glacier. Only those who turned right (clockwise) would have the freedom to roam the broad expanses of Asia for many Perhaps there was a predisposition to go generations. clockwise which was genetically ingrained into the survivors of the initial radiation of human populations.

In any event, by the 1600s when Galileo stole the design for a crude telescope from a Dutch eyeglass maker, the world had pretty much determined which way was clockwise and which way was counterclockwise. Now some claim that Galileo invented the telescope, while more enterprising historians claim Hans Lippershey, actually invented the

Few of course know that around 1277, the telescope. Englishman Roger Bacon, was imprisoned for suspicion of promoting dangerous novelties, one of which was a telescope. The thought of being imprisoned for promoting dangerous novelties brings to mind a cornucopia of possibilities that could be wrung out of the rule of law. Given that the Catholic Church had developed 1,000 years of legal precedent before locking up Roger, by the time Galileo came along with his heresies, 300 years of additional legal precedent existed which gently permitted Galileo to avoid the rack and instead live under house arrest where he calmly burned out his retina mapping sunspots (which also move counterclockwise when viewed from the pole). What is not clear from Inquisition records is whether his toilet flushed clockwise or counterclockwise

In all likelihood, Galileo wished that he too could be abducted by aliens. The Inquisition was somewhat tamer in his era compared to earlier eras, and he was merely accused of heresy, something that he could set straight by lying through his teeth. However, this was an era where wrong thinking could get you barbecued, which, I am told, is not the best way to spend your afternoon in public places. Needless to say, Galileo was no dummy and he took back every heretical word that he'd spoken and written and avoided becoming a public spectacle. But as he sat in the chamber, listening to his prosecutors, I'm sure he looked longingly at the heavens and hoped for a visit from the moons of Jupiter, or perhaps Roswell. Instead of rescue, he recanted, and thereby entered the history books as having committed the sin of telling it the way it is.

Of course, most people don't bother to notice that he proposed that the planets that circled the sun orbited in circles. This model worked rather poorly, more poorly than the then accepted Ptolemaic model that said the earth was at the center of the universe. In retrospect, Galileo might not have been tried because he said the Sun was the center of the universe, in today's world, he would have been tried because his model worked so poorly. It wasn't until the next century when Newton came up with elliptical orbits and clinched the sun centric model, which, of course, also was wrong. Newton, however, suffered from the ultimate punishment. Not only did he spend years studying calculus, he actually invented calculus. Any high school student knows something of the calculus horror that Newton must have endured

In fact, most high-school students have a culturally ingrained sense of which way is clockwise and which way is counter-clockwise. Any student who has seen the movie *The Karate Kid* knows that "Wax On" is clockwise and "Wax Off" is counterclockwise. These students know that mastery of both clockwise and counterclockwise is the only true path to getting the girl and having the time to trim small trees that grow in clay pots. Few if any will consider the deeper universal meaning that imprisoned Galileo and guided early hominids out of the Serengeti. But then, they too may someday look up to the sky with flashlight in hand saying quietly "here I am, come get me."

Tinker Toys

Suddenly I felt heat on the side of my head toward the tower, opened my eyes and saw a brilliant yellow-white light all around. The heat and light were as though the sun had just come out with unusual brilliance. About a second later I turned to look at the tower through the dark welding glass. A tremendous cloud of smoke was pouring upwards, some parts having brilliant red and yellow colors, like clouds at sunset. These parts kept folding over and over like dough in a mixing bowl. At this time I believe I exclaimed, "My god, it worked!" -K. Greisen Eyewitness account of the Trinity shot

Earlier today, in the ubiquitous charnel house of the Internet, someone mailed me a personality test intended to tell me which sesame street cartoon character most closely matched my personality. I dutifully took the test, summed up the scores, and discovered that my personality type is the same as Elmo. I looked at that result for about 5 minutes, trying to figure out how my life was now set on a better path, having discovered that I resembled a red fuzzed fictional puppet of doubtful ancestry. For some time I tried to figure out that if I dyed my hair red, gave myself rounded jovial jowls, and started speaking in a funny off pitch accent, reciting vowels and consonants with great determination, would I at last find my true calling and identity? I tried to imagine bouncing down the street saying "hello" to strangers, and standing at a bus stop chanting, "A-E-I-O-U" and singing little ditties about cows. In the end, I decided that irrespective of the test score, the Tao of Elmo was not on my path to enlightenment.

As I relaxed for a bit, I remembered a different test I'd taken a decade previously, the Minnesota Multiphasic Personality Inventory (MMPI). Now there is a test that reports scores. I actually kept a copy of mine and pulled it out to see if there were any clues to Elmoism hidden in the peaks and valleys showing my deviations from the norm. I remember sitting across from a clinical psychologist who was explaining how to interpret my scores at the time. She said, "You're a paranoid psychodeviational sensitive newage kinda guy." That sounded pretty bad at the time. Who wants to be paranoid and psychodeviational? Sounds like a prescription for a lifetime berth in a mental ward or something you bring up in your own defense at your trial for murder one Paranoid. Exhibiting or characterized by irrational fear or distrust of others. extreme and Psychodeviational: Turning away from the normal course of the mind. "Hi mom, nice day, like my knife?" We spent about an hour exploring these test scores and what they meant. It seems like I had scores that were within 1 standard deviation of the norm (66% of the population shares those scores). It seems like I was paranoid because I had answered several questions like, "do you think someone is trying to steal your ideas?" to the affirmative. At the time, my company was in the process of litigating the infringement of one of my patents, so I felt mildly justified answering "yes."

The psychodeviational score was elevated due to "excessive family discord," meaning, I was responding to a failing marriage quite normally. The upshot, according to my psychologist, was they weren't going to come after me with nets any time soon, and I'd need a world class defense attorney if I planned to dispatch any of my neighbors. In retrospect, the MMPI hadn't provided a path to enlightenment any more than my encounter with Elmo.

Two things stood out as I was contemplating my paranoid psychodeviational sensitive new-age kinda guy, alias, Elmo style personality. First, none of the testing had really made any difference in the course of my life. Second, there was no lack of people willing to come up with tests to help me neatly quantify myself and find the identity I otherwise might never have. I remember at one time, I was curious to find out what my I.Q. was. I went in search of the appropriate intelligence test to discover this crucial score, which might permit me to properly select between corner booths in bars labeled "Mensa only" and "normals." My search ran dry when I found I had only 800 tests to choose from. That made my decision easy. No corner booths—Bar stools only. Hell, who has time to read in a bar?

My reverie was broken by another thought that seemed to dribble up through the great tar pits of my mind. It was a memory, somewhere, that someone, somewhere, sometime, had won a Nobel Prize for developing the procedure used in a lobotomy. A little research and bingo—in 1949, Dr. Antônio Egas Moniz was awarded the Nobel Prize for Medicine and Physiology, in recognition of his creation of the prefrontal leucotomy. This is a procedure in which the connections between the prefrontal and frontal cortex of the brain are permanently severed from the thalamus. Basically kinda like taking a chain saw into the middle of a computer room and whacking away until the Nimda virus stops spreading. On the other hand, he *did* win a Nobel Prize. I think he got the prize, not so much because he solved all manner of mental problems, but rather, because his process had measurable and real and effective results. (Don't ask me about the *goodness* of the results, that's a different topic.)

It dawned on me that there were two kinds of extremes here. On one hand, there were psychological tests that said a lot about people, but not in any way that made a difference to the people taking the tests. On the other hand, there were psychological practices that did things to people that made a big difference to people. I wondered, what would happen if there were a psychological test that actually was meaningful and actually resulted in someone doing something different. History is full of examples of tests which people use to do things to people. I.Q. tests were used to set immigration quotas at one time. Bunches of tests exist to determine if people have learning disabilities that are used to place them in special education programs. The military has a battery of tests that are used to separate killer wannabes from baby killers. Clearly, there are lots of cases where psychological tests are used to determine what people are permitted or not permitted to do.

I looked further for something that would permit people to make decisions about their own lives based on test results. I found one. Flip on that tired computer of yours and go to http://www.tarot.com. Here, you can find a test that may change the course of your life. Me, I got the Ten of Wands, Ace of Swords, and Six of Cups. The outcome of that was that I calmly put down the leg of lamb I was going to roast for dinner and ordered pizza instead. See? It works. I'm not sure exactly what was measured, but the fact that my diet immediately changed convinced me that, whatever this test measures, it had real consequences that far exceed the power of the MMPI and any 50 other tests combined. It even exceeded the consequences of being granted an Elmo like personality profile (which by the way, convinced me to never purchase a Muppet as long as I live).

I started wondering what would happen, if someone came up with a real test that actually convinced people that they should change their lives. My academic memories recalled this guy, B.F. Skinner, who had the gall to publish a book called *The Science of Human Behavior*. In this book, B.F. had the idea that it might be possible to *scientifically* manage what we do. I had to think about that a bit. For some reason, I had to consider the difference between science and technology. If you are scientific about something, you kinda discover how things work, but you don't necessarily actually *do* anything. If you are technological about something, you kinda make things different by building a machine, whacking a starter motor with a hammer, or playing with a few isotopes.

It was Buddha who said,"All that we are is the result of what we have thought." This is perhaps the original "you are what you eat" statement. Let's assume that history's most famous fat man was right, that you become what you think. Now that could be an amazing experience. I have mental images of the little train that could actually puffing up that hill, going down the other side, and getting a full scholarship at Dartmouth. Charles Manson could walk through the bars and become a TV evangelist. And I? I could become Bill Gates, retire, buy Majorca and practice my telemarketing skills between orgies. Hmmm, I wonder though, did Buddha have in mind that we could all become our own jinni? Probably not, although rumor has it that he did know when and how to have a good time, between enlightenments.

Picture if you will, a different time. Instead of referring to a book called *The Science of Human Behavior*, we refer to a book entitled The Technology of Human Behavior. Picture also, the same intensity and dedication given to the development of a secret government program modeled after the Manhattan project, in which the most brilliant psychologists of the world spend thousands of man years creating a psychological test that actually means something to the person taking the test. Comes the moment where in the high desert we come to the time when the first test is given. The subject looks up from the table, closes the book, and waits for the scores. The scores come back and the subject realizes that he can now, thanks to the test, totally change his world. Before vanishing into thin air, the subject looks to his fellow researchers and says, "My god, it worked!"

Confessions of a Guilty Entrepreneur

Management is doing things right; leadership is doing the right things. Peter F. Drucker

Being a manager has its moments of terror. When someone you supervise suddenly doubts your ability to be their manager, you kind of sit there staring at this expectant expression in their eyes and wonder if you're supposed to come up with something profound that justifies your existence, or if you should simply give them some task that will make them vacate your office so you can get back to sleep. Or maybe you should do something to enrich their life and make them feel like you actually know what you're doing and really do belong in charge. The other day, one of my managers gave me this indirect sort of speech that went something like, "with all due respect, I don't think you know what the hell you're doing." In the business world, that is a moment of truth where a manager either takes charge, or loses control and resigns leaving the subordinate to take over and manage whatever it is you're supposed to be managing. I thought about it for a long moment, while the expression in my subordinate's eyes went from righteous anger to fear of what I might do. Perhaps a full 15 seconds passed before I responded with a friendly remark that went something like, "I think I've had about 20 years more experience than you, but if you have a better idea, please tell me more." Deferring to another's ideas after first establishing that you're the

grizzled old fart has usually worked for me. In this case, the subordinate, who probably *can* do a better job than me, looked at me with a measure of relief, probably remembering that her performance review is due in a month and asked with great seriousness, "what makes you so successful?" In the distant past, I would field the question with embarrassment and say that I wasn't successful, or that I was lucky, or that it was none of their business, but when you have to fit into the role of guiding someone through the rocky landscape of a corporate life, you sometimes realize that what you want to do, and what you should do, are two different things. Over the years, I've learned that my opinions really don't matter much. In fact, opinions are nothing more than the anchor someone else uses to confront you six months or a year down the road when they whisper, "do you know what he said last spring?" It's a kind of political thing I guess, to expose oneself with opinion from the heart, and the remedy I've learned is to never expose yourself by expressing your real opinion. The truth is all that really matters in corporate being whereas opinions are just noise. The truth of the day that is, provided the company is expanding. When it's contracting and layoffs and pink slips abound, the truth changes with the tides. I keep thinking every Easter, when I read the story of the crucifixion of Jesus, that he must have been a renegade executive from a fortune 500 company. When asked, "What is truth?" he had no answer, or perhaps he realized that he'd be dead long before he'd be able to finish the answer. If my subordinate had asked me "what is truth?" I might have simply sat there

thinking of all the possible answers, but she spared me a really hard question.

So I listened to the question my subordinate had asked, "What makes you so successful?" What she was looking for was an answer that would help her out of whatever doldrums she'd found herself in, and by asking me, she might find an answer that would guide her on a course through life under my tutelage that would help her become the success that she imagined I was. I have long since learned that what I think counts less than what she wanted to hear, and I have always been afraid that if I give advice, someone might follow it. If they follow my advice I might be cursed through eternity with the additional negative karma points I'd receive from having directed them down some path that ends with their conviction as a mass murderer of children in some water theme park. So in time, to avoid being a character witness at a homicide trial, I have come up with an answer that no one could ever use to select a path to follow based on my advice. So when she asked, "what makes you so successful?" I answered, "Bill Gates and I were together in Albuquerque."

It's not something most people can aspire to duplicate having been with Bill Gates at the beginning of Microsoft. In fact, it shuts the conversation up swiftly and I don't have to pontificate on the many issues of corporate management that I know nothing about. In this case, it worked as it has worked so many times before. She looked at me with the fear receding and contemplated the possibility that her boss might actually be someone who knew something, and certainly someone. She muttered a muffled "oh," and exited my office without another word. Now in retrospect, I'm sure that 800 people heard this story over the next few days, and perhaps that accounts for the anonymous e-mail messages I started receiving, starting off something like, "could you loan me a billion dollars," or "is it true that Bill is gay?" But I've faced the concept of stretching reality in the past, and at least some of the time, I've lived. In this case, what I said to her actually was true, well, considering my careful use of In fact, it is true in a sense that Bill and I were words. together in Albuquerque, insofar as two people can be together sharing a city with 100,000 other people who are together in the sense of being together in the spirit of community. The truth is I lived in Albuquerque at the same time that Bill Gates lived in Albuquerque. The truth also is, I never met him, knew of him, and had I met him; I probably would have ignored him completely unless he offered me a free meal when the greatest fantasy of my life was to eat a 24 inch long submarine sandwich. Yes, Bill and I were together, well, close, well, separated by perhaps 3 miles for over a year and we undoubtedly shared the same times cursing the summer heat that Albuquerque suffers in the summers. Perhaps we even listened to the same cicadas crackling in the trees in search of their mates a few branches away. Bill and I even shared similar interests at that time. He was creating the first generation of software for the first generation of personal computers, while I was creating the third generation of software for the third generation of main He leveraged his software into a monolithic frames economic force unequaled in the world. I leveraged mine into free housing in a university office building, sleeping on the floor in my sleeping bag, dreaming of a massive

submarine sandwich, lots of processed meat, onions, mustard.....mmmmm.... while I slept on the linoleum of a university office. Bill and I also left Albuquerque at about the same time. He went northwest. I went northeast. Perhaps this final choice in direction is why Bill is worth many billions of dollars and I'm worth almost enough to retire to a trailer court in 20 or 30 years.

So I didn't actually lie when I told her that my success is in some way due to Bill Gates, but I didn't have to explain that what she thinks of as my success does not necessarily mean that I feel successful. As she left my office, I realized that in some strange way, I must be successful. I can eat what I want. I have a good paying job. I have traveled the In fact, I have more electronic gadgets than I world. remember how to operate, and if I didn't have a daughter whose brain functions better than mine, I might never manage to cope with the remote control of the various things that seem to click on and off like magic. Heck, the fact that I have a daughter who's never been pregnant or arrested, or been implicated in selling drugs by itself is a measure of success. On the other hand, she has done some interesting things that we'll get to later.

As she left and closed my office door behind her, I wondered why it is some people think of what I do as successful. Perhaps it is simply that I have an office with a door that can close. It's not that I close it very often. I used to close it during a romantic episode in my life so I would whisper sweet nothings into the ear of my beloved. But closing a door is also a corporate sign of cutting yourself off from your employees, so I leave it open, if only to get a sense of who is flirting with whom. That alone is enough to make me want to close the door sometimes... seeing two people start snuggling up to each other with future disaster and life-long anguish written all over the wandering hands that are supposed to be extracting documents from the workgroup printer. But having a door that can be closed is some measure of success. So as she closed the door to my office. I wondered what it is I have that made her think that I was successful. I think the answer is that if I have a gift, it might be the ability to drill down into the core of a complex subject and extract from it the essentials that permit me to pontificate about the subject as if I am the master of knowledge. Of course, those who actually know something about the subject invariably try to educate me from my childish ignorance. But I avoid those people who actually know something, since if I had to go through the effort to learn something again, I'm not sure I could retain the remnants of an ego that permit me to exude the aura of competence and knowledge that I usually drip like sweat from an aerobic instructor's headband. On the other hand, those who master a subject often get caught up in the complexity of detail and never really quite get to the point where they can make a simple statement about a complex subject. I know this to be true. Once, I was a true expert who knew a lot about a subject. I got better. I'm almost cured.

If I were to answer her question honestly, "what makes you successful?" the answer would have been, "body odor." I really don't think that would have helped either of us, to tell her the truth. In fact thinking of Jesus contemplating how to answer, "What is truth," I realized that the discussion of a simple 2 words answer, "body odor," would lead to hours of discussion, and in a group of 800 employees would probably suck up a good man year of lost productivity within a week. But you see, success, whatever its form comes from some kind of process that results in the taking of an action that makes a change. Some people are born lucky. They win lotteries and spend money and lose friends and end up spending most of their winnings in group therapy sessions with psychologists specializing in mental diseases of the obscenely rich. I on the other hand, am not lucky. I'm someone who has to actually think before I do something. Something I learned long ago is that you can't just turn your brain on and off like a light switch. A brain is a precious commodity for me, and I have learned to never leave home without one. But I truly don't control the strange things that happen inside of my brain when I'm not paying attention. I really don't have much control over what my brain does, except for one special occasion. When I'm in the shower, I actually have the ability to say, "Now I'm going to think about something." And I do. And it works. So in truth, if I never took a shower, I'd never think. If I didn't suffer from body odor, I'd never take a shower. So the true answer must be simply, "I am successful because of body odor."

Of course, how do you measure success? I think Shakespeare once suggested that in the end, we are all worm food... or was that the economist John Maynard Keynes? Hard to know, since I really don't know much about anything. But the truth is, whatever constitutes success to one person, may be the most horrid failure to another. So I
contend that success is in the eye of the beholder. Let me suggest an analogy just to keep the suspense rolling. My brother once sat me down and looked at me and said, "So, you think you're so smart?" I said nothing, knowing full well that his math grades were better than mine. He went on, "well you know, a genius is nothing more than 1 in 100 Which means, in the United States, if you're a people. genius you're one of 2 million people. In the world, you're one of 60 million. What the heck makes you think you're so special?" I thought about that for a long time. In the shower He's right. Anyone who thinks that they're of course. special has lots of almost identical company thinking they're special too. In the end of course, we get our measure of earth, six feet deep, and get a common exposure to embalming fluids and worms, so we become, again as Shakespeare said, "equal." So success, at best, is a transient event that is sort of like the spattering sound a drop of water makes in a hot frying pan. It gets your attention for a moment, and then it sputters and vanishes in a puff of steam.

Most people that I hang out with, and I usually don't hang out with them by choice, think that success is measured by relative economics which basically means, if you can buy something at a higher price than I can, then your ability to spend means you are more successful than I am. This concept of success has both its merit and demerit. Most Americans can spend more than 98% of the rest of the human race, which suggests that most Americans are successful. On the other hand, most Americans have the moral turpitude of a hyena, which means if you have some concept of value, such as morality, Americans may be near the bottom of the dung heap. But since I am an American by birth, I tend to go with the culture of my birth, and readily embrace the idea that if I earn more money than you, I must be more successful than you, even if you're happy when you go home to your wife, and I'm afraid to go home because there's this big gaping hole that has to be filled with quality scotch, DVDs, and a computer that has an infinite ability to take verbal abuse. On the other hand the measure of success may not be money. I often think of the idea of a loving couple in a grass hut on the beach on Bora Bora earning \$50 each month catching fish, who crawl under the blanket each night and make passionate love to the sound of waves and their children at play. Standards differ depending upon what you value. I want the hut. I have the income.

Life paths... That's another concept that goes into the divination of success. Humans create a universe unique to themselves, which somehow creates a focus for all that they do for all time. Someone once told me that what you do is what you are. I thought about that for months before I decided that that person needed some serious reconstructive surgery for her brain. What most people do most of the time is eat, sleep, find cheap entertainment, labor at their job, have sex, and do the same things day after day after day. If people are what they do then they are some kind of mechanistic creature doomed to repetitively boring tasks day after day. I think that most of the things that people do are based on managing the requirements of surviving whatever cards they have been dealt. Their self-image, of course, is different. A fat lady who thinks of herself as a petite ballerina is not delusional by any means. She's merely

trapped in a pattern in the physical world that won't let her be herself. While she dreams of dancing Swan Lake at the MET, do we have the right to judge her and condemn her to the fat farm as her identity? She may be hurting inside because we, on the outside, can't picture her bounding across the stage without bounding through the stage into the orchestra pit below. Our humor becomes her tragedy when we judge her by weight and consumption of bratwurst—we will never see who the person really is if we look simply at what they do. But judging others is what we do best, so through that judgment comes our standards of success.

So success is a judgment presented to us by others about ourselves, yet if I were the judge of my life I would declare it a success because at one time, I did something that saves thousands of human beings each year from total annihilation through violence. On the other hand, I never met one of those people that I saved and the story, which you'll learn later, is so esoteric that most people would change channels before I got too far into the story. I feel fortunate, though, because I have long since decided that I will be the only judge of my success by my own measures, and I'll be damned if I'll let someone else tell me if I'm successful even if it means living in a cardboard box under a bridge. For me, all I have to do is sometimes in the shower tell myself, "you done good." Perhaps in the final analysis, the ability to say to oneself, "you done good," is the only valid standard of success.

The point of all of this, however, is to tell a story of sorts. Not to spend countless words in an analysis of the psyche or the relative merits of stock ownership, corporate largess, or meals consumed on company expense accounts. The point of all of this is to tell a story of what it means to succeed in business without really trying. To that end, I have an interesting tale, starting from the time when Bill Gates and I shared the turf of the easily forgotten Menaul Boulevard, to the time in present day, where I can show what paths work, and fail to work, for those who seek strength and honor in the gladiatorial pits of the modern combat of corporate life. A tale, perhaps, that gives the young entrepreneur a vision of what pitfalls await while practicing to be the largest ballerina at the MET. In short, this is a story of how to follow your dreams, and how to select ones that give a measure of personal success, irrespective of who thinks you should have done something differently.

Let us begin with a story of a time, perhaps 30 years ago, when I had long hair, a mustache, and a vision of reality shared by a million other male adolescents who found their draft lottery numbers to be in that magic line separating them from life and death. Let's return to that ancient time, and how I became obsessed with Heinz Catsup. Heinz 57 to be precise, for that was my lottery number in an era where mortal combat was not a choice, but an obligation.

Draft Dodging

The one bonus of not lifting the ban on gays in the military is that the next time the government mandates a draft we can all declare homosexuality instead of running off to Canada. Lorne Bloch

Most of us think of the draft as a cold wind that makes you uncomfortable. To some of us, the draft is a more scary The basic concept behind a draft is that your idea. government sends you a nice note advising you that they have volunteered you to serve your nation as a member of the nation's combat forces. What this means, is you show up, get trained to shoot a gun, and if times are bad, you get killed. Drafts have been with civilization for upwards of, well, since people started bashing each other over the head with clubs. Most Americans hardly remember that a draft exists, since it's been over a quarter of a century since anyone was drafted. In fact, the last draft in the United States was in 1973. Prior to that, the draft had nabbed 2 $\frac{1}{2}$ million volunteers in World War I, 10 million volunteers in World War II, and a paltry 1.8 million volunteers during the Vietnam War. The latter war was the one I didn't want to be part of-people were dying, and that wasn't one of my Towards the end of the Vietnam War, career choices. protests regarding the inequity of the draft system forced the selective service system, the folks who select you for service, into a more equitable mode of operation. Rather than having individual draft boards in local cities determine which fine

citizens joined up, and which didn't, the system was turned over to a lottery. The idea in a lottery was that your birthday would be assigned a number between 1 and 365, and everyone below the cut-off number would join up, and everyone above the cutoff number wouldn't. On August 5th, 1971, the lottery was held, with the result that my lottery number was 57. The cut-off number was 95. I promptly received a written notice from my fair government to report to see if I had the makings of a born killer.

By the regulations of the time, being a full time student in college, I had the privilege of completing my current semester in school, before reporting. My options were basically this: sign up when ordered, or declare myself a conscientious objector (won't kill on moral grounds) and spend 2 years in some kind of federal/community service, or jump off a chair onto a concrete floor wearing socks in hopes that I could break the arches of my feet and fail the medical exam. I thought about the option of moving to Canada, but at that time, I thought Canada was too cold.

This is when I learned to read the fine print. Along with an induction notice is a reference to something called the selective service act, which is the law that enables the draft and the provisions that explain what happens and what can happen. Buried deep within the law is a process called *filing a claim for postponement or reclassification*. Under the law, you can file documents with your local draft board that request a postponement or classification change for a variety of reasons. As soon as the claim has been received, your induction date is put on hold until the claim has been processed. Now, the intent of the law is to review all the

facts of the claim and make a determination as to whether or not the claim is valid, and then proceed with either induction, delayed induction, or reclassification. Most people would stop there, because, heck, the outcomes are determined. However, in the fine print, is a discussion about what happens if you file an *incomplete* claim. Well, it's quite simple; the draft board restarts the process of the claim and sends you a request to provide the requisite information by a certain date. If you by some unfortunate reason need to amend the claim, the process starts all over again, until you get it right. As long as you respond by the date, you are complying with the law. You must keep in mind this quote: WARNING: If a registrant knowingly submits incorrect or false information on a claim, he may be found in violation of law and, if convicted, he may be imprisoned for not more than 5 years, fined not more than \$250,000, or both. You must not lie, ever, not once! But if by some unfortunate mistake, you fail to include a document which you have referred to, or make an error of omission in one of the mandatory responses, the draft board angrily resets the clock and demands that you provide a complete package of information by a particular date. There is, according to law, no limit to the number of mistakes you can make in the prosecution of your claim. In fact, I was able to improperly document and fill out forms for almost two years until the draft ended without having me been clothed in green.

On Business

Sometimes in my life I found myself in strange and fun and unusual business settings. While I have had exalted titles, and been chairmen of the board of public companies, it is living in the trenches that has provided the most fun and entertainments.

Food Tasters for the King

Food is an important part of a balanced diet. Fran Lebowitz

Like millions of my fellow Americans, I've watched my 401K tank over the last few years to the point where my thoughts of retirement focus on finding a nice shack in a warm third world country where I can spend my dotage dining on coconuts and U.N. - WFP handouts while I seek long life and health through holistic medicines and visualization therapies. Fortunately, I need not rely on my 401k to see me through my golden years. It's not that I've given up on the benefits of living in the world's strongest economy, it's just that sometimes, when you work in the venture capital field, while the successes are sometimes spectacular, you can have these bad days when you think the only way you can make a buck is by hauling Pepsi bottles and discarded Wall Street Journals to the nearest recycling center.

A decade or so ago, I was an entrepreneur with visions of gold and a technology idea that even Frost & Sullivan thought was worthy of a 50 page report for a measly \$2,500 per copy. Today, having carried that idea from my basement to a \$100 million company on NASDAQ, I'm the managing director of a scouting firm that sits squarely between the venture capitalist and the entrepreneur, serving that delicate roll of matchmaker between the money haves and the money wants. We call ourselves "food tasters for the kings."

The kings are the many venture capitalists who sit at the thrones of investment funds overlooking their portfolios while a thronging mass of serfs jockey for audience and an occasional dole of seed or mezzanine capital. In the middle, like the old time food taster of medieval courts, we enjoy a special trust to taste the food offered the kings for the various delicate poisons buried in due diligence and only offer forth those plans and companies that seem pleasant to the pallet. Even in the best of economic times, in spite of our many successes and our freedom to call upon the king at will, ours is a role fraught with regal mood, for even when we offer forth a helping of the finest of business plans, sometimes our liege will look upon us and say, "how many times do I have to tell you that we don't eat in the transportation sector." We calmly bow back out of the royal chamber, plan stuffed in our shirt; never once mentioning that 20% of their portfolio, in fact the profitable part, is in the transportation sector.

While entering the royal chamber can sometimes be fraught with its special horrors, dealing with the serfs of the kingdom, that's the *real* nightmare. To be in the middle of a money matchmaking service is to be perceived as in the company of angels, at least from the point of view of those who seek investment capital. Were we unscrupulous, we could perhaps raise money for raising money, like so many of our fellow food tasters, but having seen the corruption and sloth of many of our compatriots, we chose at the beginning to take the high road and take little up front for our services, and only reap at the back end of a consummated audience with the king. Thus, from time to time, we find ourselves buried with prayers for service that sometimes consume us with awe, and sometimes merely consume us.

As a food taster, we can give more than a passing glance at the elevator pitch that the kings would file in the round. While an entrepreneur might have the best business concept in the world, they wouldn't be an entrepreneur if they had achieved great success in the past. Thus, we will spend more than 5 seconds looking at a concept presented by some math professor who hasn't spoken to a fellow human in the last decade. Nor will we shy away from someone who starts off their business plan with a paragraph stating that they'll give up 5% of their company for a \$10 million seed investment, which will dominate an as yet undefined \$50 billion market space. Food tasters are always looking for a new meal, even if it starts out looking like haggis neaps & tatties with a wee dram mixed with slices of raw carp and saw dust. We have long since learned how to bring the entrepreneur's expectations into line with the real world, so we will look deeply into the eyes of the unwashed before turning up our nose.

Sometimes even we get drawn into deals that no righteous mortal should ever endure. With our collective century of technology expertise, when someone walks up with a plan to revolutionize the energy production of the world for a mere half million investment, well, our 5 minute review can sometimes turn into months. One deal comes to mind...

My partner Bill, called me one day and said, "You've got to look at this! It's a company that seems to have found a low cost way to produce energy!" Visions of Pons & Fleishman danced through my head, the former kings of the cold fusion bubble, long since desiccated and barely a stain on the mantel of energy research. "Do they use a rare earth called Palladium?" I asked remembering the key component of the 1989 claim for cold fusion. "What's Palladium?" Bill asked. Sadly, I remembered that *I'm* the technology lead on the team, and it's *my* job to separate fact from fiction. "Send me the plan," I sighed.

In this day of the Internet, it took only thirty minutes before I found myself staring at an electronic copy of a business plan, some rather impressive resumes from a renowned national lab, and an mpeg video that knocked my socks off. There on the video was a clean-shaven guy in a suit, articulately guiding a tour of this machine -- one side hooked to a battery showing a current drain of 5 amps and on the other, a gallopita gallopita machine calmly showing a current output of 6 amps. Put in 5 amps; get out 6, sounds like energy production coming from what could be best described as a cauldron of plasma and bangs. I had recently had the unfortunate experience of plowing through a recent journal article discussing how a university professor had measured neutrons emanating from a small bath of bubbles using sound, cavitation, and an established freak of nature called sono-luminescence. Thus, I was primed to believe that cold fusion, in some form, wasn't a violation of the laws of nature. Granted the possibility, I could see how Bill was primed to offer this deal to Exxon for a paltry hundred million, visions of commission checks dancing like sugarplums. I picked up the phone and called the entrepreneur to see what he had.

An hour later, this is what I was sure of. The entrepreneur was technically competent, lacked the credentials to make this an easy feast for a king, didn't know why he had surplus energy coming out of his cauldron, and yet was convinced he was on to something. He had also mentioned use of trace elements of Thallium in the mix, which had me wondering whether or not I was dealing with cold fusion. Sometimes, being the technical genius of a small firm simply means you know whom to call when you're stumped by something that's far afield from your academic training. Five minutes later, I was discussing this deal with a physicist at a different national lab. He listened to the story, and between his various guffaws and snorts, he said, "well, it's possible, but if it's real, they're probably generating a ton of neutrons, so you'd better get them to find out if there's any radiation coming from the device, and if there is, they'd better buy some lead underwear before they start glowing in the dark." Such are the inputs from the technology experts of due diligence.

Over the next few weeks, Bill worked with the company to prepare them for the royal audience, teaching protocol, manners, and coaching the financials, while I dug deep into the literature and experts, knowing that in the royal audience, someone would ask, "how does it work?" and the answer "no one knows," would present us with a royal eviction notice. At last, I came across a physicist who had a clue. He said, "There are two possibilities here. First, they have an efficient means of creating thermonuclear plasma, in which case it's worth billions of dollars. Second, their measuring system is whacked, in which case it's useless." Ah ha, the measuring system -- key to the device's capabilities is a meter saying 6 amps come out from 5 amps in. So off I went to the measurement community to see what manner of disasters could reside within the cold empirical world of current measurement devices. My new physicist in a long chain of physicists on this project made a simple observation, "the cauldron goes bang bang bang, right?" I nodded. "Well, that means they're generating a pulsed direct current, which means, rather than using a current meter, we need to see the current measurements every millisecond or so. It could be that the meter is measuring the peaks of the current, rather than the average."

Thus, back to the entrepreneur I went, circuit diagram in hand, and said, "Replace your current meter on the output side with this circuit and let's see what you get." Two days later came the report, instead of 120% energy efficiency (billion dollar market), proper measurement showed 20% energy efficiency (we just wasted a month).

Bill canceled the audience with the kings, and I folded my physics hat back onto the bookshelf of the various hats that I wear. The entrepreneur naturally threatened us with all kinds of lawsuits for the inevitable competitive business that he *knew* we were forming to exploit his invention. I had a last call with him where I said, "If you ever find us coming to market with your device, I promise, we will offer no defense in the litigation."

Thus back I went to my task of knowing a little bit about everything, trying to keep one step ahead of the state of the art in all things, waiting for the phone to ring, which it always does, with Bill at the other end saying, "I've got this interesting deal in maritime leasing. What do we know about the R.O.I. of the Mediterranean cargo trade and the financing terms available for profitable shipping companies?"

"Not much," I said, "but we will."

Button Button

At points of clarity, I realize that my life on earth is meaningless, and that I am merely a pawn in a bigger game. A game I cannot possibly understand or have control of. Thankfully, before depression sets in, I drift back into my cloudy, bewildered daily routine. - Joel Patrick Warneke

For some reason, I have spent most of my career either directly or indirectly involved in *user support* issues. Now the word *user* has a variety of possible connotations. Just to be sure, I went to an online dictionary and the first three definitions, in order were:

- 1. One that uses: a user of public transportation.
- 2. <u>*Law.*</u> The exercise or enjoyment of a right or property.
- 3. One who uses addictive drugs.

I realized immediately that what I mean by *user support* might not fit the definition that most people would think of when they hear the phrase *user support*. I don't mean people who use things generically. Nor have I ever worked in a legal setting. And no, I don't mean I participate in needle exchange programs for the heroin inclined. For me, a *user* is someone who uses a computer. For me, *user support* means helping a computer user get their job done. In the annals of technology, user support is something that is the high tech

equivalent of helping little old ladies cross the street. Well, usually, they aren't little (I suspect most are at least 30 pounds overweight), and it's very rare that they are old (which doesn't mean they aren't senile), and well, they come in a variety of genders, certainly more than two.

A user support issue is one of those strange concepts in commerce where someone is doing something, gets stumped, and operates in peripatetic state of consciousness until someone resets their brain. Here's a classic example of a user support issue. You're sitting at your desk chewing on a 3 day-old cheese Danish browsing the monster board web site looking for a job in Honolulu when your phone rings. You pick it up and you hear, "NOTHING WORKS!" You spit out a bit of Danish onto your keyboard and respond, "oh hi Gloria, what doesn't work?" Little bits of crumb are scattered over the keys and you start tilting and shaking the keyboard hoping you don't get anything stuck under the letter "E" again while the voice at the other end declares, "NOTHING WORKS!" These are the times that Dale Carnegie must have considered in his earliest days as you say, "Gloria, which nothing doesn't work?" You consider banging the keyboard against the desk when you notice that some of the gooey cheese stuff is wedged under the space bar as the disembodied voice shouts, "EVERYTHING!" Having taken this same phone call, perhaps twice a day for a year, you know you've lost any chance of dislodging the cheesy bits before they harden and say, "Hang on Gloria, I'll be right down."

It's a mellow trip to the elevator and down two floors, past cubicle walls, gurgling water bottles, filing cabinets, and

copy machines until you reach the cube allocated to the user. You see a broad back billowing over the edges of the chair with long strands of unkempt black hair dripping onto the arm rests facing a computer screen, large clumping hands punching at keys on the keyboard like a pile-driver crushing steel I-beams into the earth. You say, "Hi Gloria, I'm here."

She never looks up from the keyboard and grumbles "go away, it's better now." In a previous life, you might have asked, "What's better now?" but you know the response would be something like "EVERYTHING is better now." Instead of engaging in a monologue with the cubicle wall, you wander back up the two floors to your own cube and pull out a paper clip to dislodge that cheesy thing that has now become firmly lodged for eternity between the "B" and the "N" keys. You have just had a typical user support experience.

Now user support is a hallowed concept in the annals of computing going back to the earliest days of automation. I remember a time, oh my God, 30 years ago when I first encountered my fellow user support specialists. In these hallowed days of antiquity, programming computers was a novel and magical talent shared by a small community of artisans who had memorized some of the most cryptic codes ever created by man. To write a program in those days often involved the use of something called ASSEMBLER LANGUAGE, which consisted of putting strings of cryptic symbols in columns that would look, to add 3 and 4 to get 7, something like: C = A + B**P1** START BALR 12.0 USING *,12 L 1,A А 1,B ST 1.C BR 14 A DC F'3' **BDC** F'4' CDS F END

As a hallowed programmer you would learn cryptic things like BALR, USING, L, A, ST, BR, and DC, where things like "L" meant Load, and things like "A" meant add, and things like "BR" meant branch. Ouch! That doesn't look like an explanation to me. The point is that the user support people would come up with new acronyms to help out the Things like ROMB, Read Operator's Mind and users Branch, and ECINCI, Execute Correct Instruction Not Coded You get the idea. Clever little snippets of Instruction. computer nerdness destined to support users in whatever ridiculous predicament they found themselves. As we wandered the halls with our boxes of 80 column punched Hollerith cards, we never ever imagined that common people, people of the earth, would one day transform our art form into an everyday effort to control the world. We thought of the users as Doctor so & so, never imagining that

our standard fare would turn into the nothing-works-Glorias of the world. Somewhere along the way, the artisans lost control of the process, and the users took over.

Now, more than a quarter of a century later, I am at peace with the world of user support. It is no longer a process of gaining control of the machine to bend to your will. Instead, it is a process of gaining control of the user who has more will power to do the unthinkable than could ever come out of the mind of the new generation of certified computer programmers and their managers (the one time artisans of old).

I remember a time, long ago, when there would be one computer for hundreds of users. These systems were called time sharing systems, since the idea was that people typed so slowly, you could let the computer pay attention to them a little bit at a time and everyone would believe that the computer was theirs and no one else's. The idea went through several incarnations over time. The one I remember most clearly is a time-sharing system called RAX. I don't know exactly what RAX stood for, possibly, Remote Access eXperimental or something. What I do remember is that when you sat down in front of the massive Cathode Ray Tubes of the time, the system would wait for you to hold down the SHIFT key and the ENTER key, and then it would announce, RAX IS IN CONTROL, SIGN ON. No question who was boss. None. Computers have always used some kind of strange keyboard action to do something. For a long time the ENTER key was actually the RETURN key. Then, along came smaller computers with the inevitable problem of getting stuck doing the same thing over and over. Finally,

someone got tired of unplugging the computer when it got stuck and created the famous technique of holding down the CONTROL key at the same time as the "C" key (Control-C) which was the universal instruction to *abort a process* (Computer speak for, "stop goddamnit!"). Over time, people started breaking free of the control of the computer. The early users began to rebel. Then there was a day where one of the first early users decided to rebel. Some snot nosed 17year-old kid with a cranium bulging halfway to the moon sneaked into the hallowed computer center after midnight and changed the announcement to RAX IS IN CONTROL, SIGN ON OR I'LL BITE YOUR ASS. This was probably the beginning of the end for my sense of control in my life.

I think the span of a quarter century is a clear benchmark of the time before, when we had control of our lives, to the time after, when we don't. There's an apocryphal story that I heard from James Martin, one of the earliest computer consultants and masters of control. He was telling a story to explain how the user needed a response from the computer in three seconds or less, otherwise, the system was deemed too slow. He recounted this time where he was asked a difficult question by one of his clients, the administrator of a multimillion dollar computer center in an age where computer time cost \$10 or \$20 per minute of use. He pondered the question and answered, "I have to think about it, I'll get back to you." The user replied, "But Dr. Martin, the computers are waiting." Yes there was a time where the user knew their place in the world, as the servant to the master. Now, the inverse is true, the computer can wait 'till hell freezes over as long as the user is not kept waiting. In the beginning, we

had control over the computer, primarily because the computer had no personality, no attitude, and no sense of what was proper or improper. The computer did exactly what we told it to do, every time, all the time. Now, while the computer hasn't changed, our interactions have changed. We have no control over the user, who has a personality, an attitude, and a clear sense of what is proper or improper. Instead of changing a few holes in a punched card, we have to negotiate for endless hours with some poor user, who is much happier describing how people of my ilk never understand what it means to do real work. All we do is sit in front of the computer eating Danish and looking for jobs on tropical islands while waiting for the phone to ring. Can't argue with that....

The true essence of user support can probably be found in the Old Testament. Let's pretend for a moment, that you're the Pharaoh of Egypt. You are the king of the civilized world, you come from a long line of kings of the civilized world, hell, everyone thinks that you are a god. In fact, some mornings, you too maybe think you are a god. At least you have the biggest bathtub in the Mediterranean. Now picture this, you have a few thousand slaves who have it in their heads to go on strike, forever. Instead of being thankful that you haven't slain the whole lot of them, you've given them a life of subsistence hacking and whacking up monuments to immortalize the glory of yourself and your nation. This scrawny hairy old man with a cane keeps coming to threaten you with some mystical fire & brimstone unless you agree to the strike. Hell, you're the boss. You're IN CONTROL! Won't have none of that Hebrew whining! I mean, if you

say hop, people hop, if you say frog, people frog. It's like the good old days, the way it has been for thousands of years. Of course, little do you know that the user base has These rock hewing mud-covered slaves have changed. gotten the big Kahuna on their side and where once you had control; you're merely worthy of mention in a few chapters as some poor guy who ran afoul of an angry God. Little do you know that the time has come, where after a few plagues, you realize that you're going to have go after those guys and show them who's boss. Of course, this little story demonstrates the historical basis of early computation and the true power of the user. You, the Pharaoh, have your army on chariots chasing after those recalcitrant slaves, your whole army is converging on the slaves, ready to kill and maim anything that moves, when, invoking the time honored tradition of the earliest users of computers, Moses aborts the Egyptians' process with a control-sea...²

² Thanks to Tom Galloway who first brought this ancient use of computers to my attention.

When Professor Meets Investor

When I finished school, I took my entire life savings and invested it in a business. I was young. I was inexperienced. But I was an entrepreneur, and I was proud. And in six weeks, I was broke. Mark Warner

I remember my roots as an entrepreneur. I was sitting across from the attorney representing my first investor who had just handed me a check for \$600,000. The attorney looked at me and said, "I told him that you're a bad risk, but he thinks you remind him of a CEO he's worked with. You wear the same glasses and tie. If you screw up, you're dead." With these encouraging words I proceeded down the path to build a company that later netted that law firm fees in excess of \$1 million. I was a technologist back then, with a brilliant idea and no business sense.

Since then, I've sat across the table from youngsters with a brilliant idea, and no business sense. They all have an idea worth a billion dollars. They all can bring it to market in a year, or two, maybe. They all have the finest development team on the planet. They all have a good story. To quote my favorite investment banker, "In 30 years of investment banking, I've never heard a bad story."

The active investor is used to good stories.... Often 3 or 4 each and every day. It's not the story that makes or breaks a deal. It's the certain knowledge that less than 2% of the stories will garner enough attention to get funding, and of those, less than 1/3 will ever do well enough for the investor to make money. Even so, after the investor cashes out, less than 1/3 of their investments will still be alive in 5 years.

It's not the story that counts. I've often said to entrepreneurs, "I really don't care *what* your technology is. If you can sell rodent droppings for a profit, that's sufficient."

With nanotechnology, the route to success is more complex than with other technology startup companies. In nanotechnology, the track record of companies and investors is sparse. Using a comparison to a similar technology startup sector-biometrics, we find that the biometrics sector has about 200 companies playing in the market space in any given year. About 1/4 of those companies are new/dead in any 12-month period. However, the history goes back as far as the mid 1960s, which gives this sector an experienced pool of managers, entrepreneurs, and investors who've had their measure of failure and success. A new entrée into this market space has standards against which a story can be compared. With nanotechnology startups, every story is new, and virtually no investors or entrepreneurs have any prior experience in this market space.

The nanotechnologist/entrepreneur comes to the table woefully unequipped to meet the needs of the common investor. Every segment of nanotechnology has a good story and a billion dollar market. Ho hum... most stories have a billion dollar market. What the investor is looking for is something most academics lack —Salesmanship.

There is an adage, "if you build a better mousetrap, the world will beat a path to your door." That is a lie. If you build a better mousetrap, no one cares until you sell it.

Selling consists of two things that most academics have never done-marketing and sales. Most academics don't realize that marketing is not the same as sales. Most of the business plans I see have a "marketing/sales plan" section. That's an immediate warning that whatever follows is based upon speculation and some long since obsolete Frost & Sullivan report. A marketing plan describes how a product is going to be positioned into an existing or emerging market what the features & benefits are, why this mousetrap is better, and if the sales plan works, what proportion of the market share is achievable both with and without competition. A sales plan describes exactly what you will do to actually sell this mousetrap-how much do you spend, who do you approach, what do you say, how do you price, and most importantly, something that no dissertation committee ever asks, how do you close the order?

Many academics think getting someone on board with an MBA is a good idea and rounds out the team. That sure sounds good. But if you want to really wake up an investor, spend a few days at some used car lots around town. Find the slickest used car salesman you can find, teach her/him honesty, and then hire them. I remember being at a conference with my top-performing salesman. He and I were taking a bathroom break. Someone joined us and my salesman immediately struck up an intense conversation one about Frank Lloyd Wright stall down architecture. Afterwards I asked, "How do you know so much about Frank Lloyd Wright?" He said, "Boss, I'm a salesman. I can talk about any topic for 15 minutes to establish a rapport.

After 15 minutes, I'm out of material, and that's when I hand him over to you."

He summed it up in three simple steps.

- 1. Sell yourself
- 2. Sell your company
- 3. Sell your product

If you have that capability in your team, it's not just another story to the investor.

On Japan

At two times in my life I found myself commuting to Japan for various work projects. With a net of 25 trips under my belt, I finally realized that there was something different about the Japanese culture that just hadn't come through in all the guidebooks I'd read. Most guidebooks try to teach you how to be a tourist or make sense of strange religious practices or how to finagle your way into a tea service. I found that the realities were actually, more interesting than that.

Internationalism

When you travel, remember that a foreign country is not designed to make you comfortable. It is designed to make its own people comfortable. - Clifton Fadiman

Once upon a time, I had the fortunate experience of conducting business in Japan over a period of many years. In time, I came to think of Japan as a second home, where the cars drove on the wrong side of the street, the food was always wiggling, and my sense of proper was always a bit askew. At one point, I realized that I was actually dealing with a deep and ancient culture that had, at its roots, the idea that I was some kind of sub-human with valued, yet disposable talents. Once, I had the experience of a coworker apologize to me for bombing Pearl Harbor. Ι accepted the apology, not knowing what else to do about an event that happened more than a decade before I was born. Later, in the same conversation, he asked me, what would have happened if Japan had won the 2nd world war. The answer was obvious... there would be major action in the Japanese Imperial household to stem the tide of cheap American imported automobiles.

Life on the Japanese work floor

Define your business goals clearly so that others can see them as you do. - George F. Burns

There is an order to a factory in Japan that is quite different than the order to a factory in the United States. This isn't to suggest that one factory is better or worse than the other, but merely that things are somehow, different. As you wander around the floor of an American factory, you have a sense of territory. Walls go in and out as a precursor to the definition of spaces in which to do something. In one room, there is a process for welding. In another room, there is a process for assembly. In another room, there is a process for test. As you wander around the floor of a Japanese factory, you have a sense of wide expanses. Walls are reserved for the outside of the building and the encasements for elevator shafts. Occasionally, you'll have a conference room that has 4 walls and a door, but just as often, the conference room will lack the walls, but still have a door. Space in a Japanese factory is organized not by the walls, but by the removable signs above that identify what the work area under the sign is, today.

The organization system in a Japanese factory is less geography and more process. I remember wandering through a factory floor in Atsugi, Japan, and was amazed that down one row of desks, there was the assembly test station for ISDN pay telephones. Down the next row of desks was the assembly test station for small fishing boat radar systems. Down the next row of desks, was the wavesoldering machine for surface mount electronics. Down the next row of desks was the catalog center and parts ordering desk. Each of these areas had its own sign indicating what was done here, at *this* time. My project team occupied space between a postal envelope transport system and a cash register checkout station. We were given extra space in our area because, unlike our hosts, we had no ability to squat in a crouch for hours enthralled over the intricacies of machines of our own invention.

Entering the factory was an amazing experience. We would take a bus up winding semi-mountainous roads barely wide enough for two subcompacts, in the middle of a vast sprawling city, we would top a rise on a hill, and on the left was the factory complex, while to the right, the sprawling construction of a new shopping mall. A few blocks beyond, in this rural setting, you could see the signs of noodle shops, bicycle repair shops, and the inevitable pachinko parlor where professionals would sit for hours watching ball bearings wind their way down courses of nail studded walls hoping to trap them at last in the tiny tunnels that lead to riches beyond the dreams of avarice.

Well before the pachinko parlor, we would turn left into the security gate, where the guard would politely bow and hand us, the known American engineering team, our badges of the day. We would the wind our way past the main visitor center into the back lot past the vending machines, the bicycle parking area, and the inevitable company cafeteria where the smells of lunch were already wafting through the air in the seaweed noodle and pork aromas of a Japanese

work morning. Finally, we'd enter the overhead partitions of a loading dock which would enter into the massive 4-football field sized four-story factory building #42 where we had our 250 square foot work area buried half way down the corridors on the main floor. If we arrived early enough, we could watch the ritual team building exercise program of the workers doing the morning stretch to the sounds of an obnoxious military march and a woman chanting endlessly in the background "ichi ni san shi" over and over again the "one two three four" of the morning calisthenics. If we arrived later, we would be the cause for a spontaneous break while someone would offer us some green tea from a massive urn or a cup of instant coffee made from a jar of the most obnoxious nestle coffee ever conceived on this earth (a failed product of the failed Dutch conquest of the world). This would then be followed by the inevitable cigarette break where everyone would troop over to the green tea urn where the 10 square foot smoking zone was maintained. Then, we could, ritual greeting of caffeine and nicotine over, actually attempt to begin the day, some 4 hours later than those who had greeted us.

The workday would then commence, with plenty of time for lunch, green tea breaks, all the rancid tobacco you could inhale, and finally the recap at the end of the day. The famous recap, where, if things went well, you'd suck down a Styrofoam cup of raman noodles and put in a few extra voluntary hours before heading home at 9 or 10 p.m. Or, if things were going badly, our boss would pull up a few company limos and waft us all to some fine restaurant to discuss the obvious problems that we were having that day, or week, or lifetime. Sometimes, we would look forward to that series of problems that would drive everyone up the wall, for that would be the only time for sure where we could guarantee a good meal and a bed time before midnight. However, these fine meals would have their own tension, for if we didn't deliver a solution after reaching agreement over far too many glasses of sake and the inevitable 5th of foul Suntory whisky, we'd have to go out again and again until we solved the problem, or our livers melted into a pool of grayish brown sludge, or the project came to a sudden halt when the guard at the factory gate failed to recognize us and called the local cops rather than handing us our admission badges.

But if things went well, we could show our joy at our success by coming in on Saturday, or perhaps even Sunday to make sure that we had tested everything and that it really did work. Of course, we would not be alone, for all the other people whose projects were going well would be there to greet us with green tea, nestle coffee and the unbelievably bad mild seven (mildo sevenu) cigarettes reconstituted from the factory sweepings of building #41 just down the road. Then we would join a small party of happy victors showing off the intricacies of our systems to our co-workers, keeping our shouting down of course in case the poor souls with problem systems down the aisle might be distracted by our revelry. This being a day off, we would leave early, say 4 or 5 p.m.

Life in a Japanese meeting

Meetings are an addictive, highly self-indulgent activity that corporations and other organizations habitually engage in only because they cannot actually masturbate. - Alain van der Heide

To understand a meeting in Japan, you have to accept two fundamental truths. The first is, that even after you die, you may continue the meeting in the next life. The second is, the nail that sticks up gets pounded down. If you accept these truths, then you are ready to sit at a meeting table in Japan.

A good meeting is scheduled in the middle of the week in a large conference room and has a start time of about 10 a.m. There is never a stop time scheduled. It starts as late as 10 a.m. because literally everyone has to attend, and some of the attendees have to travel ungodly distances to be there. Unlike American meetings, a Japanese meeting just sort of organizes itself around the start time. There's definitely an option of beverages from tea or coffee, a variety of fruit juices, and for the gaijin (foreigner) the selection of canned beverages from coca cola to Suntory sweat. People start arriving as early as 30 minutes before, but everyone is there as close to the meeting time as possible. Someone who will be more than 5 minutes late has a cell phone and will announce their train/traffic problem in ample time for others to settle into the comfort of planning the lunch, or perhaps the evening meal that will spin out of the meeting. The key thing in the meeting is that everyone is present. I mean I have sat in many meetings where the most evervone.

junior technician who was most recently qualified to tighten screws sat next to a division vice president responsible for 2,000 employees.

In a good American meeting, the designated organizer begins the meeting with a summary of the issues. At this time the meeting can go one of several ways. The organizer, if it is I, summarizes the issues, states the conclusions and adjourns the meeting. Alternatively, a more progressive American might make a few suggestions and then throw it open for discussion, with a careful eye on the clock. A typical up-through-the-ranks American who has no formal meeting discipline will throw the meeting to the winds and permit a rambling discussion which leads nowhere and may accidentally hit upon a solution by blind luck. However the American does the meeting, the meeting has a distinct beginning and end. The beginning is when the meeting starts, and the end is when the meeting ends.

Welcome to Japan. Meetings here have no beginning or end. The true Zen of a Japanese meeting is that they happen in waves. When the meeting is at the crest, the meeting participants are in the same room. When the meeting is at the trough, they are separated but on the phone. Between times, the meeting is either headed towards a crest or a trough. Being in the same room may simply be nothing more than the time where the meeting participants share ritual rice and feed the meeting body.

Many an American has been shocked to discover that at the end of a meeting (the time when everyone left the room), the conclusions the American had thought had been reached were still under discussion. What that American failed to realize were the two points that we started with. The first is, that even after you die, you may continue the meeting in the next life. The second is, the nail that sticks up gets pounded down. Let's discuss what these two ideas mean.

What American would assume that in the next life he may continue to participate in a meeting on, say, soybean production in Nebraska? From a Japanese viewpoint, to assume you won't participate is merely a sign of being short sighted and reeks of unprofessionalism. Remember, Sony has a 200-year corporate plan. If you don't think you're going to be involved in a problem, forever, then you simply don't belong. Dying and going to heaven is not a Japanese culture idea. Dying and then coming back and doing it over and over and over again until the stock holders scream with joy, is a more Japanese way of thinking.

The second idea, the nail that sticks up, is actually a children's proverb in Japan. This is a way of saying two things. The first is that if you're stubborn, you'll get smashed flat. The second is if someone is stubborn, you have to stop what you're doing until the stubborn one is smashed flat. This is the true meaning of consensus in Japan. If there is a disagreement about anything, then everything comes to a screeching halt until there is no more disagreement. This is one reason that meetings go on for years.

The American who expects a meeting to actually come to an end with a conclusion is simply, wrong. The purpose of a meeting in Japan is not to come to a conclusion. The purpose of a meeting in Japan is to develop consensus about the current status and direction. It takes an act of God to
come to a conclusion in a Japanese meeting, and even then, God may find himself pounded flat if he can't agree with the group.

The confusion most Americans have with a Japanese meeting is that towards the end of the day, everyone leaves the meeting room to go to a restaurant or bar. In the American context, that means the meeting is over and now it's time to unwind. In the Japanese context, it merely means that the company's food service is closed and we're all getting hungry. The good part about such things is that the food in Japan is excellent, so as the meeting continues in a smoke filled room with dish after dish of unidentified edibles mixed with alcohol slowly digesting in your stomach, there is a mellow time where you may be tempted, if you're the nail that sticks up, to go flat.

The meaning of corporate alcoholism

I hate to advocate drugs, alcohol, violence, or insanity to anyone, but they've always worked for me. - Hunter S. Thompson

Negotiation in Japan is in many ways very similar to having a team of army ants removes your skin one bite at a time in a hot blazing sun in the middle of the desert. It's not that anyone is out to get you, or torture you, it's more like, there's always another angle on a problem that hasn't been explored, yet. Always. The unwary American who thinks they've finally reached an agreement is merely preparing him or herself for a never ending series of what I call "oh by the ways." This is when someone looks up at you with big round eyes (difficult if they're Japanese, but possible) and says, "Oh by the way, what do you think about...." Eventually, though, the "oh by the ways" come to an end and you have an agreement, perhaps even a signed contract. The stupid American thinks the deal is closed. Nothing could be further from the truth.

In the Japanese context, you must understand the character of the person you have just married via contract. There's always room for divorce, but if you stay in the marriage, you darn well better understand the limits of how far you can push the relationship, just in case you have to push, which you will. A contract, as we all know, is just a piece of paper. Without the people behind the signature, the contract creates nothing. Thus, the Japanese are quite right in wanting to know more about the people behind the signature. And they have ways of understanding completely whom they are dealing with.

The favorite character evaluation methodology is the bar. In the United States, a bar is one of these places where chairs line a counter and small booths may surround the bar as a sign that food may be served in addition to alcohol. There is usually some kind of music or television background turned up load so that after a while, no matter how hard you try, you invariably grow deaf and lose track completely of whatever is happening in the conversation. In Japan, there are bars like that to cater to the western minded. That however, is not the kind of bar where business is consummated. The bar I'm thinking about is a special place. It's right off a main business district that runs 24 hours/day. It's brightly lit on the street day or night. You can see traffic jammed for miles around. As you walk you are bouncing off pedestrians and little blue mopeds with massive package hooks carrying home delivery sushi and sweet potatoes and pizza. You jostle under these crazily lit street signs that are a hodgepodge of English, and katakana and hiragana and kanji, which most Americans dismiss as "oriental". Walls that have no windows are lined with these little post-it backed postcards of nude women with phone numbers and enticing statements that you wish you could read. Suddenly, your host of the evening smiles and says, "This is it." You turn left into an alley that has plastic garbage cans on one side and a small 3-person elevator stuck into the brick wall on the other. A half dozen people crowd into the elevator with you, and you try to read the sign to see how many people can ride in the elevator. Instead of the traditional

OTIS you see MITSUBISHI and a sign that looks like " 6λ " which translates to 6 persons. Since the elevator only holds 4, and there are 8 crammed in, you don't know what to do other than inhale and try not to become intimate with the executive on your hip or the 16-year-old schoolgirl on your buttock. Five floors up, your host says "simasen..." and forcibly evicts you out of the elevator like a chicken bone popped by a Heimlich maneuver.

In the hallway, there are three doors, the one to the left, the one to the right, and the one you just came through. The right hand door is the fire escape, so you turn left under a 3banner cloth and open the door on the left. Inside it's like the den of a luxury house. There are two soft sofas in a step down configuration, a small wet bar to the left, curtains obscuring windows that were boarded up decades ago, and a unisex bathroom with directions printed in both English and Japanese. You don't know it yet, but the toilet is not western style, which means that the seat is non-existent. There just a round porcelain aiming point about 1 inch off the beautiful tile inlaid floor. By the time you need to know this though, you really won't care anymore.

The hostess runs from behind the bar as you enter shouting "simasen simasen" until she realizes that you're an American, then she says, "welcome thank you," and leads you to one of the sofas across from your host. As you settle into the plush soft sofa, out of nowhere, a remarkably beautiful young lady plants herself at your side, puts a bowl of peanuts in front of you, puts her arm around you, puts her beautiful face about 4 inches from yours and asks "what you like to drink?" If you're happily married, at that point, you turn beet red out of embarrassment of all the thoughts that can go through your mind in less than 1 second. If you're not happily married, at that point, you turn beet red out of embarrassment of all the thoughts than can go through your mind in less than 1 second. Since you take too long to answer, the girl says, "is whiskey ok?" and you nod hoping that you don't have any embarrassing growths showing. She returns in a few seconds with a 12-ounce tumbler full of something, whiskey probably, and sits close snuggling. You suddenly remember that you're with your host and look over to where he's sitting with his girl smiling at you and he asks, "Do you like?" This is the beginning of the character evaluation. Anyone who is not a Mormon or in a substance abuse program will promptly drain that tumbler.

The evening is about 5 minutes old when you realize you've had too much to drink. What you don't realize is that every time you take a polite sip from the glass, the glass magically refills itself, thanks to the girl who's worked her way into your lap at this point. After an hour or so, your host, reminds you that you haven't been to the bathroom in a while, and everyone scrambles out of your path as you zigzag the 15 feet or so from the sofa to the bathroom door. Once inside the bathroom, you have a chance to review what has just happened. Aside from the fact that you can't remember how to get your zipper down, you realize that even in your wildest dorm days, you never had that much to drink in one hour, and you feel happy that when you finally *do* get that zipper open, you can see only one urinary organ instead of three. Your life is now operating at the lowest level of Maslow's hierarchy of needs.

Back on the sofa, your host who has matched you sip for sip has the advantage since he comes here at least twice each month for the last 15 years. His liver is three times the size of yours, and he can live on 4 hours of sleep each night where you need 8, or 18 on this night. He's asking the girls what they think of you. He has a mental check list of basic character points, such as whether or not you can keep a tune, did you confess to any personal indiscretions in your youth, did you snuggle too closely with your date-by-the-minute, and how dramatically does your personality change when you're under the stress of having every neural pathway discharge at once? He then has the hostess call for a cab, knowing that when you slide out of the bathroom, the only fantasy you'll have is that of either going into a sound sleep or vomiting non-stop for 15 minutes. The bar is not designed to handle either fantasy.

Meanwhile, back in the bathroom, you've only injured yourself slightly when you tried to zipper your pants without removing yourself from the pathway. The bleeding has stopped, and you feel ready to face your host. Opening the door, you breathe a sigh of relief as they herd you back into the elevator, down onto the street and into a waiting cab without even asking you to pick up the tab. Whether or not you throw up in the cab on the way to the hotel is left to your imagination. Only one part of the character evaluation remains to be discovered. Will you remember to be at the conference room promptly at 8 a.m. for a contract review, or will you oversleep?

Fresh shrimp

Advertising may be described as the science of arresting human intelligence long enough to get money from it. - Stephen Leacock

Product discrimination is a very fine art. When two companies package sheets of soft folding tissues, perfect for blowing one's nose when attacked by some retrovirus, it is hard with a fever of 103 to tell which package should be purchased. In fact, there may be no difference between the two packages. Sometimes, the difference between two products is a word that has a confusing meaning.

It was a dark and stormy night in the semi-tropical city of Tokyo. I was stuck there for several weeks with two of my engineers engaged in one of the many "oh by the way" projects that we had been summoned to perform. This evening was a Saturday evening, and our erstwhile bosses were out visiting their families for that four-hour Saturday evening period of the week where the wife reminds the husband how many children they have and what their names are and how to tell each from the other. We, on the other hand, were on our own, in search of a dinner that wouldn't hold too many surprises for us.

To be an English speaking person in Tokyo is not all bad. To graduate from high school, the average Japanese has to study a 2,000 word English vocabulary. While few will claim to speak English, most will understand some English. Having been raised in the United States, most of us never had the exercise of learning a new kanji character each day since the first grade. Thus the street signs of Japan have this distinctly foreign and unintelligible look to them. However, if you start studying Japanese, you soon discover that the signs are really not so hard to figure out, especially the ones that advertise restaurants. Now I'm not suggesting that your average business traveler could swiftly tell the difference between an insurance office and a brothel, but I *do* contend that you could, within minutes, know the difference between a sushi restaurant and a Chinese restaurant. Every good Japanese restaurant has a display window in the front of the establishment that has a picture of the foods that are served inside. Only the blind would have difficulty finding food in Japan.

On this particular night, we were depending upon my weak knowledge of Japanese and the handy Japanese-English pocket guide that followed me everywhere. We had left the grounds of the New Otani hotel near the imperial gardens and had headed towards the nearest collection of buildings in search of.... Food.

If you are the boss in overseas travel, your employees tend to expect you to know what you're doing. If you're a Japanese boss, you are given a stern lecture by management, before you leave, that if one of your underlings comes to harm while on a foreign trip, you are responsible for their life, their family, their debts, and if need be, their burial. In the U.S. the boss is responsible for getting the tickets and making sure that everyone has a current passport. I was a somewhat better boss than most. I would actually try to make sure that my people had a good time on these trips. After all, spending 25 hours in transit followed by 18-hour workdays for two weeks is quite a shock to most people. It doesn't cost much to be kind occasionally. So tonight, they asked me to find something *different*.

After wandering the streets for about an hour, with stops every few minutes while I referred to the Kanji guide, we settled on this nice little ground level restaurant that seemed to specialize in cooking at the table with these massive built in grills. Tonight, we would have something cooked. My fellow travelers, Tom and Dan settled across the table from me while I tried to figure out the menu we'd been handed. After a few moments, the waitress returned with an abbreviated short menu printed in English. Finding that only somewhat less difficult to understand than the Japanese language menu, we felt we had enough confidence to place our orders.

There was, however, one item, which is worthy of this whole discussion. Listed on the menu, was a list that looked like this:

Scallop	¥600
Oyster	¥800
Shrimp	¥700
Fresh shrimp	¥800
Crab	¥900

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When it comes to product discrimination, one could ask, what is the difference between shrimp and fresh shrimp. Remember, you are in Japan at this point where a hunk of seafood that is more than 24 hours old is considered stale and inedible. Being the enterprising souls that we felt we were, we ordered one shrimp, and one fresh shrimp.

This style of restaurant is one of my favorite styles. The food comes to you on these little tiny dishes with bowls of flavoring sauces, and you with whatever finesse you can muster, cook whatever you like, however you like it done. Our waitress brought us our order, four pieces each on the plate of the best scallops I've ever had, some so-so oysters, little tiny tuna nuggets, and a dish each of shrimp, and fresh shrimp. She was careful to point out that the blue fringed dish was the shrimp, and the green-fringed dish was the fresh shrimp. Other than that, they looked the same. Each of us took a shrimp in our chopstick, dipped it into a barbeque sauce, and broiled it on the grill. They were delicious. Then, each of us took a fresh shrimp in our chopstick, dipped it into a barbeque sauce, and broiled it on the grill. The difference between the shrimp and the fresh shrimp was immediately obvious. The fresh shrimp was still alive and tried to escape from the grill. What an amazing difference one word can make in product discrimination.

Fresh Fish

Be everywhere, do everything, and never fail to astonish the customer. - Macy's Motto

A captive customer is a wonderful thing to have. It's actually better than having a rich uncle who never forgets your birthday or Christmas. A captive customer is better because every time your captive customer has a headache, he comes to you for advice and aspirin. After you give him advice and aspirin, your captive customer goes away happy and never forgets to pay the bill that you send for the aspirin, the advice, and the surcharge fee for interruption of normal business services. I always thought a captive customer was a myth promoted by people who didn't have to work for a living. However, there was this time, when I found out what a captive customer is, and how annoying a captive customer can be.

To set the stage, you have to imagine that you've been up 'till 1 a.m. the night before in a Japanese bar acquiring the most incredibly bad hangover ever to grace the planet. Put in personal terms, I had arrived at the hotel barely in a condition to find the bed over the floor. Then, before I could properly settle into a good REM sleep, the stinking alarm went off at 6 a.m. I got up just about the time the wall stopped spinning, with about 45 minutes to shower, shave, put on my one and only wool three piece suit, and somehow, arrived at the train station at 6:45 a.m. so that I could be escorted to the airport for a flight to the Japanese city of Fukuoka. By some amazing state of grace, which today I claim is the raw strength of youth, I managed to show up at the appointed train station at the appointed time while several different Excedrin headaches contested for control over the inside of my skull. My keeper at that time was an engineer named Iijima, who's English surpassed my Japanese by several thousand words. The only problem I had in understanding him came from a previous unfortunate exchange where we'd been discussing a particular kind of flower. In fact, it was a lily. At least, in English it was a lily. I've long since forgotten the Japanese word for lily. There is one problem with a lily to a native Japanese speaker. The Japanese language has no sound for the letter "L". So, a native Japanese speaker will pronounce an "L" like an "R." Mr. Iijima and I had spent a rather hectic time in a garden, each with our language dictionaries trying to understand what the other called this flower. Finally, as we reached some consensus on the flower, I looked up the word I'd been offered and said with surprise, "Oh! It's a lily!!" Iijima looked at me with surprise and said, "Reary?" And I said, "Yes it's really a lily!!" He looked puzzled and said, "It's reary a riry?" I looked confused and lapsing in a moment of total non-conformity said, "Yes it's really a riry." I don't think either of us knew exactly what was being said at that point, but we figured out that we were stuck on some kind of "L" problem and burst out laughing.

It was this same Mr. Iijima who met me at the train station and escorted me onto a 747 for the trip to the southernmost island of Japan, to the city of Fukuoka. Now Mr. Iijima had been with us at the bar the night before, and

rather than take a 15 minute cab ride home the night before, and a 20 minute subway ride to the station in the morning, he had a full 90 minute train ride each direction, God willing that a train bothered to go to his home city at 1:30 a.m. I figure he thrived on the 2 or 3 hours of sleep he'd had the night before, whereas I was almost to the point where if my head split open spilling the dissolved remnants of my brain on the station catwalks, it would be a complete and total joyous relief. We sat on the plane, watching the nose camera giving pictures of the runway, and patiently waited for the stewardess to bring me some kind of green tea, which I thankfully used to inhale a half dozen ineffectual aspirin. lijima watched me in silence for a while, and then asked, "How are you this morning Grenn-san." My face split an attempt at a smile, which probably looked like I was about to bite him, and I think I grunted out a paragraph or two that sounded a lot like the word, "fine." After about half an hour of flight, I turned to Iijima who was studying some notes for the upcoming meeting and asked, "Do Japanese have a sense of humor?" He thought about it for a long time and finally answered, "No, we are serious all the time." I knew at that point what it meant to die and go to hell.

By the time the plane landed, I felt like there was a reasonable chance that I'd live through the day, until that is, I stepped outside of the plane. Fukuoka is a nice city of about 1.2 million souls nestled in a bay on the southern island of Kyushu. This is a semi-tropical city. At the time I arrived, it was probably 80 degrees outside with relative humidity in the 90 percentile. I may have mentioned that I'm from Minnesota, where at the same time of year, February, the

temperature is known to not reach up to zero degrees for weeks on end. In Minnesota, it is the height of prudence to wear a wool three piece suit when venturing out doors, along with major amounts of goose down stuffed in nylon wrapped around for good measure. Stupid me. I hadn't purchased a nice lightweight silk suit for the trip. The heat hit like the backside of a broom and almost knocked me back into the 747 where the temperature was a more suitable 55 degrees. Being good hosts, Iijima and the rest of our team guided me to a company limousine where the air-conditioning was turned to high for my comfort. As we drove away from the airport to our destination, Iijima looked at me and asked, "You know Grenn-san that Fukuoka is very famous for sea foods. What would you like for dinner tonight?" I answered as only I could at a time like that, "Surprise me." Iijima smiled

Our first stop was a restaurant for lunch. It is important to understand that many Japanese believe that a good sweat is much healthier than air-conditioning, so it is relatively rare to find air-conditioning even though it's readily available. To support the idea of cooling, many Japanese will drink a hot beverage, usually a green tea, and then wave a fan in the more natural form of evaporative cooling used by land animals since they crawled out of the mud some 300 million years ago. I however, am a more highly evolved creature. I don't sweat enough to cool a sock for a ken-doll. I found myself in a crowded restaurant, with an ambient temperature of about 85 degrees, no ventilation, drinking hot tea, wearing a three-piece suit, hung over, and can you wonder that I didn't feel too good? In fact, things that had recently seemed clear to me, like windows and doorframes, started getting I spent some time with my English-Japanese fuzzy. dictionary and managed to convey that my vision was getting blurry and that this was not a good sign of prime health. Iijima responded by handing me a mint and suggesting I take a walk. I took a mint and took a walk. The walk, it turned out, was an excellent idea, for only a few yards from the restaurant was a hardware store with an active display of various air-conditioners that the less traditional Japanese could put in their homes. I found one that removed the most BTU and simply stood in front of it dropping therms as fast as the Freon cooled airflow could remove them. Too soon, it was time to go, and we piled back into the company limousine for our visit to the captive customer, the Fukuoka police department as it turned out. I looked back longingly at the hardware store display and promised myself, if I ever had a chance, I'd come back and buy that floor model for my very own.

This captive customer, the prefecture police department of Fukuoka had purchased almost everything in the world from my host, which was the NEC Corporation, known at this time as Nihon Denki (which meant Japan Electric). If there was an electron to be moved, it was housed in a box with an NEC label on it, and then handed to the customer in Fukuoka for payment. One of the most wonderful things NEC had sold to this captive customer was a large mainframe computer called an ACOS. In this day, a mainframe computer was the height of sophistication and engineering, and to pamper these multi-million dollar toys, massive amounts of air-conditioning were required to keep them from prematurely failing in the midst of their daily chores. In fact, as far as I can tell, the only room in the entire city of Fukuoka that had air-conditioning was the computer center where the ACOS was housed. Had I previously mentioned in this narrative that I was hung over, and over dressed and exceedingly hot? I spent an hour in that room asking every conceivable question about the computer, its use, how it worked, why the colors on the console were green, what that button did, how many pounds it weighed, you get the picture? They literally had to push me out of the room to get on to the meeting.

Ahh, the meeting. This was my whole purpose in making this trip. For reasons that I'll never understand, I was the guest of honor, the American who had made the trip from Minnesota who was going to do some kind of software magic that would rid this fair city of crime and make it a safer place for humankind. I was introduced to my interpreter at the door, a gentleman who had been imprisoned by the British during the second world war, who had such a thick cockney accent that I didn't understand a word of English that he spoke. Sadly, he didn't understand a word of my English either with my southwest U.S. dialect. To this day, I believe the meeting would have gone far better if I hadn't had this particular translator, but it was an honor to have one, even though neither of us had a clue what the other was saying. He escorted me into a large meeting room where about 30 people were arranged in a circle. Since everyone smoked, some smoking two or three cigarettes at a time, the room was stuffy, and hot, and way over in the corner opposite me, perhaps 50 feet away, someone had

cracked a window and put in a small 5 inch desk fan to encourage air circulation in the room. I sat in my chair next to my interpreter and started wondering if removing my clothes would be considered a normal behavior for a guest from Minnesota.

The meeting droned on and on and on, as all meetings of 10 or more people do. It was followed by presentation after presentation with my interpreter occasionally mumbling things like "jolly well put" and "good show" amidst a mumble of other words that I couldn't quite place. It was somewhat refreshing to sit there in that big plush leather chair, watching that fan turn way far away in that corner, until I noticed that I was still hot and had suddenly ceased sweating completely. Somewhere in the back of my mind I remembered the symptoms of classic heat stroke. This, I began to think to myself, is the end. I will simply fold into this chair, and no one will notice, and when they leave, I will slowly desiccate into a brown leathery form that will be indistinguishable from the leather of the chair. I will never be seen or heard from again and will spend the rest of my physical days on this earth supporting the overheated buttocks of strangers who've never been in an airconditioned room. On the verge of becoming one with the chair, a semblance of sanity hit me. I leaned over to my translator and whispered. "I need water. I need salt. Now." Amazingly, he looked surprised like he understood. He signaled one of the girls who always stand around meetings like this, who rushed over and took my order for water and salt. A few minutes later she returned with a small 6-ounce glass of water, and a small silver tray with a neat pile of salt

in the center and a small spoon to the side. I spooned the salt into my mouth and drained the water and waited to see if I was going to lose consciousness or not. The answer, was... not. As I waited for the outcome, my interpreter leaned over to me and said, "You speak now." I stood up, and with the certainty that no one in the room would understand a word I said, and the greater certainty that my interpreter would say what I should have said, I entered into a speech that probably resembled the jabberwocky in complete logical consistency and flow. I think I was there to discuss how a certain kind of statistical analysis would help implement preventative crime intervention programs, but as best I can tell, I rambled about the weather in Minnesota, the high price of Freon in Japan, and the wonderful climate that had been shown to me in the computer room a short time ago. I then said something like "thank you" and the room burst into applause. They had never seen a Minnesotan in a three-piece suit survive such a meeting before and my guess is the applause was a tribute to my survival to that point. I looked at my interpreter and asked in all seriousness, "What did I say?" To which he replied in all seriousness, "I have no idea." At that point, I decided I love a captive customer.

It was now time for dinner. I was sweating again, and there was a breeze, and the temperature was now in the high 70s, and I could loosen my tie, and I actually thought I'd live through the day. What I hadn't remembered was what I had said in the car when Iijima had asked, "What would you like for dinner?" Do you remember what I had said? I had said, "Surprise me."

So off we went in search of dinner. In Japan, a restaurant is rarely in a building by itself. A restaurant is often found above or below something in a large building or building We entered what in the U.S. would have complex. resembled a large bank building and then walked down three flights of stairs into a cool basement restaurant where we sat on traditionally tatami mats and prepared for a relaxing celebratory dinner. As I sat, the waitress brought me a glass of water, and then two more as I seemed to absorb each one within seconds. Iijima smiled at me with that typical Japanese smile that is lacking major dental care and said, "This is special restaurant." I didn't care, I had water, I was alive, and my tie was on the ground next to me. I managed a weak smile back and asked, "So what's for dinner?" Iijima smiled at me and said, "Fish."

Eating in Japan is often done without a chair. A small cushion is often used and you sit on the floor next to a table that is about 18 inches off the ground. It's really easy to get used to that kind of eating style, and it's hard to break the habit when you return to more western countries. However, sitting on the floor at a McDonalds to eat a big Mac and fries would probably get you arrested rather than respected for your internationalism. It makes you chummier to eat this way, and, it makes you closer in some sense to your food. Another thing about Japanese dining is that it tends to be lots of small dishes served in a series to give a sense of a banquet than can last literally for hours. Our first dish was a small porcelain cup filled with the standard Japanese seaweed in vinegar. Most Americans would think of it as soaked green thread. It's quite good actually, provided you don't chew. This preceded the main course.

The main course was brought in with great fan fair. You must picture this scene, a table with 6 adult males, one of them a foreigner, me, seated around a rectangular table on the floor of a small semi closed room in the basement of a bank building in a city of 1.2 million people living by the sea. Into this room, walks the waiter, carrying an extremely ornate wooden bowl perhaps three feet long by 2 feet wide. The bowl is carved monkey pod, and is carved in the shape of a fish, with each of the intricate details of the scale and fins clearly chiseled with great care. In the center of the bowl was a massive pile of crushed ice on to which had been piled the bodies of fish, on top of which were the thin slices of the fish, the sashimi, which were our meal. In Japan, eating raw foods, even fish, is a normal and actually quite appetizing thing. As the bowl was placed in the table, even I, the boy from Minnesota, was getting hungry and this looked pretty good. I reached for a piece of sashimi with my chopstick, and then noticed something, the fish underneath was looking back, and its mouth was opening and closing. Iijima looked at me and said, "This is very *fresh* fish."

The thoughts that pass through your mind at a time like that, especially given the events of the last 24 hours are really very few. There's nothing left to protest with. Nothing. I was totally drained. I ate some very *fresh* fish. After a while, the fish on the ice stopped moving, and I could start thinking that they weren't so fresh anymore. The waiter returned after a few minutes and took the monkey pod bowl away and passed out small bowls of little round things. I asked the only question you should never ask when dining in Japan. I asked, "What is it?" Iijima looked at me in his fatherly broken toothed way and said, "Remember fish that was just here?" I nodded. He said, "This is son of fish." Son of fish wasn't too bad, as long as you don't think about that little squirt that jets out of the eggs when you bite down.

I felt sure I could live through any meal at this point when the waiter brought in what distinctly looked like the heads of the fish. I didn't bother to ask this time, it was the heads of the fish, only cooked this time. We dined on the cheeks which it turns out were quite good. Then the next course found its way to us. Somehow, they had extracted the complete skeleton of the fish, and deep-fried it into a delicious crunchy delicacy. Each of us got our own skeleton to dine on. And last but not least was the final course, which was a big bowl of soup for each of us, containing of course, whatever part of the fish we hadn't previously eaten. In one sense, it was probably the most ecological meal I've ever eaten.

Of one thing I am certain. The captive customer paid for that meal.