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Interview with Glenn Fishbine

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Questions by Sander Olson. Answers by Glenn Fishbine.

Glenn is currently the Director of Information Systems with a medical device manufacturing company as well as a board member of a small biometrics company. With 25 years of business and management experience, including pure startup through IPO experience, Mr. Fishbine brings unique and seasoned business experience from a career of technology management in both the United States and Japan. With over a dozen patents and experience in patent litigation, Mr. Fishbine's grasp of intellectual property issues focuses on bottom line performance. Having directed the development of over one half million lines of software in unique parallel processing environments and managed the marketing and P&L functions of several companies he provides a unique business acumen. He currently focuses his efforts on emerging and small pre-IPO companies. His latest book, "An investor's guide to nanotechnology," is due in the fall of 2001.

Question 1: Tell us a little about yourself. What is your background, and what are you doing currently?

I have been in the technology arena since the mid '70s, primarily in software engineering. I started a company in my basement that later became traded on NASDAQ. I have about a dozen patents in a variety of different areas. I am currently the chairman of the board of a publicly traded biometrics company, a scout for a consortium of European Venture capital firms, and the Director of Information Systems in a global manufacturing company. I have a book entitled "An Investor's Guide to Nanotechnology and Micromachines" coming forth this December from John Wiley & Sons. Currently, I'm debating between starting a new technology company versus talking some youngster into doing it for me. I was raised in the mountains of New Mexico and currently reside in Minnesota. For hobbies I enjoy scuba, composing music, discovering new ethnic foods, and trying to teach my youngest child to drive without doubling my insurance rates.

Question 2: When did you first become interested in the concept of Molecular Nanotechnology?

In the spring of 2000 it became clear that I was going to write a book on nanotechnology. Nanotechnology means many different things. To get a handle on the meaning of nanotechnology starts by creating a dictionary that translates from one research domain to another. For example, your question refers to molecular nanotechnology, which to some has the precise meaning of building objects out of molecules. To others, it refers to building objects at the size of molecules. To others it's the simulation of what happens at the molecular level. To some, it's a meaningless concept. Nanotechnology is too young and vibrant for the terminology to have settled into consistent meanings. For me, to think of nanotechnology at any scale, nanotechnology is the art (not yet science, art) of imposing structure on the interactions between individual atoms. This can be done at any scale whether done an atom at a time or in a blast furnace.

Question 3: What do you think of the current investment climate of Molecular Nanotechnology? Is it adequate? Is it increasing?

For this answer, I'm taking "molecular nanotechnology" to mean a very narrow research topic, akin to molecular electronics. At this time, funding is adequate. Most of the investment is from the NNI, although there are some significant corporate sponsors such as MITRE and HP. There are 1 or two private companies working in this area
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with no time horizon for profitability. There are perhaps 50 university settings Investment tends to follow profits. Profits are derived from products. There are no molecular nanotechnology products at this time, so the investment in hand is probably adequate. If you drop the word "molecular" from the question, it's a much much broader answer. I come from the school of investment done for commercial interests (profit motive). Less than 10% of all nanotechnology investment comes from a profit motive. Companies and investors who invest in nanotechnology tend to not care that they're investing in nanotechnology. A smart investor "assumes the magic" and pays more attention to the management team, the market, the product, and the competition. If there are problems with the investment climate for nanotechnology, it's not from lack of interest or potential. The startups that attempt to work with nanotechnology tend to be seriously deficient in business skills and business experience. The investment climate globally is bad for everyone right now, but if a nanotechnologist could put together a good business team and a good business plan, then they would find investment with little effort. I have yet to see that happen. If you can prove to an investor that you can make a profit selling rodent droppings, you will be funded. Nanotechnologists tend to expect people to pay for being fascinated but forget that Hollywood has the lock on global entertainment. Investment is in the hands of the technologists. It does no good to solve thorny technology problems if you can't figure out who's going to buy the result.

Question 4: How much money is the U.S. Government spending on nanotechnology research? What about foreign Governments?

Approximately 1/2 billion dollars per year. Foreign governments are spending equivalent amounts. Corporate research is probably on the order of 1/4 billion on a global basis. However, keep in mind that MOST of the "nanotechnology" research is actually directed at MEMS.

Question 5: Do you believe in the concept of full-blown Drexlerian Molecular Nanotechnology? If so, when do you anticipate it will happen?

Absolutely not. I anticipate that Drexlerian concepts will evolve into real concepts. Drexler serves the evangelism role in promoting concepts which are ultimately funded. On the other hand, probably very little of what Drexler has proposed will find any basis in reality. The things he didn't think of, the really strange and wonderful stuff, will come forward as the technology evolves.

Question 6: Do you think that molecular nanotechnology techniques will ever be used to create bulk commodities? If so, how will this happen?

No. The principle of replication is well suited for biological mechanisms, but with 1.5 billion years of evolution, biological systems have managed to find means to bulk replicate organisms. The goal of nanotechnology is not to create bulk nanomachines. We don't need a competing life form at this time. Bulk commodities are essentially presumed to be something for nothing. The actual fact of physical reality is that the expenditure of energy and matter to create a can of Pepsi will probably be served more easily by current technologies than any possible nanotechnology. This isn't to suggest that nanotechnology will not result in the production of myriads of valuable commodities, however, you have to keep in mind the economies of scale sometimes make it easier to use a drill press than a hundred billion nanomachines to drill a hole in a sheet of aluminum.

Question 7: Will the current economic slowdown have a significant effect on the development of nanotechnology?

No. Economic slow downs affect the availability of R&D at the corporate level. This affects maybe 12 % of the net investment in nanotechnology. As long as the tax base holds and competing governments invest in the technological high-ground, R&D for nanotechnology will continue. What would tank investment globally would be if tax revenues drop off. If that happened, nanotechnology R&D would come to a screeching halt.

Question 8: How long do you believe that Moore's law will continue?

I don't think it's a belief issue. The physics require Moore's law, which by the way, isn't a law, to come to a screeching halt in 10-15 years or so. However, Semiconductor Research Association data indicates that the law is

failing already. Sometimes, physics gets in the way of marketing hype. Moore's law is more of a sociological commentary than a commentary about physical reality. Alternate physical approaches may result in different laws. Today's semiconductor technology is 2-D---Components per square inch. 3-D technologies are on the horizon which would create a different set of laws. It is interesting to speculate what happens when we start stacking components in 3 dimensions instead of 2. Implementing Quantum devices which have no respect for traditional von Neumann architectures could make Moore's law irrelevant insofar as computational performance is concerned. A quantum device that contains a thousand components covering several square meters could conceptually outperform semiconductor devices containing a billion components fabricated at the nanometer scale. I think a paradigm shift is pending which will make Moore's law about as relevant as Karl Marx's "Capital."

Question 9: What is your opinion of writers such as Ray Kurzweil and Hans Moravec, who argue that real artificial intelligence will come within the next several decades?

My opinion is they have more money than I do, therefore, they get the moral high ground before I do. However, artificial intelligence (AI) presupposes that we have intelligence of any kind. Psychology has no empirical model of intelligence. Insofar as we can't even state what intelligence is, suggestions that artificial forms will occur in any time frame are so much bull. If we were able to define intelligence, then we could define what is required to replicate it. If that were to happen, AI would happen in a few years. As things stand, AI researchers have been bloodied over the last 4 decades for failing to come up with anything resembling the intellectual capacity of a flat worm, let alone a human. I don't doubt that we will be talking to our computers in a few years. I do doubt that they will say anything to rival Socrates in the near term. To speculate about things coming in decades hence is an interesting exercise. I would strongly advise any futurist to watch Stanley Kubrik's movie, 2001, to determine the value of technology forecasting.

Question 10: What do you think are some of the most vital legal questions pertaining to the development of nanotechnology? Are there any laws that will need to be passed to encourage development or prevent abuse?

At this time, it is a concern of people who have nothing better to do.The simple fact is, science and technology will happen with or without a legal framework. Thus far, the human race has been lucky by failing to create the unstoppable suicide machine. Nanotechnology poses no greater threat than the hydrogen bomb. People of conscience have tended to be lucky enough to prevail in any era of potential mass destruction. Sometimes, people without conscience prevail. No legislature ever conceived will figure out the moral, legal, or survival questions before the power being legislated is beyond their control. I think we need, simply, to be lucky, and trust that our technologists and scientists have some sense of morality that permits the race to survive. Sadly, I commend our fate to the quality of the public education system and its ability to teach ethics to our scientists. The human cloning debate of August 2001 may point to the futility of such trust.

Question 11: What advice would you give to someone who wants to have a nanotechnology related career?

Plan A: Study physics. Get a PhD. Then go back to school and get an MBA.

Plan B: Choose your parents wisely so that you have several hundred million to invest in the minds of others when you come of age.

Question 12: What are your plans for the future?

I think it's time to focus my attention on genomics.Those working in genomics have finally figured out how to make money. This is an area that will explode before I become too senile to participate in new technology. Nanotechnology is going to evolve through the sidelines over the next decade. I think companies that produce corrosion resistant paint will have far more to say about nanotechnology's development than any room full of Drexlerian evangelists. The simple fact is, profitability drives innovation. Products exist today that are derived from nanotechnology. However, in the majority of the cases, the people who derived the nanotechnology based products had probably no clue that they were even involved in nanotechnology nor had a spiritual agenda. Their

attention was focused on solving problems. Their solutions happened to involve small things... at the nanometer scale. That tends to be the way of capitalism. I happen to like this approach. It creates a world of surprise and wonder.

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