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INDUSTRY

Interview with Glenn Fishbine
Author, *The Investor's Guide to Nanotechnology and Micromachines* (John Wiley & Sons, 2002)

It seems you've been tracking the Nanotech field for quite a while - is that correct?

My interest in nanotech started with my brother. He's a PhD at Los Alamos National Laboratory, and has been working with Buckytubes for about a decade.

What brought you to put together this book?

The reason Wiley [the publisher] asked me to do this book was because I had been involved in the development of the biometrics industry about 15 years ago from the ground up. So the question was: here's another emerging industry. OK, you've been through this before. You understand what it takes to bring an industry from your basement into commercial practice. Now take a look at nanotech in the same light.

What are the commonalities? Is it real? If so, what do we have to think about it? See if you can translate your prior experience to where nanotech is in its current phase. That's the orientation we were taking...trying to help investors make sense of complex technologies, and help entrepreneurs understand the viewpoint of serious investors. I'm never going to claim that I am a nanotechnology guru, but I do know quite a bit about emerging markets.

Can you pinpoint some common trends or factors to both industries?

One of the things you have to be watchful of in any emerging industry is the evangelist. The evangelist goes out on a limb and says, "Look at all these fantastic things that are going to be possible!" But they don't know how to make them.

Then there are the technologists who say, "Well I can make this now." They do the real work, but may not know the difference between fascinating science and a potential product.

And then there are the shysters. The shysters say, "Hey, this is a great buzzword. Let's go make a million dollars selling stock for a technology that doesn't exist yet." There are several of them out there. Beyond that you have the capital formation people who generate commissions on finding money, including VC's and broker-dealers. There seem to be a number of people who want to be THE venture capitalist for nanotechnology. I guess there's one particular individual who comes to mind who's undoubtedly going to exceed the wealth of your wildest dreams over the next 5 years by virtue of the fact that he is the self-proclaimed wizard of nano venture capital. But he only has to close one deal every two years to be extremely wealthy. Yet if history repeats itself, maybe 1 in 3 of the companies he finds money for will do OK. Broker-dealers get paid up front even if the company shuts down a week after the deal closes.

On the entrepreneur's side, one of the things that I found very disheartening was the high fatality rate for start-ups. I'd say 20% of the companies that I included in the reference section are gone. That doesn't mean they're completely gone, it just means they've shifted into other areas. However, for every company that's died there are three that have started up in the nine months since I finished the book.

The major thing most startups are missing is an understanding of what a venture capital business model is. They haven't a clue of what a management team is supposed to be.

Well, what is a real management team supposed to look like?

A management team includes a CEO--he doesn't have to know what the technology is, but he's the paramount salesperson who can keep everybody together and share and preach the vision. Then you need a CFO, who is someone who can manage the money--in the good times and the bad times. You need some kind of a chief technology officer--somebody who knows how to make whatever it is that the company is going to make. And you need a sales guy, who can define a market first, and then sell to the customers in the market. You need those four functions for any enterprise to survive. If they're good, the enterprise will do more than survive, it will thrive. The number of nanotech companies that actually put together management teams that have these four components is dismally small at this time.

From the investor's point of view, you're selling a management team first. Then you're selling a market. Then you're selling technology. But you have to get the order right. Or it just isn't going to happen. The VC doesn't care that it's nanotech, he cares that these people can make money because of who they are. Next, that there is a market. And then, finally, what's the product?

That's the order the VC looks at. The nanotechnologists who do start-ups tend to get it backwards. They say, "Here's the technology. Isn't it wonderful, oh and maybe there's a market."

So part of the thrust of the book is to try to get nanotechnologists thinking like business people rather than like technologists.

You have a pragmatic, if fairly unorthodox, definition of nanotech as "anything too small for the eye to see."

Well, that's the way the National Nanotechnology Initiative is doing the funding. A micro-air vehicle with a 5-inch wing span is nanotech? Not a chance! But DARPA puts nanotech dollars into that. Now somebody like Smalley or Drexler might say, you're not manipulating individual atoms, so it can't be nanotech.

I say, follow the money. Wherever people are spending money and calling it nanotech, then that's nanotech. From an investor's point of view, it's not what is real that counts, it's what people think is real that counts. From a physicist's point of view, there's physical reality. We can't argue with physical realities. But from an investor's point of view you can change the reality to fit the current conditions of the market. Markets are psychological phenomena so you can manipulate markets with good marketing and good expositions. Every entrepreneur should carefully ponder the economics of the "pet rock." This is a product, a rock, inside a cardboard box with humorous writing on the outside. It made millions of dollars in profits. Most investors would understand investing in the next pet rock more easily than some esoteric self-assembling nanostructure.

For physical realities with real markets, consider the fact that the current size of Intel's fab is down to 130 nanometers for line widths. If that's not nanotechnology, OK fine. But it's pretty darn close. And it's going to keep moving down in scale for some time. But it might not count as nanotech for the Drexlers and Smalleys.

It seems like the universities are very aware of the potential of technology transfer, both to boost revenue and as a way of incubating local businesses. You included a whole chapter on this in the Investor's Guide.

Most of the NNI's investment ends up in universities. For the investor though, a major problem is that a good technology transfer team in a university has a life expectancy of three years. After that the team gets smart and realizes that they can make more money elsewhere. They've been trained at university expense, and they get out and start their own company once they've got the formulas down. The other thing is, only about a third of all the intellectual property that comes out of the university actually goes thru the tech transfer offices. This is because much of the funding for university research is corporate, not federal. If the money comes in from Monsanto it's never coming out of the tech transfer office.

Technology transfer is lucrative and generates a fair amount of money for university coffers. But very few university tech transfer offices are on a break-even basis. If you're playing that game you have to figure out how to maintain stability in your office. Somebody like Harvard or MIT, they're going to hit a gold mine every 3 years and make a million bucks in licensing a year. But most aren't so lucky. For investors looking for nanotechnology investments, it's important at this stage to understand how technology transfer offices work. Similarly, for entrepreneurs in the university environment, it's equally important to know how to work with, or avoid, the technology transfer offices.

For such a nitty gritty business book, I was surprised to see you also touch on some of the more far-out, controversial visions of nanotech, such as nanobot swarms and nano-pollution.

Yes, in the last chapter I pose an interesting problem. Machines break-how do you get rid of them? A pile of broken nanomachines is just a garbage dump. If you don't know how to get a broken machine out of the body, you better not put it there in the first place. If you don't know how to shut down the coal-mining nanobots before they strip the surface of the planet clean, don't put them out there in the first place.

You've got this whole concept of control/counter-control that occurs in any system. You have to think of this from a systems perspective, the dynamics of feedback control. The nanotech people are coming up with a novel concept that has not been dealt with by computing science in any extensive way. There's a whole infrastructure of software engineering that's missing, a whole infrastructure of communications management, and fundamental gaps in our knowledge about how to build complex interacting systems that we can communicate with. How do you get a million robots to cooperate with each other and do something collaboratively? Even if you had a perfect autonomous Nanobot swarm there's no clue today how you could control it. The concept makes sense, but the infrastructure technology is simply not present. Then you have to deal with the prospect of unpredictable emergent behavior among a mass of semi-autonomous units all trying to interact. Many of the challenges are not in the building of these machines, but in the management and control of these machines.

Have you read Neal Stephenson's science fiction novel The Diamond Age? He spells out a lot of those scenarios in some detail.

No, I haven't. He's probably a better author than I am with the freedom to let his imagination run wild, and probably doesn't have editors looking over his shoulder at every word trying to figure out if they're going to get sued because I said the wrong thing about the wrong person or company. Fiction writers have more latitude than finance writers.

Would you say there's a social dynamic where technology is often driven by grandiose dreams of the possible?

In nanotech I think it's a little less driven by the dreamer than by the practical realities.

If you look at the impact of quantum mechanics on the economy of the United States, something like 40% of the growth in gross domestic product over the last 10 years is due to developments in engineering and physics that deal with quantum mechanical devices-the whole semiconductor industry. The original theoreticians were not evangelists. They were just physicists. They came up with very sound theories that translated into very sound physics. This in turn translated into very sound engineering in existing markets where people were solving real problems. Thus we end up with a semiconductor industry worth 100 billion dollars a year. If that isn't nanotech I don't know what is.

You can read more about The Investor's Guide at the author's web site: glennfishbine.com.

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