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Forbes/Wolfe 2006 Nanotech Person of the Year

*Every so often, you encounter someone who embodies a rare combination of personal achievement, business success and great civic and philanthrophic contributions—**Bernie Marcus** is such a person. It is with great pleasure that we award him the inaugural "Forbes/Wolfe 2006 Nanotech Person of the Year" for his significant personal contribution to advancing nanoscale science and technology and encouragement of entrepreneurship and free enterprise in the sector.*

*Marcus is a co-founder of **The Home Depot** [HD], the world's largest home improvement retailer—which revolutionized the home improvement business with its warehouse concept. He served as Chairman of the Board until his retirement in 2002 and remains director emeritus and Home Depot's largest single stockholder. The company's market cap: currently more than $80 billion.*

From 1972 to 1978, Marcus was Chairman of the Board and President of Handy Dan Improvement Centers, Inc., a home center retail chain. Prior to Handy Dan, Marcus was President of O'Dell's, a manufacturing conglomerate, and Vice President of Hard Goods Merchandising for Vornado, Inc., a retail chain.

Marcus is Chairman of the Board of The Marcus Foundation, the center for his philanthropic pursuits which focus on Jewish causes, children, medical research, free enterprise and the community. In 1991, he and his wife Billi established The Marcus Institute, which joined forces with the Kennedy Krieger Institute in Baltimore for children and adolescents with disorders of the brain and their families. Other philanthropies include founding the Israel Democracy Institute in Jerusalem, chaired by former U.S. Secretary of State George Shultz, The Shepherd Spinal Center, The City of Hope, The Marcus Jewish Community Center, and Business Executives for National Security. A native of Newark, New Jersey, Marcus received his B.S. degree in Pharmacy from Rutgers University.

Having built the second-largest retailer, and the recently opened $290 million Georgia Aquarium—the largest aquarium in the world, housing more than 125,000 animals from 500 species—I thought it was safe to say he doesn't do things small—but his recent $15 million donation to Georgia Tech for a nanotechnology center, proved me wrong.

What inspired your generous gift for the new nanotech institute at Georgia Tech?

It goes back to what I learned as a young Jewish boy growing up in Newark, NJ with immigrant parents: you have an obligation to give back to society. Thirty years ago, when I had no money, I worked for various charities, gave my heart, soul and time—now I can also give money. The majority of the money my Foundation gives away is anonymous; with the exception of Georgia Aquarium and Georgia Tech, which were very visible. I gave the Georgia Aquarium to the city of Atlanta. It drew over 3.5 million people in its first year and you won't see my name anywhere. I'm not driven by ego; I don't need to have my name on the building. I did put my name on the donation to Georgia Tech, because I want my children, my grandchildren and great-grand children to know I was associated with nanotechnology. The building is the laboratory. It's not for housing; it's a building for innovation where great things are going to be created.

Bernie Marcus

What allowed Georgia Tech and Emory to collaborate without competing?

They form a powerful combination. They intrigued me because of the most important component: people. I saw an easy working relationship, driven by science and research, not ego. They worked everything out financially before they started working together, so there would be no problems. I like that attitude. They want to develop product they can sell. That is what America is all about. This collaboration will be great for the state of Georgia, great for the region creating jobs and will serve as a magnet for new companies. It will have a very strong effect on the free enterprise system within the U.S.

How did you learn about nanotech?

I'm basically a dinosaur. I don't use email. But I do recognize the importance of science and the resulting possibilities. Two years ago nanotechnology came to me through a phone call from a friend, another dinosaur, involved with Georgia Tech, who explained their desire to establish a building for a nanotechnology program.

The first thing I said when approached about the Georgia Tech gift was my trademark, "are you

INSIDE

Top 5 Nanotech Breakthroughs of 2006

This year saw a slew of remarkable nanotech breakthroughs, and narrowing down the top five was no easy task. One major theme of 2006 was the intersection of computing and biology—integrated circuits were used to study everything from neural activity to tissue dynamics, and disposable bio labs-on-a-chip became a reality. One Harvard research team, led by Robert Westervelt, created a hybrid chip that can control the motion of biological cells; with the chip, researchers can assemble cells one by one into artificial tissue which can then be used to test the efficacy of various drugs.

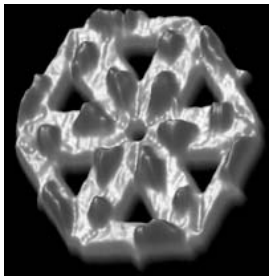
This year also brought us several steps closer to nanotube computing, as many research groups developed new ways to custom design nanotubes. Researchers at Stanford University and at Northwestern University came up with two novel ways to sort nanotubes by their electrical properties, and a group led by James Tour at Rice University developed a revolutionary method first envisioned by the legendary Richard Smalley for growing mass quantities of nanotubes from nanotube "seeds". These methods will find near-term applications in innovative materials, high-def displays, and solar cells, among others.

While many breakthroughs came out of academia, the corporate sector held its own. For instance, **Motorola**'s [MOT] carbon nanotube TV's are ready to leave the lab and hit the market, outperforming today's flat panel displays and **IBM** [IBM] is leading the way to nanoscale computing. From biotech to electronics, it's been an exciting year, and the following breakthroughs are the cream of the crop. So without further ado, we give you the top five nanotech breakthroughs of 2006…

1) DNA ORIGAMI

Researcher: Paul W. K. Rothemund (Caltech)

The sheer simplicity and versatility of Dr. Rothemund's "DNA origami" renders it a revolution in nanoscale architecture. Rothemund developed a technique to fold a single long strand of DNA into any 2D shape held together by a few shorter DNA pieces. He created software to quickly determine what short sequences will fold the main strand into the desired shape, such as the DNA smiley face he built, which is a mere 100nm across and 2nm thick, or his nanoscale map of the Americas. They sound silly, but these creations are proof of concept: here is a method for building scaffolding that can be used to hold quantum dots in a quantum computer or proteins in a multi-enzyme factory, to name just a few potential applications.



Atomic Force Microscope (AFM) image of scaffolded DNA origami (Courtesy of Paul W.K. Rothemund, Caltech)

2) NANOMAGNETS TO CLEAN UP DRINKING WATER

Researchers: Vicki Colvin, Amy Kan, William Yu, J.T. Mayo, Arjun Prakash, Joshua Falkner, Sujin Yean, Lili Cong and Heather Shipley (Rice University)

According to the World Bank, nearly 65 million people are at risk from arsenic-related health problems due to millions of contaminated wells, especially in developing nations like India and Bangladesh. Now, a research team led by Vicki Colvin at Rice University has developed a simple and inexpensive way to solve the problem. Rust nanoparticles, which have magnetic properties, bind to arsenic; the rust and arsenic can then be lifted out of the water by nothing more than a hand-held magnet. The breakthrough was the realization that the manipulation of nanoscale rust would not require huge magnetic fields, as was expected. The unique properties at the nanoscale cause the rust nanoparticles to act as one large magnet that can be easily drawn out of the water, leaving behind drinking water pure enough to meet EPA standards. The method, which requires no electricity or extensive hardware, will have a global impact.

3) ARRAYS CONNECT NANOWIRE TRANSISTORS WITH NEURONS

Researchers: Charles Lieber, Fernando Patolsky, Brian Timko, Guihua Yu, Ying Fang, Andrew Greytak, and Gengfeng Zheng (Harvard University)

In the first ever two-way interface between nanoelectronics and living neurons, Dr. Lieber and his team have created a revolutionary way to study brain activity. Silicon nanowires link up with the axons and dendrites of live mammalian neurons, creating artificial synapses between the two and allowing scientists to study and manipulate signal propagation in neural networks. The device can measure the brain's electric signals with unprecedented sensitivity, amplifying signals from up to 50 places on a single neuron. It will allow researchers to accurately model complex brain activity, pave the way for powerful neural prosthetics, and open the possibility for hybrid nanoelectronic and biological information processing.

A hybrid structure consisting of a neuron with separate axon-nanowire and dendrite-nanowire (Courtesy of Lieber Research Group)

Nano in the News

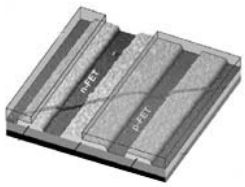
City of Berkeley, California to Regulate Nanotech

The Berkeley City Council is the first city in the nation to apply local nanotechnology regulations. The city ordinance passed on December 12 places no extraneous limits contrasting state and federal laws that would prohibit production of nanomaterials. Instead, by amending the hazardous materials laws, they will require local nanotechnology firms to document their materials and processes for their handling and disposal. According to *USA Today* no one in Berkeley is working directly with nanomaterials except for the federally run, Lawrence Berkeley Laboratory which is exempt from local ordinances.

4) SINGLE NANOTUBE ELECTRICAL CIRCUITS

Researchers: Phaedon Avouris, Zhihong Chen, Joerg Appenzeller, Yu-Ming Lin, Paul Solomon (IBM's T.J. Watson Research Center); Jennifer Sippel-Oakley and Andrew Rinzler (University of Florida); Jinyao Tang and Shalom Wind (Columbia University)

This year IBM unveiled the most complex and highest performance electrical circuit based on a single nanotube, demonstrating the applicability of CMOS technology and paving the way for the future of computing. The integrated logic circuit consists of 12 transistors made of palladium and aluminum tracing the length of a single carbon nanotube. The circuit is hundreds of times slower than today's silicon processors, but it is 100,000 times faster than any previous carbon nanotube device and has the potential to be much faster. Unlike silicon it doesn't require doping, which scatters electron flow, and is far more heat efficient. Expect to first see these nanotube circuits in hybrid nanotube-silicon computers.



AFM image showing the design of an intramolecular logic gate (Courtesy of IBM)

5) NANOPARTICLES DESTROY PROSTATE CANCER

Researchers: Robert Langer (MIT); Omid Farokhzad, Benjamin Teply, Ines Sherifi, Jerome Richie (BWH and Harvard); Jianjun Cheng (U. of Illinois); Sangyong Jon (Gwangju Institute of Science and Technology, South Korea); Philip Kantoff (Dana Farber Cancer Institute)

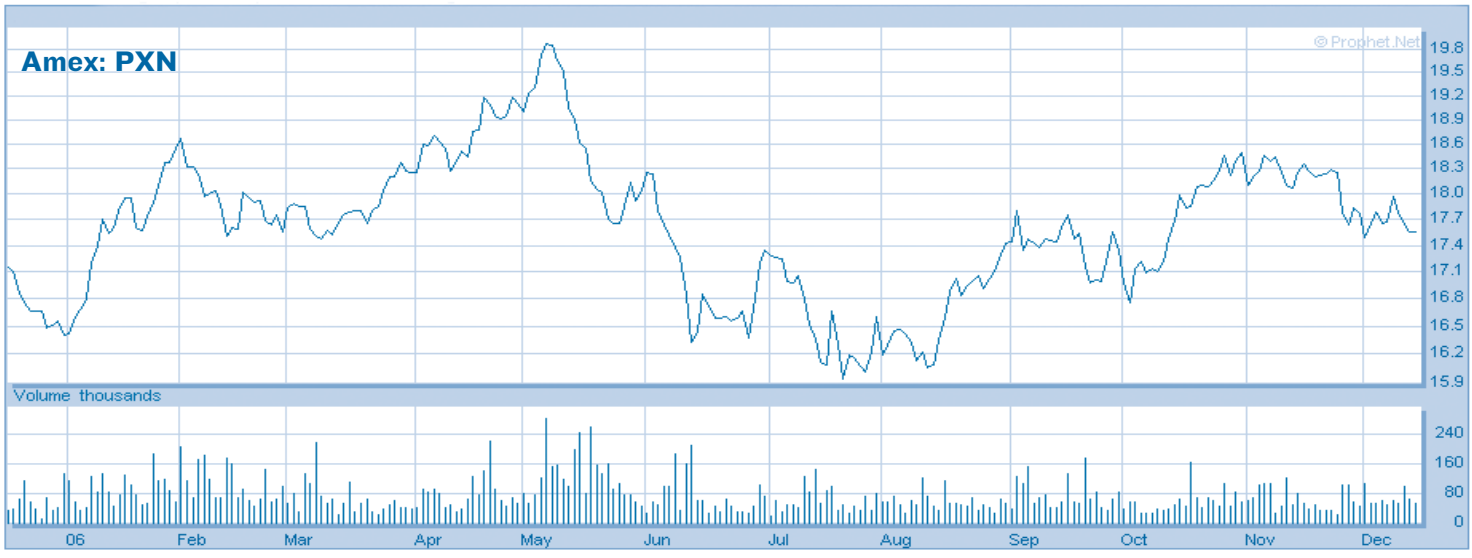
Here's one battle with cancer where cancer is losing dramatically—researchers at MIT and Harvard have custom-designed nanoparticles that hone in on prostate cancer cells and deliver doses of targeted chemotherapy. In trials with mice which were given human prostate cancer, a single injection of these nanoparticles completely eradicated tumors in five out of seven animals, significantly reducing tumor size in the other two. The work may be replicable for treatments of breast and pancreatic cancer, as well. Look forward to seeing these cancer-killers in human clinical trials.

Looking Ahead to 2007:

What do we have to look forward to in the coming year? We are sure to see more groundbreaking developments in the emerging interface of nanoelectronics and biology. The number of novel nanoparticles for biomedical applications is poised for accelerated growth, and there will be a special emphasis on combination products that can be used for medical imaging and targeted drug delivery, especially for cancer. As the corporate world continues to go green, environmental nanotech will come to the forefront, with applications in fuel cells, solar energy, and hydrogen storage, to name a few. There's a lot looming on the horizon, and we will keep you several steps ahead of the game on the pages of this newsletter. Here's to another great year of thinking big about thinking small! N

Nanotech Stocks: The Year in Review

2006 was a volatile year for the markets and nanotechnology was no exception. After falling in May, along with the Nasdaq and the Dow, the PowerShares Lux Nanotech ETF is up strongly and should end the year on a high note.



Nano in the News

EPA Clarifies Position on Regulation of Nanoparticle Silver Use and Production

The EPA has mandated that any product containing nanosilver intending to act as an antimicrobial must conform to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The change is intended to correct the EPA's original classification which called nanosilver-based products pesticidal devices. Nanosilver is used in many different products from Sharper Image's food containers to smell resistant clothing. The new classification forces many companies to be more accountable and show heightened forethought concerning the risks of their nanotech products. This will not impact biomedical applications of nanosilver, like **Nucryst**'s [NCST] wound dressings.