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REPORT

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The Insider

Josh Wolfe, Editor

In this month's issue, we sit down for three exclusive interviews with cleantech VC investor Ira Ehrenpreis, high-tech CEO Greg Young and a crusader against Malaria, Chris Hentschel.

Few investors were as early to energy investing or have the level of energy for energy investing as Ira Ehrenpreis. It's hard to keep up with Ira. On any day he might be evangelizing the virtues of cleantech investing at industry conferences, running around meeting with entrepreneurs for his fund to finance or sitting in board meetings and ad-

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Ira Ehrenpreis: Clean Capitalist

Ira Ehrenpreis has been with Technology Partners since 1996, where he is a general partner leading the firm's investments in advanced materials and energy and water technologies. Funded companies include Tesla Motors, Accelergy, Deeya Energy and Nanogram. Ira is a recognized leader in both venture capital and the emerging "cleantech" sector. He serves on the board of the National Venture Capital Association (NVCA) and the Western Association of Venture Capitalists (WAVC). Ira received his JD/MBA from Stanford Graduate School of Business and Stanford Law School, where he was an associate editor of Stanford Law Review. He holds a B.A. from the University of California, Los Angeles, graduating Phi Beta Kappa and Summa Cum Laude.



Ira Ehrenpreis

What have been some of the biggest changes you've seen since you started investing in "cleantech?"

We have been investors in energy technology and the alternative energy sector since the early 1990s. This was before the moniker "cleantech" was actually used, and at the time, it was rightfully described as contrarian. We've seen many changes since those early days. First and foremost, back then only about 1% of all venture dollars were going into the sector. Now, it's between 15% and as high as almost 20%, depending on the quarter. Cleantech has emerged as the third leg of the venture capital stool, right alongside IT and life sciences.

A decade ago, when you talked about "green" investing, people thought it was all about the environmental benefits. What's really been the transformative realization is that you can have the green of the environment and the green of economic profits.

What factors have been the primary catalysts for the spread of cleantech?

We think about it in terms of a framework of five drivers. The first one we always talk about is the diversity of this sector. We start with this notion that cleantech is an umbrella term that really touches every major industry: energy, materials, chemicals, transportation, utilities, agriculture, _____ Continued on page 2



Greg Young

Greg Young: Delivering Data At Light Speed

Greg Young serves as President and CEO of Luxtera [full disclosure: my venture firm Lux Capital is an equity investor]. Prior to Luxtera, he was Vice President and General Manager of the High Speed Ethernet Controller and High Definition Media PC Video business units _____ Continued on page 4



Chris Hentschel

Chris Hentschel: Squashing Malaria Like A Bug

Dr. Chris Hentschel is President and CEO of Medicines for Malaria Venture (MMV) in Geneva, Switzerland. MMV is a nonprofit foundation that aims to facilitate the discovery, development and delivery of affordable new drugs for the treatment of _____ Continued on page 6

consumer products and services. It's creating entirely new markets. In the early days, particularly during the first part of this cleantech boom a few years ago, I think people narrowly thought of solar and biofuels, yet now I think we can safely say it's a transportation play, too. But that's really just the tip of the iceberg. Our portfolio includes investments in solar, transportation, storage, biofuels, fuel cell technology, coal technology, demand response, environmental registry, and advanced materials.

The second driver that I always talk about is really the corporate evolution. Up until recently, corporations didn't pay attention to green and clean, and that's been a major obstacle. A few years ago, some pioneering corporations decided to put a stake in the ground. **GE** [GE] began their "ecomagination" program, **Wal-Mart** [WMT] started greening its entire supply chain, and **Google** [GOOG] decided to make renewable energy to better expand their corporate mandate. In the last couple of years, every sector in the economy has now focused on green. So that's the second piece.

The third one is the public interest. When I first started investing in cleantech, people didn't understand what green or cleantech meant, and it wasn't a popular conversation at cocktail parties! People didn't always think about how they powered their homes or cars. They didn't think about environmental impacts of products. Now, you can't turn on the television or open a magazine without seeing shows and articles devoted to green themes or stories about the environment. There is a mania about going green, analogous perhaps to the mania a decade ago about going digital.

The fourth important factor is the political landscape. Now, we have essentially bi-partisan support for clean energy alternatives. If you look at the states that have passed renewable portfolio standards, and add in those states that have net-metering provisions, it really highlights essentially the "greening" of America.

The last driver is the global opportunity in cleantech. Every major area of the world is focused on cleantech, and that's creating the kind of global platform for the products and services of the companies that we're investing in.

John Templeton was fond of saying that the four most dangerous words for investors are, "This time it's different." How does this boom in cleantech differ from prior booms and busts in alternative energy?

I do think that the corporate environment today is different. The public environment and the interest in buying and thinking about these things are different. The political environment today is different. We didn't even touch on the unprecedented capital support for this by the U.S. government and, more importantly, governments across the globe. When Jimmy Carter was promulgating alternative energy back in the late 1970s and people talked about solar as one of the solutions, the cost-per-watt for solar was \$40 or \$50. Contrast that with technologies today that are getting down to \$1-per-watt and grid parity—if not superiority.

What about the human capital aspect to all of this?

Today the best and the brightest entrepreneurs are looking at cleantech as the next chapter in their personal and professional lives. We can talk about all the macro themes, but at the end of the day the companies that we invest in really depend upon the underlying people.

How do you pick winners in an environment where lots of people are coming on as 'me too' cleantech investors?

I think it's really important to distinguish between the long-term opportunity and the underlying trends that helped create this long-term opportunity, versus what it means to have something hyped or bubbled. The drivers that we're talking about are really long-term, enduring issues that create a platform of opportunity for the coming decades, not for the coming months. It's going to be natural and productive for the Darwinian effect that has always characterized the VC industry to unfold here.

vising and coaching CEOs. While Ira feels strongly about energy security and independence, he also feels strongly that there's green to be made in going green. If you could bottle Ira's energy, you could probably power a village.

Speaking of moving at the speed of light, it's been said that any sufficiently advanced technology is indistinguishable from magic. And the technology developed by rapidly growing Luxtera sure feels like magic. They incredibly turn information into light and are the world leader in nanophotonics, converting electrical signals into precise beams of photons. This is the next generation of computing. We sit down for an exclusive look at the future being brought to you by Greg Young, the CEO of Luxtera [*full disclosure: my venture fund Lux Capital is an investor*], and hear about the remarkable progress afoot.

And on the topic of progress: since their advent, nonprofits have been held to different standards of operational and capital efficiency than for-profits. And sadly, they often fail to attract leaders with the vision and business acumen to execute. So they come up short on delivering on any mission of social responsibility. But in past decade, one nonprofit has raised the bar: Medicines for Malaria Venture (MMV), led by Chris Hentschel. MMV celebrates its tenth anniversary this year with more than 50 drug candidates in their pipeline, including 10 in the clinic, and \$32.6 million in operations reserve—all while funding, manufacturing and distributing anti-malarial drugs to poor rural Asians and Sub-Saharan Africans for just cents per pill.

It's true that the future is already here, it's just unevenly distributed. Enjoy meeting some of your couriers. As always here's to thinking big about thinking small...and to the emerging inventors and investors who seek to profit from the unexpected and the unseen...



How big of an opportunity do you think cleantech represents?

These are trillion-dollar markets and opportunities. The easiest example is solar. Today, solar power accounts for only 0.02% of U.S. electricity generation. These companies are not competing with each other. They're competing with traditional energy—with the grid. Our companies need to hit cost-per-watt, cost-per-gallon, efficiency targets, or whatever metric these companies are using, to get to either parity or superiority with traditional energy.

Are there any areas within the cleantech sector that you think of as perhaps overinvested, and conversely what areas have been overlooked?

We've done two coal technology investments, at a time when people weren't investing in coal technology. We did our first battery/energy storage investment when people questioned whether or not you could do a battery investment as a venture capitalist. Energy storage is now one of the hottest sectors in venture capital. We invested in the electric vehicle industry at a time when people doubted whether venture capitalists should be involved in the automotive sector. We're one of the few VCs investing in the water sector, which today is incredibly underinvested.

With all that said, our internal philosophy is that one of the most important facets of being a successful VC is being open-minded to the far more creative and genius entrepreneur who might happen to walk through your door. We've had smart, creative entrepreneurs walk in and blow away our underlying assumptions, and we've made investments in areas we might have previously been averse to. Solar is a good example of that—it's an area that has received so much attention from the VC industry that we had a very high bar set for any solar opportunity. Yet now we've had a series of solar entrepreneurs who blew away our macro assumptions by their micro experience and ideas and creativity, and we've invested in them.

What are the traits that you look for in an entrepreneur?

It's a combination of leadership, commitment, persistence, tenacity, an understanding of calculated risks, creativity, fearlessness, delusional optimism, and focus.

Back to cleantech—you've spoken in the past about the historical levels of R&D spending within energy companies vs. tech companies, and I've always found that anecdote striking. Can you share it?

I would say there are actually three areas of underinvestment in the cleantech sector. The

first we touched on, which is the venture asset class. Historically, only 1% of all venture dollars flowed into this area. Number two, which is what you're referring to, is the corporate side. In the traditional areas of venture capital—IT and life sciences—everyone understands that the pace of innovation is governed by the fact that in order for companies to succeed, they need to understand that people are innovating all around them. So, when you look at IT companies like **Cisco** [CSCO] and **Microsoft** [MSFT] and **Intel** [INTC], they are taking 10, 15, sometimes 20% of their revenue and plowing it back into R&D! That's a proxy for how these companies think about innovation. On the life sciences side you see a similar phenomenon. Now, contrast that with the large energy companies of the world, which typically have invested two orders of magnitude less of their revenues into innovation. And you can see this desert of innovation that we've had by both the venture capital community as well as the corporate community. The third leg of the stool is the government. Historically, about a billion and a half dollars was flowing into the DOE while \$30+ billion was going to the NIH. You can think of that as a proxy for the importance that the government has placed on policies around health-care (which we are enthusiastic supporters of), but contrast that with the small amount of money that the government has invested in energy innovation. Again, you can see a glaring hole of innovation. So in all three of these areas we have this historic underinvestment which I think is leading to an unprecedented opportunity for entrepreneurs and venture capitalists investing in innovative companies.

Who are your heroes?

If I had to give you one, I'd say my grandfather. He was an immigrant to the U.S. who didn't have a formal education. He ultimately started nine companies. The first eight companies were not terribly successful. But as a wonderful example of the tenacity and perseverance that I spoke about earlier, the ninth company turned out to be very successful over time. I lived three doors away from my grandfather, so growing up he would bring me on sales trips, he would put me into the warehouse to work, and he would expose me to aspects of business that, for someone of my age, was an incredibly unique experience. And I will be forever grateful.

As your own children grow older, what will you encourage them to study?

Probably interdisciplinary studies. I am someone who firmly believes that what's criti-

“We have this historic underinvestment which I think is leading to an unprecedented opportunity for entrepreneurs and venture capitalists investing in innovative companies.”

cally important is really the interrelationship between education and thought processes and the way one thinks. While I'd encourage my kids to get deep into areas they're interested in, I want to make sure they've got a broad-based interdisciplinary approach. That is the key, and I think there are many examples of that. Our business is really about the ability to take knowledge and information from one area and apply it to another. So that would be my strongest message.

Is there an investment that you wish you made, where a subsequently very successful company pitched you and you passed?

One of the **eBay** [EBAY] co-founders was a Stanford business school classmate of mine—a friend and a great guy. He pitched us and we turned down the opportunity. So that would probably be in the "hall of shame," and I think anyone who'd been doing this business long enough has at least one of those. If you don't have just one poster child, but a whole series of companies that you turned down and later regretted, then you really haven't been a venture capitalist. But we don't get paid for the misses—we get paid and measured by how far we hit it when we do take that bat off our shoulders and swing.

Is there an overarching philosophy you have for how you approach life?

For me, it is about not following the herd, rather following your passions. There are countless examples of this in venture capital, and I think it characterizes our own commitment to the cleantech sector today. It's not something we're doing because it's fashionable—it's something that we've had a longstanding conviction around before it was fashionable, and that type of conviction leads to the most successful people. **ET**

Young: Delivering Data At Light Speed

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at **Broadcom** [BRCM]. While there, Greg led the growth of the Ethernet Controller business unit from concept to hundreds of millions in revenue and the #1 market share position. Prior to joining Broadcom, Greg was with **Intel** [INTC] where he held several engineering marketing and leadership positions.

What career path led you to Luxtera?

After trying some startups out of school I joined Intel in the mid 90s, beginning as an engineer and then transitioning over to marketing and running product lines. I worked at Intel until 1999, when I joined Broadcom. I spent eight years at Broadcom helping to pioneer the company's participation in the Ethernet market for the network interface controller business. Ultimately, I helped grow that business to about \$350 million dollars a year in semiconductor revenue. Most of my career has been spent building businesses off of advanced transceiver technology (devices that both transmit and receive information), so when I recognized the opportunity within Luxtera, it was easy for me to see how the technology could be built into a large-scale enterprise.

What excited you about the company?

First, some market backdrop here: it's getting harder and harder to send fast signals over copper wires. The world of optics has been sitting out there for a long time as the performance leader, but it has been a very expensive way to get the performance that you need for the same kind of input/output speeds. When I recognized that Luxtera had the ability to create a complete

optical transceiver in CMOS technology to take performance to 10 gigabits and well beyond 10 gigabits at a cost point that was previously unachievable, I saw the same kind of opportunity I was given at both Intel and Broadcom.

Put it in perspective—how fast is 10 gigabits?

If you use a cable modem at home, that's about a 1 megabit connection—a million bits per second. We're talking about ultimately transitioning people to the point where they can readily transmit 10 billion bits a second. That's the equivalent of downloading over 300 songs every second.

Why do photons trump electrons when it comes to broadcasting bits?

When you send an electronic signal over copper wires, there is a relationship between speed, distance, and signal integrity. As you get faster and faster over the same distance of wire, your signal integrity gets worse, and you see distortion in the signal that starts to dominate the signal quality at higher speeds. Because of that relationship, there is a natural limit for how fast and far you can push a signal over a copper wire. At 10 gigabit speeds, electrical interconnects over copper wires really start to break down—it's hard to transmit the signal even 10 meters. Alternatively, you can send a burst of photonic energy down a low-cost fiber optic waveguide, and you can easily send a 10 gigabit signal over 10 kilometers. You can do it with less power, less complexity, and with Luxtera's technology—lower cost.

Why is transceiver technology important in this industry?

While at Intel and Broadcom, I saw two things: first, mixed signal circuitry (combined analog and digital circuitry) would enhance the communications signals between systems, and second, I realized that the rate at which you come out with new transceiver technology is really what controlled the cadence of the innovation in the industry. I first saw this at Intel. The company was able to utilize its own technology to build transceivers for 100 megabit Ethernet. At the time, 3Com was the dominant player, but by leveraging the cost and performance benefits of hav-

ing an integrated transceiver technology in CMOS, we were able to transition the market from 10 megabit to 100 megabit Ethernet and move Intel's position from a minority player to the market leader within the network interface controller business. That was a really interesting learning experience for me. When I joined Broadcom in 1999, the company was the leader in mixed signal in CMOS and was just entering the Ethernet space, building up their business as an Ethernet transceiver vendor. What I was handed when I came into the company was a complete, single-chip gigabit Ethernet transceiver. At the time, no other company in the world knew how to build a single-chip transceiver for 1 gigabit data rates, and by having that technology I was able to facilitate a very similar transition to what I had been involved with at Intel—driving the market from 100 megabit Ethernet to 1 gigabit Ethernet. Today, you can barely buy a computer that doesn't have a gigabit Ethernet network controller in it, and it was that transceiver advantage that Broadcom had that allowed them to subsequently grab the number one market position from Intel.

CMOS, photonics, optical transceivers - sounds complex! In the simplest of terms, what is it that Luxtera's technology does?

Our technology takes a high-speed signal and gets it from point A to point B. A transceiver sends out a signal at point A and receives the same signal at point B. We send that signal over a fiber optic cable, giving us performance and signal quality advantages. Our system is less expensive than other optical approaches because of nanophotonics—we've shrunk the optical elements down to the same scale as the transistors that sit inside your PC's CPU. By being down at that scale, we've enabled the manufacturing of our systems with the same processes that makes computer chips, meaning we can precisely stamp them out in large quantities, without needing complex assembly. We've been able to move the world of photonic interconnects from an era equivalent to that of the vacuum tubes, to one of the modern integrated circuit.

“At 10 gigabit speeds, electrical interconnects over copper wires really start to break down... (but) you can send a burst of photonic energy down a fiber optic waveguide to send a 10 gigabit signal over 10 kilometers.”

Who's competing with Luxtera in this market?

If you look at the area of silicon CMOS photonics, Intel, IBM, HP, and many other big names within the industry are all doing research. But Luxtera is the leader in development in this space. The original foundation for the company came out of advanced research at Caltech, which stimulated the very early years of development. We have pioneered a brand new space, moving nanophotonic structures into a CMOS-compatible silicon process. By doing that, we've figured out how to increase performance while reducing cost. We've blazed a new trail, and in doing so we've established the methods and techniques needed to bring this technology into production. Based upon research papers written by other companies exploring this area, we estimate that we're at least five years ahead of the nearest competitor.

What do you see as the current market opportunity for this technology?

There is a huge short-term opportunity for Luxtera within the high-performance computing segment. High-performance computing refers to supercomputers and computer clusters like data centers that are trying to achieve maximum performance to solve complex computations or process large amounts of data. They are all on the cutting-edge of technology, and typically that technology very quickly waterfalls down into the mainstream PC market. High-performance computing centers are typically the starting point for many innovations in the industry.

In each of these centers, there are many, many processors that are trying to communicate with one another at mind-boggling speed, and it's becoming nearly impossible to make that communication work with copper wires. While there has always been a broad opportunity for photonics, the photonic approaches thus far have always been too expensive to implement. Our technology allows us to take the performance of optics and reduce the cost so that we're able to interconnect these high-performance computing centers economically.

When will we see this type of technology in our home computers?

Over time, optics will transition into every market as speeds get faster and faster. The

move from copper to fiber optics is a very natural transition forecasted by just about every industry pundit. You can find this technology today within the high-performance computing space, where we have products that send signals over fiber optics used to connect high-performance computing data centers. Some of the world's fastest computer systems use photonic interconnects, and over time you're going to see that transition down into consumer electronics: home PCs, DVD players and TVs will all ultimately pick up optics for communications between subcomponents.

What's notable is that optics has already moved into the home. The transition from magnetic media—like VHS and cassette tapes—to digital optical data storage on CDs and DVDs is a great precedent where storage requirements exceeded the limits of magnetic, copper-type systems and transitioned over to optics. Communication interconnects are moving down that same path.

Is Luxtera still focused on research or is the company shipping products today?

We are in production with products today. While we continue to do research to move the edge of technology forward (with 23 PhDs on staff), we are a product company with development engineering and manufacturing operations. In fact, we recently announced that through a partnership with Freescale Semiconductor, we've reached full-scale production status for CMOS photonics technology.

What does this collaboration with Freescale mean for the company?

It means we can now design and produce chips that use our structures on a very large scale. Freescale already has a process that they use to build transistors at very large scale, and they produce lots of chips for things like network processors and automotive sensors. We've been able to integrate our novel nanophotonic device structures into Freescale's process, so now their factories can produce CMOS photonic transceivers.

As anyone in the semiconductor industry knows, it takes about five years to develop a new CMOS process, and once you have that process in production, you build products in it for a number of years. By taking our process to maturity through our relationship with Freescale, we can now design a whole host of

“Photonic approaches have always been too expensive to implement. Our technology allows us to take the performance of optics and reduce the cost so that we're able to interconnect high-performance computing centers economically.”

products and bring them very quickly from design into volume manufacturing.

How do you think big players like Intel and Broadcom perceive your company in the market today?

I think that Intel in particular, and others that work in silicon photonics, see silicon CMOS photonics as being part of their future roadmap. Having a company like Luxtera out there that's in production with CMOS photonics, on the cutting edge of technology, I think one, it comforts them that the roadmap in front of them is truly viable, and two, if I were in their shoes, I would be a little threatened by it. Our technology can be applied to anyone in the industry. Any company that wants to be able to adopt CMOS photonics to gain performance benefits in a very large market can leverage our technology platform and get to market very quickly. On the other hand, I think a lot of companies view us as an opportunity to get their hands on a technology that could move them ahead on their own roadmap faster.

The ease by which we transport massive waves of data may leave many unaware of the physical systems that enable our virtual world. How do you give people a sense of appreciation for the importance of this technology?

Here's an analogy that may give people some sense of scale: many people have gone through the transition from a 56k modem to a cable modem or DSL service. What photonics represents to high-performance computing is akin to the transition from dial-up to broadband. **ET**

Hentschel: Squashing Malaria Like A Bug

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malaria. Hentschel earned his undergraduate degree in biochemistry and his doctorate from King's College, London, U.K.

From 1978 to 1997, Hentschel was CEO and scientific director of the U.K. Medical Research Council's Collaborative Centre. Concurrently, he headed the Department of Molecular Genetics at Celltech from 1983 to 1987. In 1999, he became a senior research fellow of the Emerging Technology Program of the Wharton Business School. He is also a non-executive director at two biotechnology companies, an adviser to a European venture capital fund and on the supervisory board of the Global Medical Forum, Zurich and of the High-Level Advisory Panel for Global Health Innovations project at the Saïd Business School, Oxford. Hentschel is currently active with Roll Back Malaria (RBM) Partnership, representing the product development constituency.

What brought you to Medicines for Malaria Venture?

I studied biochemistry at King's College and thought I was going to be an academic. I drifted into molecular biology and I came to Switzerland to do my postdoc after completing my PhD. at the National Institute for Medical Research in the U.K. (part of the Medical Research Council, the equivalent of NIH in the U.S.). I was surrounded by people getting involved in the nascent biotechnology industry, and a colleague of mine told me to explore biotech opportunities in the U.K. I went and talked to Celltech, and transitioned from an academic life into a biotech life. Later, I set up an institute that took ideas from the academic fields and worked with the private sector to develop pharmaceutical products. I ran this organization, called the MRC Collaborative Center, for about 10 years. It made me realize that there was potential and tremendous added value by blending the best of the academic and public sector worlds with private industry. The concept for MMV came from discussions between the WHO and the IFPMA (a trade body for the research-based pharmaceutical industry in Geneva) in the late 1990s. I immediately contacted the people involved and suggested I might be a good fit as founding

CEO. The timing was great for me—I got involved when there was just a draft business plan in place, and I helped develop it further from there.

How serious of a problem is malaria these days?

It's a much bigger problem than most people realize. There are hundreds of millions of cases per year and approximately one million deaths per year, worldwide. Beyond the deaths are a great number of people, children mostly, whose lives are damaged forever by this one infection. In countries where there is a lot of malaria, mainly in

“Getting products supplied in the thousands of tons at a price that’s as low as needed for rural Africans is a huge challenge.”

Sub-Saharan Africa, this has a huge economic impact as well. There are actually four human malaria parasites. *Plasmodium Falciparum* is the predominant one in terms of mortality and morbidity, but if you really want to do something about malaria you have to think about the others as well. The secondary one, which is called *Plasmodium Vivax*, is more common in Asia and is very widespread. It doesn't tend to kill you but it produces a host of significant health issues if left untreated. Unfortunately, this particular malaria parasite receives fewer research dollars.

How has MMV's mission evolved over the organization's first decade?

Malaria doesn't create a big market opportunity because most of the people that get it are very poor. So it's a huge medical need but not a really substantial market. The challenge is: how do you get innovation to occur in those circumstances? Originally, the objective for MMV was to create new drugs because of resistance to the old drugs. In 2007, the Gates Foundation col-

lected a group of opinion leaders in Seattle and determined not just to control the disease and prevent it from getting worse, but rather to eradicate it. Now MMV operates like a virtual pharmaceutical company—virtual in the sense that the staff here is all management. The actual R&D operations are performed all around the world, from the U.S. to Australia and New Zealand. We work with partners on the individual projects such as **Novartis** [NVS], **GlaxoSmithKline** [GSK], **Pfizer** [PFE], **Merck** [MRK], and quite a few other biotech companies. We jointly manage each project. The R&D is done in exactly the same way—with the same quality—as would be done for any blockbuster commercial project. In Geneva, at MMV headquarters, we coordinate the portfolio at the top level. We make decisions about what kinds of projects should come into the portfolio and whether or not they're making expected progress.

When evaluating drug candidates, what criteria are essential to delivering on MMV's mission?

A for-profit organization trying to develop malaria products would first think about the prophylactic use for travelers, and wouldn't be as worried about the cost of the product. We, on the other hand, are incredibly interested in the cost because we are trying to produce products that will ultimately sell for a few cents after moving through a complex supply chain. Getting products which are supplied in the thousands of tons to be at a price that is as low as needed for rural Africans is a huge challenge. I often get approached by people in the biotech industry who say "I have a great antibody or biologic or something that will do this or that for malaria" and I say, "it might work fantastically but the chance is small that you're going to have an innovative product at the right price, that you're going to be able to supply it, and that it still works where people don't have refrigerators, etc." You have to think in a completely different way than a normal pharmaceutical executive or a normal pharmaceutical R&D guy would in the U.S. or Europe.

What are some of the challenges of delivering approved drugs to your target populations?

You're not bringing these products into sophisticated, well-regulated markets like the U.S. or Japan. In fact, you're bringing them into markets where almost everything that can go wrong, does go wrong! There's a large base of very bad products that don't work at all. Or, if they have any active ingredient in them, it is only a small proportion of what should really be in there. This is found all over Africa. Then there are problems with corruption, the regulatory systems, and so on. Just as in R&D, we only work in the distribution chain with very strong on-the-ground partners—usually the sovereign government. Increasingly, we're trying to get involved with our partners to develop private supply chains in Africa because they reach much farther than the public ones and get us to the people that we're interested in helping—the rural poor.

How are the projects funded?

The funding is done jointly, with different negotiated agreements with each of the partners. The biotech company itself will typically pay for internally performed work. MMV would pay for all the clinical trials. This costs quite a bit of money, which comes mainly from the philanthropic sector, such as the Bill & Melinda Gates Foundation, but also from the U.S. and several European governments, too. Ultimately, our partner gets any commercial rights to the drug, as well as public relations benefits and any priority review vouchers that the FDA may grant. MMV gets the public health rights to the product for our target patient populations.

How long does it take to negotiate a partnership?

It takes less time now than it used to. It could take up to 18 months before we had everything worked out because both sides were exploring things and we didn't know there were templates against which we could compare. Now that we've got literally hundreds of agreements in our business development office, it's easy for us to approach a potential partner with a fairly standardized agreement that has been accepted by many other companies. I

think the other contributing factor is that more companies want to be involved with this kind of work, for many different reasons.

How do you align incentives across the different organizations involved?

There are approximately 20 items that we negotiate with our partners, including the priority review voucher (a prize awarded by the FDA), clauses about publicity, how we work together, and so on. The big companies are interested in this, in part, because they can use it for their corporate social responsibility activities. And as in any other good faith negotiation, we don't walk away until both parties are satisfied. For example, let's say there's a profitable market segment that emerges from joint R&D work (i.e. the traveler's market, which does not interest MMV). Rights to that market segment would go to the private partner, and we would get rights to the public health side and may also negotiate commitments from the private sector to manufacture the product to certain volumes.

What are some of the accomplishments of which you have been most proud?

We are part of a very complex picture, not just in innovation but in disease control. Ultimately, MMV is about drugs and, with more than 50 projects, we have the largest pipeline of anti-malarial drug candidates ever assembled in history, and that has been done in less than 10 years. I always thought that this idea would work, otherwise I certainly wouldn't have relocated from the U.S. to Geneva to do the job, but I was a bit surprised about how well it worked.

What are the biggest lessons you've learned over the past decade?

Once you create the basic structure there is really an enthusiasm for doing this. A lot of people were very skeptical to begin with, at every level. They were skeptical that you could get the private sector to be involved in this, that you could get the staff to transfer over from the for-profit sector. The only incentive socially responsible organizations have is that we give people incredibly interesting careers in which they feel that they are doing some good. But what

“With more than 50 projects, we have the largest pipeline of anti-malarial drug candidates ever assembled in history...in less than 10 years.”

we've proven is that this is a very big attraction to some people.

What can we expect from MMV over the next decade?

Shorter term, you can expect many more products coming out of the pipeline. I think you'll see some which are, in a very significant way, better than the classic anti-malarials. You'll also see ones that tackle all four of the malarial parasites. I think you'll also see a huge reduction of malaria over the next 10-15 years. In a 50 year period, because you have to be realistic about how difficult this is, maybe we can eradicate malaria from the whole globe.

What new malaria treatment technologies are opening up?

At the front end of the pipeline are combinations of drugs that were already known from previous work at MMV. In the middle of the pipeline there are candidates there that are totally novel modes of action and incredibly potent compared to the old drugs. So if these things make it all the way through trials, instead of having a typical three-day treatment course—or in the case of *Plasmodium Vivax*, a 14-day treatment course—we will be bringing these treatments down to perhaps just one pill. That would be a major breakthrough. It's not something that we say will happen. In animal models we can do this.

Do you see yourself venturing back into the for-profit world?

I keep a foot in the for-profit world as an advisor to venture-backed companies who are doing purely for-profit work through Poly-Technos, a venture firm in Munich. However, if you ask me, am I thinking about jumping back into the for-profit world in any serious way? No, not really. I'm very excited about what we're doing here at MMV. **ET**

The Emerging Tech Portfolio

Company [symbol]	Coverage Initiated	Current Price	52-week range	Mkt Cap (\$mil)	Buy/Sell/Hold
Intellectual Property Incumbents <i>Leading researchers in the physical sciences, with big potential for spin-offs and revolutionary breakthroughs</i>					
GE [GE]	8/07	\$12.09	\$5.87-\$30.39	\$128,130.00	Buy
Hewlett-Packard [HPQ]	3/02	38.35	25.39-49.20	91,510.00	Buy
IBM [IBM]	3/02	105.89	69.50-130.93	139,920.00	Buy
Materials <i>Companies producing materials with novel properties that have applications for a wide range of industries</i>					
Symyx [SMMX]	3/02	6.10	2.39-12.58	207.86	Buy
ShengdaTech [SDTH]	8/08	4.30	2.52-10.60	233.07	Buy
Life Sciences <i>Companies that are working at the cutting edge of medical technology</i>					
Life Technologies [LIFE]	11/05	39.92	19.56-44.65	6,970.00	Buy
Nanosphere [NSPH]	11/07	5.34	2.71-12.00	118.70	Buy
Electronics <i>Companies that have corralled the key intellectual property that will be the foundation for next generation electronics</i>					
Nanosys [private]	3/02	n/a	n/a	n/a	n/a
NVE Corporation [NVEC]	7/03	47.55	16.56-47.89	222.01	Hold
Energy <i>Companies that are developing high-efficiency, low-cost alternative energy technologies</i>					
First Solar [FSLR]	8/07	173.46	85.28-301.30	14,650.00	Hold
Enabling Technologies <i>Tools and instrumentation that enable critical science and technology discoveries</i>					
Veeco [VECO]	3/02	12.99	3.22-18.80	417.36	Buy
FEI Company [FEIC]	1/03	22.02	11.36-29.14	823.11	Buy
Accelrys [ACCL]	3/02	5.45	2.63-5.73	148.56	Buy
Investment Vehicles <i>Funds that have investments in promising emerging technology companies</i>					
Harris & Harris Group [TINY]	5/02	5.34	2.65-8.50	138.09	Buy
PowerShares Lux Nanotech Portfolio [PXN]	8/07	8.87	5.25-14.63	43.42	Buy
PowerShares WilderHill Clean Energy [PBW]	8/07	10.35	5.78-22.45	742.32	Buy

Word on the Street

GE: GE shares fell 6.9% on investor fears that the Obama administration's plans for financial regulatory reform would force the company to spin-off its GE Capital unit. GE reiterated to shareholders that it was committed to retaining GE Capital, which now has approximately \$540 billion in assets.

HPQ: HP rose 11.7% after the company agreed to form a 10-year global alliance with Alcatel-Lucent to help customers "leverage the convergence of telecommunications and IT". The deal is a response to Cisco's aggressive competitive moves. HP estimated the partnership could yield multi-billions in incremental revenues. HP also announced a new line of products and services (Eco Solutions) aimed at reducing power usage for customers ranging from the individual computer user to the largest enterprise customers. HP shares currently trade at 10x the current year's earnings estimates—an attractive entry point for patient investors.

IBM: IBM slipped 2.8% on the month. Big Blue announced that NEC Electronics and Toshiba joined the IBM alliance to develop a 28-nanometer CMOS semiconductor process technology. The alliance, based at IBM's facility in East Fishkill, New York, also includes Chartered Semiconductor, GLOBALFOUNDRIES, Infineon Technologies, Samsung, and STMicroelectronics. The low-power, 28nm technology can contribute to faster processing speed and longer battery life in next-generation mobile communication devices and other consumer electronics applications.

SMMX: Symyx continued its strong rebound, leaping 26.6% higher. The stock is now up 155% from its March 2009 low of \$2.39.

SDTH: ShengdaTech advanced 11.4%, though shares of the

leading manufacturer of nano precipitated calcium carbonate (NPCC) still fetch a reasonable 13x projected 2009 EPS of \$0.32 per share.

LIFE: Life Technologies gained 5.2% as investors singled out the company as a leading beneficiary of the Obama's administration focus on funding advancing biomedical research and market trends toward personalized medicine.

NSPH: Nanosphere rocketed 56.1% despite a lack of news. Speculative issues have seen increased affection from traders as the flight to quality has taken a hiatus.

NVEC: NVE Corporation rose 23.7% to hit a new 52-week high on the heels of a favorable profile in Investors' Business Daily. The company earned \$2.04 per share on sales of \$23 million in the most recent 12 month period. NVEC now trades at 20x the current year's profit forecast of \$2.38 per share—not exactly a steal, but reasonable given the company's solid and consistent growth.

FSLR: First Solar lost 4% as analysts grew increasingly concerned that the solar sector's torrid rebound over the past 3 months had come too far, too fast. Investment bank Robert W. Baird initiated on FSLR with a Neutral rating and Soleil downgraded the stock to a Hold from a Buy. First Solar remains the unquestioned leader in low-cost, thin-film solar PV, but the availability of project financing for large solar developments still remains a glaring weak spot.

VECO: Shares of Veeco Instruments surged 34.6% following an initiation of coverage from investment bank Merriman with a Buy rating. Long-time CFO Jack Rein also retired after more than 15 years with the company.

FEIC: FEI shares were marked up 15.8% after Merriman

gave its thumbs up by announcing coverage of the stock with a Buy rating. FEI also made a tuck-in acquisition, paying \$4.1 million to buy the mineral liberation analysis business of Australia-based JKTech Pty. Ltd. Mineral liberation analysis enables mining companies and research scientists to use electron scanning microscope technology in evaluating the mineral composition of various ores.

ACCL: Accelrys gained 21.1% as investors applauded the hire of Scipio "Max" Carnecchia as the company's new CEO. Mr. Carnecchia most recently served as President of technology company Interwoven, a global leader in content management solutions. Interwoven was acquired by Autonomy Corporation plc earlier this year in a transaction valued at roughly \$800 million.

TINY: Traders reconsidered the value of Harris & Harris Group's illiquid VC portfolio, sending shares 31.2% higher on the month. Market confidence and reallocation to riskier issues should boost the carrying value of TINY's portfolio of nanotech and cleantech start-ups. TINY investment and algal fuel developer Solazyme also announced that it had raised \$57 million in a Series C funding.

PXN: The PowerShares Lux Nanotech Portfolio rose by 12.1% as riskier small-cap holdings including Nanosphere rose across the board.

PBW: The PowerShares WilderHill Clean Energy rose 6.6% as positive investor sentiment served as rocket fuel for technology stocks big and small.

Stock prices as of June 19, 2009

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