INSIDE

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The Insider

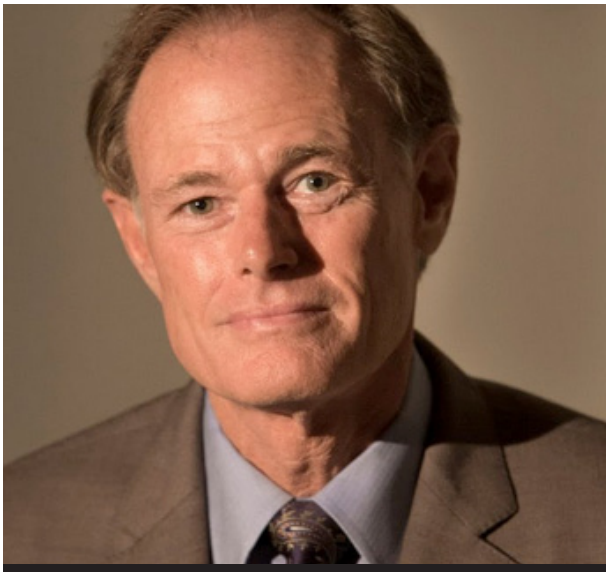
JOSH WOLFE, editor

In this month's issue we speak with a world-renowned neurologist and bestselling author, an artificial intelligence pioneer pushing the limits of facial recognition and the first blind person (and one of only 150 people) to climb the Seven Summits, the highest points on every continent.

We lead with Dr. David Perlmutter, renowned neurologist and *New York Times* bestselling author of *Grain Brain* and *Brain Maker*. Dr. Perlmutter shares some of the astonishing scientific discoveries that are uncovering relationships

Discovering Links Between Gut Bacteria And Brain Function

David Perlmutter, MD, FACN, ABIHM is a Board-Certified Neurologist and Fellow of the American College of Nutrition. Dr. Perlmutter serves as an associate professor at the University of Miami School of Medicine. He has contributed extensively to the world medical literature with publications appearing in the *Journal of Neurosurgery*, the *Southern Medical Journal*, *Journal of Applied Nutrition* and *Archives of Neurology*. He is the author of many books, including: *The Better Brain Book, Raise a Smarter Child By Kindergarten, Power Up Your Brain: The Neuroscience of Enlightenment*, the #1 *New York Times* bestseller *Grain Brain–The Surprising Truth About Wheat, Carbs and Sugar–Your Brain's Silent Killers*, *New York Times* bestseller *The Grain Brain Cookbook*, and *New York Times* bestseller *Brain Maker: The Power of Gut Microbes to Heal and Protect Your Brain–For Life*, and is recognized internationally as a leader in the field of nutritional influences in neurological disorders.



DR. DAVID PERLMUTTER

continued on page 2

Teaching Computers To Think Like Humans—But Better

MATTHEW ZEILER

Matthew Zeiler, Ph.D., is founder and CEO of Clarifai Inc. (*Full disclosure: my venture firm Lux Capital is an equity investor in Clarifai*). Matthew's independent research after graduation produced all five of the top five results in the 2013 ImageNet classification competition and he continues to find new

continued on page 4

Trailblazer Finds Blindness No Barrier To Adventure

ERIK WEIHENMAYER

Erik Weihenmayer has become a celebrated and accomplished athlete despite losing his vision at the age of 13. Redefining what it means to be blind, Erik has transformed the image of blindness and opened up the minds of people around the world. On May 25, 2001, Erik became the first blind climber in history

continued on page 6

Discovering Links Between Gut Bacteria And Brain Function

continued from page 1

Tell us a bit about the relationship between the human microbiome and the brain.

We've really done some incredible work over the years from the diagnostic prospective, but when it comes to actionable treatments, we've been at a loss for maladies involving the brain, particularly with major issues such as Alzheimer's, autism, Parkinson's and depression. We're starting to discover the incredible role of the microbiome–the 100 trillion organisms living within the human intestine–in virtually every important physiological process that happens in the human body. It's become very clear that the changes in these processes underlie our most important brain related disorders.

We now understand that gut bacteria play a critical role in regulating immunity and inflammation. As it turns out, especially regarding inflammation, this is a cornerstone of virtually every degenerative condition of the brain that you might describe. Even diseases that are not classically considered 'degenerative,' such as autism, are also primarily considered inflammatory disorders. It's a very exciting time to be involved in neurology, as we have discovered that the answer to some of our most feared brain disorders may actually reside outside of the brain.

What are some of the links that have been shown between the gut and the brain?

We now know that exercise, lack of obesity and keeping blood sugar low are associated with reduced risk of Alzheimer's disease. Data has shown a dramatic correlation of very subtle elevations of blood sugar and future risk, up to seven years later, of becoming demented. That's powerful information that we can't sweep under the rug. According to a study from the Mayo Clinic published in the *Journal of Alzheimer's Disease*, individuals that have a higher carbohydrate diet have about an 88% increased risk of Alzheimer's, whereas those individuals whose calories come more from fat have about a 44% reduction in risk for becoming demented. That's powerful information that I think the public needs to know now, not 10 to 20 years from now when the interventional trials have been done.

Those are the types of data that have gone into books such as *Grain Brain*—which advocates a very low carbohydrate, higher good fat diet—and *Brain Maker*, which focuses on this incredible role of the gut bacteria, in terms of inflammation.

What are some other actionable steps that can be taken regarding keeping our gut microbiomes healthy?

I will first say that we are at a very primordial stage in our understanding about this microbiome and its role in brain health. That was the purpose of writing *Brain Maker*—to provide a fairly indepth overview as to where we are right now in 2015, and what the future may hold. In order to protect your microbiome, you can reduce your consumption of antibiotics, your non-steroid anti-inflammatory drugs (NSAIDs), acid blocking drugs, and eat more foods that are enriched with probiotics. Eat foods that have been fermented, as well as foods that contain what are called 'prebiotic fiber,' to nurture good gut bacteria. The notion of antibiotics overuse was described by Dr. Martin Blaser in his book *Missing Microbes* [Editor's note: Dr. Blaser was featured in the June 2014 *Forbes/Wolfe Emerging Tech Report*].

I'm saying this based upon 47 pages of peer reviewed research, all of which appear in *Brain Maker*. The recommendations made in *Grain Brain* and made in *Brain Maker* are sound overall for your health anyway. If you have a choice, why not deliver your children by vaginal delivery? Why not reduce the antibiotic exposure for our children as is recommended by the American Medical Association? Why wouldn't you want to reduce sugars and carbs in your children's diet and your diet as well? I provide the science that supports that. But at the end of the day these are recommendations that are good for the microbiome.

Is everyone's microbiome different? If so, does that mean there are different answers for diet for different people?

Everyone's microbiome is different, but there's still so much we don't know. What we do know is that the most fundamental influence in terms of shaping the gut bacteria—in terms of diversity and complexity —is the food choices that we make. We know that people who have very complex and diverse microbiomes that move to Western countries and switch to a Western diet rapidly lose their diversity, and this has been associated with increased risk for various inflammatory disorders.

Is there a way for consumers to understand the makeup of their microbiomes and to try to take proactive steps to increase their microbial diversity?

There are stool tests and to some degree, certain blood tests will give you inferential information in terms of your microbiome. What we do in *Brain Maker* is provide readers with a little quiz they can take to determine if they've threatened their microbiome and/or have any ongoing issues that may reflect that the microbiome has been challenged. Things like being born by C-section, getting antibiotics early in life, having your tonsils out, being overweight, being depressed, being food sensitive, food allergies, gluten sensitivity and having an autoimmune condition—these are all indications

The Insider

between the human microbiome and the brain. We learn how even choices, such as whether or not to have a C-section while giving birth can have seismic ramifications on our bacterial makeup, and thus, our livelihoods.

Next we speak with Matthew Zeiler, a pioneer in artificial intelligence working on bringing the world's best image recognition technology to market (*Full disclosure: my venture firm Lux Capital is an equity investor in Clarifai).* Matthew teaches us some of the principles of deep learning and machine learning, and explains why he's so excited by what his team is working on.

Finally we sit with Erik Weihenmayer, an inspirational explorer who is a testament to the astounding power of the human spirit. A lifelong adventurer despite losing his sight at age 13, Erik is the first blind person (and one of only 150 people) to climb the Seven Summits, the highest points on every continent. Erik shares some of the unique challenges he faces and the technologies that help him transcend boundaries.

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.

continued from page 2

that relate back to the microbiome. It's fair to say that by and large, the microbiomes of most people living in Western cultures are less than ideal.

What are some of the new therapeutic approaches we're seeing in this space?

A Dutch doctor performed fecal transplants on 250 humans with Type 2 diabetes with material from healthy, lean donors. His results were nothing short of breathtaking, as he was able to reverse Type 2 diabetes by changing out the fecal microbial milieu of these individuals who were affected. Dr. Thomas Borody in Australia has reversed symptoms of Multiple Sclerosis in a handful of individuals through fecal microbial transplant. The University of Arizona has just completed the recruitment phase of a study designed to assess the ability of fecal microbial transplant to help children with autism. We know that there's an aggressive disturbance of the gut bacteria in autism and we know that autism is characterized by inflammation. Dr. Emery Meyer at UCLA has discovered that changing the gut bacteria of a group of women has changed the way they perceived the world around them. And this is just scratching the surface.

Diet is an often overwhelming decision that people face every meal of every day. What are some simple guidelines people can use to maintain a healthy microbiome through their diet?

It's important to get back to foods that are rich in prebiotic fiber—which is a unique type of fiber. Foods like jicama, Mexican yam, asparagus, dandelion greens, garlic and onions are foods that contain high levels of a particular type of prebiotic fiber that's called inulin. Inulin is really helpful in terms of nurturing good gut bacteria. Our healthy gut populations use prebiotic fiber such as inulin to multiply and to increase their metabolism, and facilitate the creation of amino acids, the provision of vitamins, the reduction of gut permeability, and therefore inflammation.

They even facilitate the creation of serotonin and dopamine. The gut has a huge role to play in terms of that activity. So, prebiotic foods are very important to bring to the diet. Also, foods that are enriched with bacteria. That sounds distasteful, but these are foods that are fermented. Foods like kimchee, kombucha, cultured yogurt, sauerkraut, fermented meats, fermented vegetables; these are foods that are teeming with good, probiotic bacteria that have been long part of the human diet.

"It's a very exciting time to be involved in neurology, as we have discovered that the answer to some of our most feared brain disorders may actually reside outside of the brain."

The types of food choices that threaten the bacteria are foods low in fiber, high in simple sugars, and foods that contain artificial sweeteners. Artificial sweeteners are very threatening to the gut bacteria, and change the gut bacteria in such a way as to favor obesity. Think about that.

Do we know why that is?

We've puzzled over this for a number of years, but we now know why. Why is it that people who stop drinking sugar-sweetened beverages and opt for artificial sweeteners suddenly gain more weight and dramatically increase their risk of becoming diabetic? It turns out that the changes that are imparted in gut bacteria by aspartame and other artificial sweeteners are changes that favor obesity, inflammation and metabolic change associated with diabetes. As a result, artificial sweeteners compromise metabolism, resulting in the body extracting more and more calories from foods.

What do you think about the growing movement to optimize diet through powdered food replacements and supplements?

I think we should eat food and not food replacements. While there are some decent food supplements out there that people can use when they travel or don't have access to a really good source of organic, nutrient dense foods, my vote is to opt for complexity. Foods offer up the best benefit in their natural state. Juicing is very popular these days, and while you are getting a great dosage of vitamins and nutrients and mineral, you've thrown away the fiber. That being said, there is a very powerful role for probiotics as a supplement because people really aren't consuming the levels of fermented foods that they need, nor are they getting enough prebiotic fiber. It's been estimated the average American consumes about 5g a day of prebiotic fiber in comparison to our Paleolithic ancestors, who may have consumed as much as 135g in a single day. In that regard, sources of prebiotic fiber—such as acacia gum, which is really common at the health food store—makes sense.

How do you welcome back to the plate prebiotic food, probiotic enriched foods, and really get your arms around the fact that other foods you may be eating are threatening your microbiome?

By and large, I think we should look for foods that aren't packaged, which don't have a list of ingredients. You don't find a list of ingredients on a carrot, which is a good thing.

What are some interesting startups in the microbiome space?

One particularly interesting one is a startup at MIT called OpenBiome. It is doing some incredible work in providing fecal microbial transplant material to more than 150 hospitals here in America, and is also cataloging the genetics of the human microbiome in a large number of individuals and harvesting this data, which I think is going to be incredibly valuable moving forward.

Is there anything else you'd like to add?

We're in the early stage. From an interventional perspective, who knows where the therapies will come from, and how they'll be directed. I think what we'll see in the next five to 10 years will be a greater interest in this science on the part of pharmaceutical companies looking to develop specific strains of bacteria that can be instilled into the human microbiome, into the colon that will have specific activities that will be remedial for certain disease processes. To me, this information is on par with the germ theory in terms of how big of a deal it is. I think the furthest reach has been the brain, as we now realize the brain is intimately related to what's going on in the gut. It's a very exciting time, and I'm looking forward to the future in a very big way. **ET**

continued from page 1

ways to innovate in the field of artificial intelligence. Matthew founded Clarifai at the end of his tenure at NYU to push and surpass the current limits of practical machine learning and power the next generation of intelligent applications and devices.

How did you first become passionate about artificial intelligence?

I grew up in a very small town outside Winnipeg in Canada. I grew up in a medical family— my dad is a doctor, my mom is a nurse and my brother is a doctor—so I also started on the pre-med track. When I was a year in at the University of Manitoba, I realized that the physics, math and engineering courses were the most exciting to me, so I ended up switching to the University of Toronto to go into this awesome program called Engineering Science. In that program you get to take a huge variety of courses in the first two years ranging from quantum mechanics to special relativity to biochemistry. After those first two years, you're supposed to specialize in one of eight different options.

At the time I was about to decide, I talked to one of Geoff Hinton's Ph.D. students (Hinton is one of the pioneers of neural networks and a professor at University of Toronto) and he showed me a video of a flame flickering that was completely generated by a machine learning model. I was blown away and chose to go into the computer option and pursue machine learning more.

How did your studies inspire you to start Clarifai?

I took Geoff Hinton's course in my third year and I ended up doing my undergraduate thesis with Geoff in my fourth year, which is really rare, as he usually doesn't work with undergrad students because he has so many other graduate students on his plate. He recommended I check out NYU for graduate school, specifically studying under Yann LeCun and Rob Fergus. I spent about four years doing my Ph.D. there focusing on images and video and before I graduated I did a couple internships at **Google** [GOOG] working with Jeff Dean, head of the Google Brain group. When I was finishing my second internship at Google, they gave me a really significant offer, along with **Apple** [AAPL], **Facebook** [FB] and **Microsoft** [MSFT]. I had to do a gut check, because ever since I was a kid I wanted to start a business and I knew the technology that I was working on in my Ph.D. was working really well. I decided to turn them all down and start Clarifai in November 2013.

Once you decided to pursue your own business, what were the first steps?

Right after I started the company, I submitted the very first results to a large image recognition competition called ImageNet. Each team could submit up to five entries and we ended up sweeping the top five places, with my team consisting of just myself and and some GPUs [Graphics Processing Units] in my apartment. This was great advertising, as Fortune 500 companies were watching those competitions to scout who really understands this technology and can push the limits of it. As a result, we haven't needed to do any advertising so far since there's been a lot of inbound interest due to the competition and resulting news articles.

Can you give a high level definition of machine learning and deep learning?

At the highest level, what we're doing is artificial intelligence. A subset of artificial intelligence would be machine learning, which involves trying to program computers to do pattern recognition. With deep learning specifically, the model of machine learning you use is a neural network, or a set of algorithms that try to simulate how the human brain works.

"At the highest level, what we're doing is artificial intelligence… With deep learning specifically, the model of machine learning you use is a neural network, or a set of algorithms that try to simulate how the human brain works."

Why have we seen such a surge in public and corporate attention to artificial intelligence recently?

There has been huge progress in deep learning in the past couple of years brought upon by the use of GPUs—graphics cards that were previously used for gaming. The landscape has shifted so much that **NVIDIA** [NVDA], traditionally a gaming-oriented company, devoted its entire keynote to deep learning at its annual technology conference. The switch to GPUs has given us a 3,000% computation boost.

What are some mainstream applications of deep learning that people may recognize?

One example is speech recognition, where researchers have developed a really deep neural network in order to extract features from an audio signal to predict what words are being spoken. Now, virtually every cell phone, whether using Siri, Google Now or others, is running a neural network. We're all using neural networks every day, even though most people don't realize it.

Tell us about the Clarifai platform and what it offers.

We have built an API that lets you plug in an image or a video, and we return back exactly what features our software recognizes in it. Our platform now understands more than 10,000 different concepts. For example, if you input an image of a heart, wedding or people kissing, in addition to describing the actual scene, our software will also output high-level terminology such as "love" and "romance." For a video, it will automatically tag all of the content at one-second intervals. Clarifai gives you a whole time series of information from the video, allowing you to search within that video to find the optimal point you are looking for. There are countless real-world applications for this technology. For example, we're working with advertisers to find the most engaging place within a video to advertise.

Additionally, our software can understand themes at a very high level and show you similar imagery without the need for keywords. This is very powerful because if you're an e-commerce company like **eBay** [EBAY] or **Etsy** [ETSY], you can leverage our technology to display truly relevant content to users. This is an important distinction from cur-

continued from page 4

rent text-based searches, which are unnatural when you're looking for and thinking of images. This similarity metric can serve as a very powerful discovery tool.

How much of what you do in designing these networks is art versus science?

It's a bit of both. On one hand, architecting the number of layers in neural networks, how wide these layers are, how many neurons we use in total and how to format the data is more of a science. On the other hand, picking the size of the model and how fast you want to update it is more of an art. There's a lot you learn from experience, but there's no golden hammer that solves it every time. Tweaking the model for performance and getting it to work in the first place takes a lot of experience.

If algorithms improve from more data, does that mean you're always looking to grow your database? If so, from where do you get it?

Yes, the more data the better. We get our data from a variety of sources. We crawl the Web and we get data from our partners, a lot of whom have their own data sets. We also encourage our developers to integrate feedback in our API so when you make calls, it gets smarter over time. For example, we're integrated with some consumer stock photo sites so when someone uploads a photo it will automatically recommend tags, then users can edit those tags, and our model gets smarter over time by taking those into account. We're really excited about this organic growth of data as more and more people use our system.

You mentioned before that Facebook, Microsoft, Google and Apple are all interested and intrigued in this field. Does that concern you from a competitive standpoint?

I think those companies are really interested in their own applications, how to satisfy their own end users and how to acquire more of them. They like to build platforms within their companies. Google Brain, for example, is a neural network platform that other groups within Google can leverage, such as Street View, speech recognition and Google Ads teams. They're really interested in building out that capability. I don't think they're as interested in sharing their neural networks with other businesses. Keep in mind that you named a handful of companies. Hundreds of other Fortune 500 companies and many more companies around the world still need this technology. They don't have the research teams or the huge data sets to make it work. Therefore, we can leverage our expertise and our collection of data to give these other companies the same technology and get them on the same level as the Googles, Facebooks and Microsofts of the world.

"We have a partnership with a company with a new device that attaches to your cell phone to take pictures within your ear to recognize diseases… Because it attaches to a cell phone we can automatically understand the diseases and give a diagnosis in real time."

On that note, do you feel threatened by what appear to be similar image recognition capabilities in the new Google Photos software?

We're actually quite excited about Google Photos because our platform enables every other company to do similar things. There has been a lot of buzz around Google Photos and immediately after the announcement companies that we've been talking to wanted to accelerate the development process with us. Other companies see this as a challenge to keep up with the big guys, and we can give them the technology to do that. It's really exciting for the consumer, too, as everyone is competing to provide the best possible user experience.

Can deep learning algorithms potentially discover patterns that humans have not recognized yet?

Yes, in fact machines are much better than humans at recognizing abstract patterns. Images are very simple for humans to see and recognize. But where the technology really shines is when you apply it to a billion images. This type of application is really powerful and leverages the ability to recognize these patterns on much more data. Additionally, there are also the patterns that can be recognized from certain types of information such as financial data. There are very subtle things going on in that data, and it's very hard for people to interpret a ton of variables in a time series. It's not possible for a human to really dig in and understand everything that's ever happened in the stock market across every stock, but a machine can easily take in all that data and understand what's happening. How reliable those patterns are can be a whole other discussion, and we're not doing anything in the financial sector yet, but that's only one area.

What are some other areas where deep learning has potentially exciting applications?

One exciting area is the medical space, where we are already partnering with some companies. It's very hard to be consistent in diagnoses, even if you're a professional with many years of experience. On the other hand, machines don't get tired and they can run through every example of imagery that's been created and the troves of new information that are being created daily. We have a partnership with a company with a new device that attaches to your cell phone and leverages the phone's built-in camera to take pictures within your ear to recognize diseases. Doctors are starting to use these devices in hospitals because they're very affordable and accurate, and are providing us with label data. This really excites me because we can take this technology to third world countries where there aren't enough doctors to support the population. Because it attaches to a cell phone, we don't even need good Internet connection; we can just automatically understand the diseases and give a diagnosis in real time. Applications like that are really exciting. It's really hard, if not impossible, for humans to do similar things at that scale. **ET**

continued from page 1

to reach the summit of the world's highest mountain, Mount Everest. At the age of 33, he became one of less than 100 individuals to climb all of the Seven Summits—the highest peaks on each of the seven continents. A former middle school teacher and wrestling coach, Erik is the author of *Touch the Top of the World* and *The Adversity Advantage*. He is the recipient of numerous awards, among them the prestigious National Courage Award and the 2002 ESPN ESPY award. Erik lives with his wife and two children in Colorado.

Tell us about what it was like being a blind wrestler in high school.

I've been blind since age 13. When I started high school back in the 1980s, I had heard of blind wrestlers who could learn body positioning by feeling somebody's hand. I thought I'd give it a try. I remember tapping my cane up the hallway to the wrestling room for tryouts. The captain of the team wrestled each freshman in a row, and he slammed my head against the mat just like every other boy. I loved that he didn't treat me with kid gloves. I found a community, and I needed a community at that point.

You were a teacher before launching into full-time adventuring. What made you leave that career?

I was a teacher for six years and loved it. However, I wanted to climb the Seven Summits, and those climbs happen in the middle of the school year. That was unfair to the kids, so I stopped teaching and started climbing full time. With support from companies like Mountain Hardware and from the National Federation of the Blind, I started working my way around the world climbing the tallest peak on every continent.

I've been climbing mountains, kayaking, writing books and making films for 20 years now. The opportunity to adventure full time doesn't come that often to people, especially for a blind adventurer, but I've been making it work. And, it's been really fun.

You're visually blind, but that doesn't mean you can't see the world in some sense. How would you describe the way you see the world?

Even though I can't see with my eyes, I see the world through my other senses. Eyes are just the hardware. The brain, the visual cortex, is where vision happens. Because I could see until I was 13 years old, my brain can create images. I get information through my sense of touch and through my ears, and my brain translates that information into something visual.

What technologies have enabled you to achieve these incredible feats?

I've been lucky to live in an age of massively exploding technology. My iPhone talks to me—I e-mail and Skype. Other technologies I use include the BrainPort. It's a camera that translates images to my tongue, and from the tongue to the brain. Basically, I can see images through my tongue. A lot of amazing technologies are available for blind people. I'm super psyched about Aira, a technology that uses wearables like **Google** [GOOG] Glass to help blind people navigate (*Full disclosure: my firm Lux Capital is an investor in Aira).* Say I'm in the airport at the baggage carousel. To find my luggage, I'd usually have to feel every bag, which is cumbersome. With Aira, I can call an agent who will spot my bag and tell me when to reach for it. The agent can also tell me where the bathroom is or read a phone number on a business card. It's a perfect blend of high and low tech to solve the day-to-day problems a blind person faces.

Tell us a bit about your organization.

No Barriers began after a climb with one of my personal heroes, Mark Wellman. Mark was paralyzed after breaking his back, but he has learned to climb again. He was the first paraplegic to climb El Capitan, a 3,000-foot rock face in Yosemite Valley. He has a system to pull himself up the ropes; climbing El Capitan required 7,000 pull-ups in eight days. Mark invited me to climb this rock face with him, along with Hugh Herr, who is a double-leg amputee [Editor's note: Hugh Herr was featured in the January 2015 *Forbes/Wolfe Emerging Tech Report*]. On that climb, Hugh wore prosthetic legs with rubber feet designed like climbing shoes. Now he's the head of a laboratory at MIT, where he's creating incredibly high-tech prosthetic legs.

"Even though I can't see with my eyes, I see the world through my other senses. Eyes are just the hardware. The brain, the visual cortex, is where vision happens."

After our climb, Mark decided to start an organization to help people who face tough challenges: injured soldiers, physically challenged people, youth who have experienced trauma. Many of these people get shoved aside by barriers and they wind up in a dark place—they don't know how to climb the mountains. No Barriers helps people figure out the tools and the mindset to break through those barriers and get back into life. We started with small events of 12 people, and kept growing.

Rafters and kayakers talk about reading the river, and that's usually a visual experience. Can you describe how kayaking is different for a blind person?

When you're in a little kayak, it's like a Ferrari sports car. Twenty-foot waves seem a lot bigger when you're punching right through them in that tiny boat.

As a blind person, you rarely hit those waves straight on. You have to be bracing all the time, and listening to the person yelling commands like, "Hard left! Hard right! Charge! Paddle hard!"

Rivers have these crazy features. Holes like washing machines, waves coming from every direction, and eddies where the water goes in the wrong direction. I understood mountains, but it's another thing altogether to be down so close to the rapids, stretching your other senses to read the river and understand its energy.

Some blind people use echolocation, in a manner similar to bats, to navigate their world. Have you ever experimented with sound in that way?

When I'm out on a mountain, I'm constantly

continued from page 6

listening. Sound is comprised of vibrations that bounce off objects in a way you can hear. Snapping and clicking sounds can be used to navigate and indicate features in the landscape. Daniel Kish is the world expert in this domain; he calls it "flash sonar." He taught me how to ride a single bike, which I hadn't done since I was 13. We put zip ties in the spokes of the person in front of me, so I could follow the sound.

Many people consider darkness to be one of their great fears. Do you think that being blind has actually helped you be more adventurous and conquer your fear more than you might have otherwise?

That question has actually become one of the tenets of No Barriers. We've started calling it alchemy, this idea of making what you have into an advantage. We might expect some situations to crush a person—and sometimes they do—but they also tend to make people stronger. Confronting a limitation can bring out hidden talents. Maybe the barrier itself becomes an energy that we harness and use to propel ourselves to a new place.

You've heard the expression "The will to win is nothing without the will to prepare." How do you prepare both physically and mentally for these challenges?

The physical preparation takes a lot of time. Skinning up mountains, then ripping the skins off the skis and skiing down. Climbing and ice climbing, the punishing days out on the mountains that teach you a lot mentally and physically. Then there's the whole aspect where you're preparing your systems. You want to be able to get to your gloves easily, put your crampons on quickly, and not drop a boot off an ice face when you're changing your boots.

On that note, are there specific aspects you've had to adapt to in order to make climbing and skiing possible?

When I started to ice climb, to climb frozen waterfalls, people doubted that a blind person could do it because you swing sharp, heavy metal tools at the ice face. You don't want to knock off a huge chunk of ice the size of a refrigerator and crush yourself or your teammate. So, I had to come up with a new way to ice climb.

"We might expect some situations to crush a person—and sometimes they do—but they also tend to make people stronger. Confronting a limitation can bring out hidden talents. Maybe the barrier itself becomes an energy that we harness and use to propel ourselves to a new place."

With the help of friends, I learned to tap my tool against the face and feel the vibration through the tap on the ice. By judging that feel and that sound, I determine whether it would be a good swing.

My favorite adventures are those that get off the beaten path: the big ice faces in Peru and the Himalayas, and the Cordillera Blanca. Sleeping out with a couple friends, shivering through the night, and achieving big things together.

How do you find balance between the spirit of adventure and what some would regard as recklessness?

That is a fine line, and it becomes apparent when people go on emotion and push the envelope too hard. That's when people get hurt or killed. There's a science and an art to knowing when to push it, when to lay it out there, and when not to. Especially when you're blind.

I won't just take a big risk and hope to live through it. Everything has to fit into a careful risk equation. For one: I climb with safe, smart people. Two: I prepare a lot. Three: I think very carefully about what adventures fit within my risk threshold.

Have you ever had to call off any trips or abort missions because they were too dangerous?

Plenty of times. For example, I just summited Mount Huntington, but it was my fourth try. My success rate in the mountains is 50%, at best. That's a good record in the mountains. They say there are old climbers and there are bold climbers, but there are no old, bold climbers.

Sometimes a change of plans can dramatically increase your chances of summiting. The mountain isn't going to change for you; you have to change your approach. A little creativity and flexibility can up your chances.

What upcoming challenges are you planning?

As part of No Barriers, I'm helping lead our "No Barriers Warrior Expedition." We've been working with teams of soldiers who were hurt in Afghanistan or Iraq. We started this program in 2010 with a climb of a 20,000 foot peak near Everest.

To summit that peak with soldiers and vets who have been blinded, have lost legs, experienced post-traumatic stress or traumatic brain injuries, and to stand on top of a mountain together—that is really powerful. Our training happens throughout the summer in the Rockies, and we'll climb Gannet Peak in Wyoming.

Where can our readers learn more about No Barriers, and about your other projects?

Check NoBarriersUSA.org to learn how to get involved. There are all sorts of great experiences that people and families can join. People can also learn more about me and my team through TouchTheTop.com. We have tons of videos and photo galleries and great activities for kids.

Do you have any advice for people struggling with disability?

We all struggle with something. Our barriers unite us as much as our triumphs. I believe that each of our lives is like a map with barriers. We yearn to figure out ways of breaking through those barriers. Those big No Barriers journeys help you figure out what your map looks like, and how you're going to break through and embrace the fear and the doubt, the bleeding and the failing. It's everything along the way, and it can be a ton of fun. **ET**

The Emerging Tech Portfolio

Company[symbol]	Coverage Initiated	Current Price	52-week range	Mkt Cap ($mil)
INTELLECTUAL PROPERTY INCUMBENTS Leading researchers in the physical sciences, with big potential for spin-offs and revolutionary breakthroughs				
GE [GE]	8/07	$27.21	$23.41-$28.68	$274,300.00
Hewlett-Packard [HPQ]	3/02	31.71	31.00-41.10	57,400.00
IBM [IBM]	3/02	166.26	149.52-196.40	163,700.00
ELECTRONICS Companies that have corralled the key intellectual property that will be the foundation for next generation electronics				
Nanosys [private]	3/02	n/a	n/a	n/a
ENERGY Companies that are developing high-efficiency, low-cost alternative energy technologies				
First Solar [FSLR]	8/07	53.48	39.18-73.78	5,400.00
ENABLING TECHNOLOGIES Tools and instrumentation that enable critical science and technology discoveries				
Veeco [VECO]	3/02	30.87	27.80-38.40	1,250.00
FEI Company [FEIC]	1/03	83.40	72.74-93.38	3,500.00
INVESTMENT VEHICLES Funds that have investments in promising emerging technology companies				
Harris & Harris Group [TINY]	5/02	2.68	2.51-3.85	83.80
PowerShares WilderHill Clean Energy [PBW]	8/07	5.71	4.75-7.08	142.5

Stock prices as of June 15, 2015

Word on the Street

GE: Shares finished flat on the month as debates with regulators continued over GE's potential acquisition of Alstom's power and grid assets. Separately, CEO Jeff Immelt accelerated the timeline of the company's exit from financial services with an announcement that it will sell its sponsor finance unit, GE Antares, as well as a $3B bank loan portfolio, to Pension Plan Investment Board (CPPIB). The total announced sales of about $55B bring GE nearly a quarter of the way through its $200B in GE Capital divestitures.

HPQ: Hewlett-Packard stock fell 5.6% as the computing giant reported mixed earnings, with declining revenues but increasing profit resulting from cost-cutting. HP reportedly walked away from acquisition talks with **Computer Sciences Corp.** [CSC] despite previous reports that it was nearing a deal. Separately, HP was forced to pay $100M to settle a lawsuit related to the write-off of its ill-fated acquisition of Autonomy in 2011, and also settled $810M in pension liabilities.

IBM: Big Blue shares finished this month down more than 4%. IBM made investments into cloud and big data technologies, acquiring private cloud Blue Box Group, and establishing a new technology center in San Francisco focused on the open source project Apache Spark. Along with the technology center, IBM expects to employ more than 3,500 researchers and developers to work on Spark-related projects.

FSLR: First Solar reversed its progress from last month, dropping 5.7% despite announcing that it had broken a world record for cadmium-telluride (CdTe) solar PV module conversion efficiency. Analysts at RBC Capital downgraded the stock to Underperform, expecting the solar manufacturer to report flat revenue growth this year and next. First Solar shares are up 20% year-to-date.

VECO: Veeco Instruments was unchanged on limited news.

FEIC: FEI Company shares closed 6.7% higher after the company announced a 20% increase in cash dividend and authorized an additional share repurchase.

TINY: Harris & Harris Group fell by almost 4% on the month.

PBW: The PowerShares WilderHill Clean Energy portfolio lost 2.2% during the month.

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