Ninja Style
Saul Griffith, inventrepreneur. His specialty is applying way-out mathematics to real problems, small and large.

Welcome to Other Lab. Don't mind the mess

SAUL'S HOUSE OF ICOOL IDEAS

By Josh Dean | Photographs by Cody Pickens

LIKE ANY THOUGHTFUL PERSON, Saul Griffith has ideas as he walks around: *Hey, wouldn't it be cool if… You know, we sure could use… Why doesn't someone make a better…* But it's hard to imagine anyone who does this as often, and in such a variety of areas, and—this is the important part—with such acute ability to execute them. Whereas most people muse, Griffith makes.

"My life is a living laboratory," Griffith likes to say, and he certainly does live it that way, walking around until he bumps into a problem and then retreating to his San Francisco lair to figure out how best to create his way around it. The bearded, 35-year-old Australian is a rare specimen in the commercial universe: a

hybrid of inventor and entrepreneur with the aptitude to identify things that the world needs and then make and sell them. He is, for lack of a better and more established term, an inventrepreneur, and to follow Griffith around is to be constantly stooping to pick up ideas for products and companies that trail behind him like coins that have fallen through a hole in his pocket.

"Saul is an omnivorous inventor," says Neil Gershenfeld, the director of MIT's Center for Bits and Atoms and one of Griffith's former postdoctoral advisers at that university. "He invents the way most people breathe, as a fundamental aspect of how he functions."

When the MacArthur Foundation handed Griffith one its famous "genius grants" in 2007, it called him a "prodigy of invention in service of the world community." It cited his work at MIT, where as a graduate student he demonstrated how machines can self-assemble, and where he designed a membrane-based molding system that could be used to mass-produce cheap corrective lenses for the developing world (and that eventually became a company now known as OptiOpia); as well as his work educating children about science through the quirky, instructive cartoons known as Howtoons; and, lastly, for the many other clever and practical devices born at Squid Labs, the now defunct Bay Area research laboratory that once served as his home base.

When I visited him in San Francisco last fall, Griffith was in the middle of a career swerve. He had recently removed himself from his last start-up, an ambitious alternative-energy company known as Makani Power, and he had only just turned on the lights at his newest company, Other Lab.

Other Lab is not an easy business to define. You might call it an incubator, though Griffith avoids the term because of the stink it obtained during the dot-com boom and bust (that is, as a place where investment capital is wasted on foosball tables and projects that go nowhere). You might call it the lair of a mad scientist. Essentially, it is a workshop where inventions are launched and tested in the hopes that they become products that either will be sold off or will grow into companies.

Griffith is especially worked up these days about climate change. It's the issue that most drives him, and his colorful talks on the subject make him a hot commodity at egghead jamborees such as TED and PopTech. Of late, he has embarked on a personal "energy diet," attempting to curtail what he realized was a hypocritical lifestyle for a climate-change evangelist. How did he come to realize this? Because he was curious, and when he's curious, interesting things almost inevitably happen.

In Flight
Griffith started, but recently left, Makani Power, which builds robotic kites that produce electricity. This one, flying over Maui, produced enough juice to power five homes.

In this case, Griffith and his Other Lab mates built arguably the world's best and most user-friendly carbon calculator. WattzOn (*wattzon.com*) will possibly one day become a thriving business—you can easily imagine companies licensing the technology to analyze their business footprint—but in the meantime, it's a free online tool that spits out detailed analysis that, in Griffith's case, not only caused him to give up driving but also to forgo imported wine, cancel his beloved *New York Times* subscription (to the continued chagrin of his wife), and ditch his dryer for a clothesline that ticked off his landlord.

"I'm working on phasing carbon out of my life," he tells me as he plucks his infant son, Huxley, from a plastic tub mounted to the front of a clunky-looking three-wheeled bicycle he had brought back from Denmark; he is, naturally, intending to build a better, cooler version of it. "As a friend put it—very well—I'm trying to figure out how to live the life I would like others to lead." He sighs. "But, man, it's hard."

If the economic climate were different, and investment capital for out-there-seeming businesses hadn't suddenly vanished in late 2008, Griffith would likely still be pedaling from his San Francisco home for a ferry ride to Alameda Island and the retired air-traffic-control tower that housed Makani Power. There, he and his pals were well on their way to delivering scalable wind energy using airplane-size robotic kites inspired, in part, by the wings Griffith has been designing to power his kite-surfing hobby since college.

COURTESY COMPANY

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You just never know when an idea that looks like a toy will one day morph into something far bigger and why, in these early days of Other Lab, a bike is never just a bike.

I ask him what other things he has bumped into in his quest to go carbon neutral that he would like to reimagine.

"There are so many," he answers. "Public transportation. Heating systems. Videoconferencing…" He shakes his head at me. "We should have been doing this interview by videoconference."

The Genius Racket

The inventor embodies a particularly appealing version of the entrepreneurial ideal. Everything he or she creates is potentially a business. But especially among the truly gifted, the problem would seem to be focus. A brilliant and curious mind wanders, and successful business requires focus. Or does it?

Not necessarily, says Mark Rice, the Frederic C. Hamilton Professor for Free Enterprise at Babson College and the Professor of Technology Entrepreneurship at the Olin College of Engineering. Rice has also headed up the technology incubator at Rensselaer Polytechnic Institute, so he has spent much of his career at the corner of entrepreneurship and invention.

Rice believes that this issue of singular focus versus a more scattershot approach is moot for the most exceptional people in the still small constellation of successful inventrepreneurs. "The really good ones do both," he says. "So much of innovation comes from connecting across things where other people don't make connections." (The most celebrated of the really good ones would have to be Dean Kamen, he of the AutoSyringe insulin pump, the Segway, the iBOT stair-climbing wheelchair, and a new robotic prosthetic arm. Kamen produces his inventions through a successful company called DEKA.)

Rice would argue that it's a waste of Griffith's talent to limit himself to a single project, because true innovation involves far more misses than hits. "Our VCs are the world's best pickers of promising innovations," says Rice. "And they only get it right two times out of 10. And they've looked at 100 to invest in one. The challenge still is, how do we get more Deans and Sauls?"

Part and parcel of being an inventrepreneur is the acceptance that you will often be ahead of the market, and that you have to just create and move on. Griffith calls this the "throw it over the fence" approach to invention: Create, show off, and then quickly sell the entire product (or its license) to a company that will build and market it at whatever scale is appropriate.

For a number of reasons, we are in a golden age for inventors, one in which anyone with a great idea can share it with the world. Griffith is particularly well positioned. He has got a burgeoning brand name (his own), a cheap marketplace (the Internet), and the software, technical know-how, and contacts to micro-manufacture. He has no inventory and not much overhead. He owns the intellectual property. He has minimal pressure to produce revenue in the short term, because he's always been able to attract grants, investment money, or consulting contracts. About the time I was pondering what it means to be Saul Griffith, I happened to read a Thomas Friedman column in *The New York Times* intended as a rebuttal to the many people ready to drop the curtain on the American business empire. Our country, Friedman said, had at least one ace up its sleeve.

> *[T]here are still two really important things that can't be commoditized. Fortunately, America still has one of them: imagination. What your citizens imagine now matters more than ever because they can act on their own imaginations farther, faster, deeper and cheaper than ever before—as individuals. In such a world, societies that can nurture people with the ability to imagine and spin off new ideas will thrive.*

Now, Friedman wasn't talking about Saul Griffith. But his point is critical to understanding why Griffith's unconventional way of running a business isn't really that unconventional at all.

Take WattzOn. Griffith isn't entirely sure how or when WattzOn will make money, but that's not the point. In the tomorrow-is-too-late tech culture, there's no time to analyze risk. And because tools are so readily available, there's no reason to. Just build it. If it doesn't find a market, move on.

For now, WattzOn is used by a core of dedicated people whom Griffith invites to refine and critique it; even the calculations used to measure the impact of a particular thing (say, drinking bottled water) are open to debate. The idea over time, though, is to perfect all of those specific measures, and to have users add every possible nuance of an American's life so that the tool gets easier and easier for people to use. At some point in the not-distant future, Griffith will have the most accurate tool around for measuring an individual's (or collective's) energy use, as well as a gigantic pile of data, both of which will be commercially quite valuable as we are pushed toward a greener lifestyle.

As a business, he says, "we're letting it grow until we figure out what to do. It's easy to do these things and see how they go. Then figure it out later."

The Ninja Scientist

You will find Other Lab in an unremarkable two-level industrial building in San Francisco's Dogpatch neighborhood. Inside is the (barely) organized chaos of a place where guys don't just think things up but also make them. There are work-

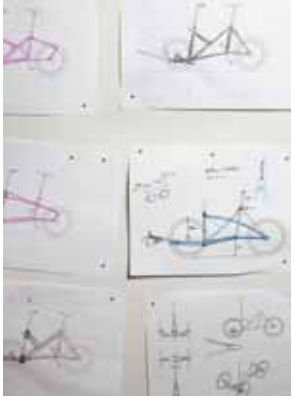
COOL MATH

"There's a deep relationship between information and structure," says Griffith. The prototypes and explorations at Other Lab are expressions of that.

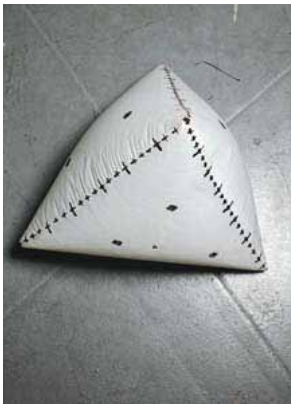
Origami insulation
Explorations in the design of lightweight, high-efficiency energy-saving materials

Space-filling curves
Patterns for a 3-D chain that can create any shape. Now it's the basis of a puzzle; the long-term goal involves the development of programmable matter. Think Terminator 2.

3-D test
An early test of a software program that renders 3-D objects in flat pieces. This ball is made of 12 pieces; the software can now make a ball in two interlocking pieces.



Tricked-out trike
Drawings for a particularly personal project: a superior child-carrying tricycle



Inflatable airfoil
A study for a lightweight airfoil, or wing. The goal was to see how much distortion occurred when the wing was inflated and how that affected performance.

benches and power tools, bikes and parts of bikes, built and half-built models of things, and two massive filing cabinets with neatly labeled drawers containing what would seem to be every kind of bolt, screw, cleat, nut, valve, and nail manufactured on the planet Earth.

In these lean, early days, Other Lab has only three full-time employees: Griffith, the mechanical engineer and so-called lead scientist; Jim McBride, a fellow MIT postdoc and the house physicist (who happens to be on vacation during my visit); and Jonathan (Jach) Bachrach, yet another MIT guy who is technically a software engineer but like the other two has a far broader purview. He is an artist and language fanatic who studied cognitive psychology, computer science, and visual arts and who wears shorts that could be confused for pants, or vice versa. Like the boss, he sports a serious beard.

When Bachrach spots me scribbling something he said in a notebook, he clarifies that it is Jach with an *h* and not a *k*. He had, he says proudly, "reverse engineered" his name so that it is perfectly aligned, and that while that might be unusual, it made a lot more sense than changing the *h's* in his last name to *k's*, because that would have required a more formal name change and might have screwed things up for his wife and kids.

"It's the third name he's had since I've known him," Griffith says.

One of the first things Griffith does when he arrives at work is remove his Crocs. He then proceeds to carry out his day, in a workshop full of screws, nails, razor blades, and wood chips, barefoot.

"There are two theories on safety," he pronounces. "There's the SUV model: You wear steel-toed boots and helmets and just survive the injury. Or you go naked, and you're hyperaware of your surroundings. That's ninja style. I'm ninja."

So Saul Griffith works barefoot in a workshop.

"Don't tell OSHA."

He and Bachrach have a conference call scheduled with one of the world's largest toymakers, based in Germany, and because Griffith is stuck with unexpected childcare, he hasn't been able to make a model they need. So the two men convene over a drafting table, and Griffith begins to cut a cardboard model that appears to be a giant puzzle piece while cooing at his son.

Later, Bachrach suggests to me that one thing that makes Other Lab effective (and nimble) is that it can easily produce prototypes in-house; impromptu fabrication is a strength for both him and Griffith, on top of their individual specialties. Bachrach was inspired recently by a friend who is a toymaker and who churns out prototypes and stows them away in a cabinet. When the market appears primed for a specific kind of toy, he pulls one out and sells it. Then it goes on top of the cabinet as a totem of his success. And the collection grows. Some will be hits. Others might fail.

"To some degree, we want to do that," Bachrach says. "We're playing around with the idea of building a reputa-

CODY PICKENS

tion as a home of cool ideas."

The tip of Griffith's razor blade snaps off and pings across the office, just one more hazard waiting to test the ninja scientist.

What else are they working on here? So many things.

The bikes and partial bikes are study pieces for the kid-carrying trike. Griffith shows me a model built out of Legos—it is more stretched than Griffith's Danish bike, has two wheels up front, and leans with the rider. "Legos—the best prototyping tool of all time," he says.

At one point, a deliveryman wanders in and announces the delivery of 400 pounds of lightweight metal shafts, a peculiar order. "It's for a bike-rack project," Griffith says, and then produces a model for a small, customizable, lightweight, and easily assembled bike rack that can be fit to any car in any configuration. You just cut the shafts to size and put it together. The design of the racks is, essentially, in the joints. "It could be a bike rack, a surfboard rack, anything," he says.

In Griffith's world, almost everything can be improved, and almost anything is worth the time that might take. Not because the world so desperately needs a smarter bike rack, but because there are direct but invisible threads that run from the frivolous to the profound.

Many things under way at Other Lab relate to a DARPA project on programmable matter (DARPA being the Defense Advanced Research Projects Agency, the famous federal government research laboratory where far-fetched ideas are pursued until they become not-so-far-fetched. For instance, the Internet). "It's cool math for decomposing 3-D geometry," Griffith says.

Currently, the men are toying with toy applications based around some nifty modeling software written by Bachrach (that's the math Griffith is talking about). Using the software, they can scan or design pretty much any object and then print it in pieces so that the object can be assembled in 3-D. The first tangible application of this project is the 3-D puzzle. Sitting here and there are plastic elephants and dinosaurs that appear to be inflatable but are actually puzzles made up of interlocking plastic pieces. There's a metal ball, made of pieces, as well as a 3-D gorilla made by stacking flat pieces of cardboard on top of one another.

"What's the mega-application?" I wonder.

"I'm not sure there is one," Griffith says. "Making car bodies a little easier to assemble, maybe? Sometimes you gotta enjoy an idea for what it is and hand it off to somebody and see what they can do."

For the more linear among us, it would seem hard to create a productive day out of this mess, but a mind like this doesn't require conventional structure. You seamlessly shift from toys to energy and then make a bike rack over coffee.

"Did I promise you something other than chaos?" Griffith asks me at one point. "If so, I'm sorry."

Look! Up in the Sky!

"Basically, I just spent two-and-a-half years working on utility-scale energy," Griffith says with a sigh as he chews at a slice of fancy pizza. By this he means an energy project that could produce electrons for the grid in mass quantity, as opposed to something clever that barely generates more energy than you put in to build it. "For me, energy is the issue of the century both in consumption and the way we make it."

By 2007, Squid Labs had splintered into the various component parts that it had spawned: OptiOpia; Howtoons; Instructables, a user-generated DIY site that teaches people how to make just about anything at home; Potenco, which makes hand-held human-powered generators that can be used to recharge cell phones and laptops, and which is also working on bike-mounted units that could bring power to remote areas; MonkeyLectric, which makes some seriously cool bike lighting that is now on sale in bike shops around the world; and Makani Power, where Griffith chose to deep-dive.

Griffith devised a way to harness wind energy where no one else was—high in the sky, where it blows hard and, more important, consistently. Makani's plan was to deploy robotic kites the size of corporate jets. They would fly at 1,000 to 5,000 feet, converting wind to energy through a turbine and running the energy down to earth via a tether line. A fleet of Makani kites, Griffith believes, could power a city. The company received $15 million in investment from Google as part of that company's renewable-power initiative. "It's a matter of time before someone makes high-altitude wind energy a commercial success," Griffith says. "It's not going to be next year, but it's not 100 years away."

For the more linear among us, it would seem hard to create a productive day out of this mess. **"Did I promise you something other than chaos?" Griffith asks. "If so, I'm sorry."**

And until the dying days of 2008, Makani was humming along, honing its technology and increasing both the size of the kites and the duration of their flights. A prototype the size of a piano tested on Maui was generating enough energy to power five American homes. Then the recession hit. The investment tap ran dry; Griffith says, "We had to scale back pretty dramatically to survive. We cut down to

the smallest possible technical team."

This would gut many people, and surely it was painful for Griffith, but he also saw it as an opening, and so among the things slashed from the budget was himself. "I'm an expensive employee," he says. "I could still be useful, but there are others who could be more useful." As founder, he remains involved in the company's big-picture decisions, but he is no longer involved in the day-to-day operations. Instead, Griffith took survey of his life—fragmented market, baby on the way—and decided to abandon the deep dive and return to the surface. He would paddle around and pursue many ideas.

It was not a particularly complicated or well-thought-out process. He collected a few core people and thought, We've got some interesting ideas. We can survive. We'll boot up Other Lab.

To get things started, he had some consulting gigs ("major energy companies, I think you can say") as well as a DARPA grant, his 3-D modeling software, and "a whole bunch of other ideas in the energy space." Plus Howtoons, which sells books and hopes to soon complete a deal to produce educational materials for a federal agency. For start-up capital, he dipped into the $500,000 award that came with his MacArthur grant.

"We have some work that's good and paying," he says. "We have a whole bunch of intellectual property we're trying to get out in the world—cool stuff that we've developed but never had time to push out. We do this superhigh abstract math and physics stuff, but then you're always thinking about its association with other things. We realized, Wow, we could use this to make amazing cardboard gorillas or jigsaw puzzles."

"DARPA said, 'We would like you to build us Terminator 2, quite literally.' Their example: **Wouldn't it be great if our soldiers had a screwdriver that became a wrench that became an airplane?"**

So that started as something else entirely?

"That started," Griffith says, "when DARPA said, 'We would like you to build us Terminator 2, quite literally.' [Terminator 2, if you're not familiar with the movie of the same name, was a sort of animate silver goo that looked like mercury and could fashion itself into any form it encountered, animal or otherwise.] Their example: Wouldn't it be great if our soldiers had a screwdriver that became a wrench that became an airplane?"

I laugh. He doesn't. "There's a deep relationship between information and structure," he says. "You need a certain amount of information to describe a 3-D structure."

This is not easy to grasp, but the gist is that Griffith and Bachrach haven't yet made T2, but in the early stages of fumbling in that general direction they have made some cool 3-D gorillas that can easily be manufactured in pieces, and given a few more months, they might also change the way cars are assembled.

"We specifically have been working on this idea that we can build a mechanical synthetic analog to DNA," says Griffith. "Turns out, I can build a string that can fold any 3-D shape from a string of tetrahedra. By choosing a left- or right-hand fold at any hinge, it can make any shape. And we developed some pretty elegant math and theory that describes how you do that."

That has since become another puzzle—a strand of plastic DNA that can be made, via a series of rights and lefts, into just about anything. It's out at toy fairs now and should be in stores sometime in 2010.

"This is a pretty cool frontier," he says. "So we developed a bunch of tools that describe geometry—that's how we ended up doing these surface models, which relates to making better jigsaw puzzles, which relates to inflatable elephants, which relates to how you sew more optimized T-shirts. It's a very fruitful, fun area to think about."

As much as Griffith loves to come across as a fun-loving eccentric, he also wants to make it very clear that he's also up to serious science. Sure, he's having fun with puzzles and bikes, but his real passion is and always will be energy.

As he bounces along from idea to idea, all the while salting his sentences with ominous facts about the energy problem, I can't help wondering if he isn't going to give himself a crisis of conscience. I ask, does he ever feel like he's not making the best use of his abilities? Does he not feel pressure to be the Dean Kamen of climate change?

"Every day I wonder if I'm working on the right things," he says. "But I want to enjoy what I do. Everyone does."

He would be thrilled to churn out one product after another that finds a market, however small, because he feels like the little guys are now at the helm of innovation's ship. But he certainly hopes that a big hit isn't far off. And he wants more than anything for one—or several—of those hits to make a real impact on climate change.

He has, he says, "every entrepreneur's problem. You're always trying to find the union of things you want to work on and things that are marketable and investable. And to find the overlap in that Venn diagram."

As the two of us eat lunch, Griffith wandered back around to the underlying question of all these conversations.

"Here's the business story," he says. "We're going to hit 450 parts per million"—the scientific assessment of the maximum amount of carbon our atmosphere can handle—"because we have no choice, and whoever invents technologies that allow people to increase their quality of life while hitting that number wins—and wins big." He pauses.

"The business landscape looks like infinite possibility."

Josh Dean is a regular contributor to Inc. *For the March 2009 issue, he wrote about the Wexley School for Girls advertising agency.*