The Inventors

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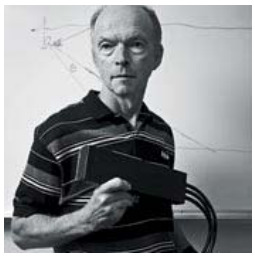

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Looking deep: John Bird, who once helped the military spot Soviet subs, has developed what could be the world's cheapest and smallest 3-D sonar

Inventors: John Bird, Paul Kraeutner
Invention: 3-D side-scan sonar
Created: 1998
Origin: created at SFU, licensed to Teledyne Technologies Inc. (Thousand Oaks, CA), Marport Canada Inc. (St. John's) and Ping DSP Inc. (Sidney, B.C.)

For a man who helped develop sonar technology for the military during the Cold War to spot Soviet subs, dragging a bulky, hand-built prototype off the side of a canoe might not seem so glamorous.

Unless, of course, you believe the bulky machine you're testing is the grandfather of the cheapest and lightest high-end sonar in the world. The way SFU engineering professor John Bird describes it, his sonar is downright revolutionary.

To grasp what makes his invention so unique, one needs to be introduced to two types of sonar widely used today. The side-scan sonar is the cheap and light one, Bird explains, which sends a broad sound wave through the water and transforms the echo that comes back into a flat, two-dimensional image. The multi-beam sonar is the big, expensive one, he says. Some send up to 60 highly focused sound waves to the bottom at a time and put together three-dimensional images with the signals that bounce back.

Bird and his colleague Paul Kraeutner have created a small side-scan sonar that produces three-dimensional images just as well as its heavyweight multi-beam cousin. By using precise angles, careful timing and lots of math, they've coaxed this simpler machine to produce complex images.

The winning moment was in 1998, when they used the sonar at B.C.'s Pavilion Lake to take pictures of some coral-like growths being studied by NASA, Bird recalls. They published their findings and started talking to sonar companies.

"That was when we really realized we had something," Bird says. "It was like you took the water out of the lake and you could see the bottom in 3-D."

A major sonar company (Benthos, since acquired by Teledyne) was impressed enough by the images to license the technology and use it in one of its products, Bird says. But the end result wasn't really what Bird and Kraeutner had imagined. "This was originally designed to be small and low-cost, but they designed a fairly large, high-cost system," he says.

But Bird's vision took a big step closer to hitting the marketplace when St. John's-based Marport Canada Inc. bought a technology licence in October. The company hired Bird as their senior sonar scientist while he's on sabbatical from SFU. "They're going to follow my dream a little bit," he says.

Kraeutner is developing his own sonar system at his Sidney-based company Ping DSP Inc.

Inventors: Don Mavinic, Noboru Yonemitsu, Fred Koch and Ahren Britton
Invention: waste nutrient extractor
Created: 1999
Origin: developed by UBC, commercialized by Ostara Nutrient Recovery Technologies Inc. (Vancouver)

If nothing else, it's a beautiful concept: protect the environment while making money. That's the vision behind the "fluidized bed reactor," a water-treatment system developed at UBC and put out to market through Vancouver-based Ostara Nutrient Recovery Technologies Inc. In 2005 Ahren Britton

co-invented the system as a UBC grad student, and he now serves as Ostara's chief technology officer.

Essentially, the fluidized bed reactor takes harmful phosphorus out of waste material and turns it into a valuable fertilizer. Phosphorus is an element that exists in every living thing, and it's a main ingredient in the fertilizers that maintain modern agriculture. Much of this phosphorus gets consumed, digested and flushed down the drain. From there it can end up in water systems and do significant environmental damage. According to Britton, many municipalities already have waste-treatment facilities to remove phosphorus.

That's where this invention comes in. Municipalities can install Ostara's seven-metre-tall device as part of their standard water-treatment process, Britton explains. It adds magnesium to the waste material in a steel tank, which causes the phosphorus to crystallize, form into heavy pellets and fall to the bottom. These leftovers can be sold as a high-quality fertilizer – which means cities can essentially sell farmers their spent fertilizer back to them.

Britton claims the entire operating cost of the device can be covered by revenue earned from the recycled fertilizer. "Once it's built, it runs for free," he says.

The use of fertilizers in agriculture is constantly increasing, especially with the rise in ethanol production, and the amount of new phosphorus that can be mined out of the ground is limited, Britton says. Capitalizing on a renewable phosphorus supply is piquing interest all over North America, especially since most cities are already spending money to remove it from their waste.

Ostara installed its first full-scale commercial unit in Edmonton this spring, which, Britton says, is expected to produce about 1,000 tonnes of fertilizer a year. The company has also demonstrated its machine in Virginia, Oregon, Winnipeg, Calgary and Saskatoon, and it is getting more invitations from several cities in California.

While he gets to travel to all kinds of cities to show off the invention, Britton admits that he spends much of his time at some of their smelliest venues, from sewage plants to hog farms: "We get all the glorious places to visit."

Inventor: Marc Turcot
Invention: air-powered tents
Created: 1996
Origin: developed independently, now marketed by AirZone Technologies Inc. (Kelowna)

Marc Turcot's air-powered tent is the result of a decade of dreaming, designing, building and marketing. His story shows that invention is as much about tenacity as it is about creativity.

The idea was born during a camping trip in 1996, Turcot recalls, when a tent pole snapped. Most of us faced with the same situation would have simply cursed those finicky, segmented tent poles, but Turcot did something about it. Over the years, he and his father developed a tent held up by seamless rubber air tubes, made out of the same stuff as the inner tubes in car tires. The camping tents can be raised in 45 seconds with a foot pump, and in as little as 10 seconds if you're packing a pressurized CO2 cartridge. "It took probably 100 prototypes before we got it right," he says.

The tents started selling and fans sang its praises, but the marketplace wasn't kind. The cost might have had something to do with the lacklustre sales,Turcot admits. The tents sell for upwards of $300, while a standard pole tent might put you back $100 at your nearest big-box. Finding its place in the market has been Turcot's biggest challenge. "It's been a bit of a struggle to find out where we need to be," he admits.

So, with an idea too good to waste and a trusting lawyer sealing up patents, Turcot began looking for new applications. His first real success, he says, was with inflatable golf nets. His tent-shaped nets are perfect for practicing swings in the house or backyard, he says; just plug the on-board inflator into the wall to inflate the net and start whacking golf balls. Turcot says he's sold 450, and recently signed a distribution agreement with a Japanese golf manufacturer aimed at capitalizing on space-poor Japanese golf enthusiasts.

But it's Turcot's latest adaptation that gets him excited. What he calls the "air beam" is a 14-metre-long inflatable beam capable of making a single arch nine metres wide and four-and-a-half metres high. A shelter made out of a couple of these beams and a suitable covering could easily house 1,000 people, he insists. The trick with air beams is the inflation system, he explains, which is capable of quickly and evenly inflating multiple beams simultaneously. It's all driven by a standard gas-powered air compressor, the kind a contractor would use to power air tools at a construction site. A 1,000-square-foot structure can inflate in about seven minutes.

Turcot dreams of one day supplying them for festivals, weddings, sporting events, work sites, emergency-response services and the military.

Levelling out: Ian MacDonald sold his table-stabilizing invention to a major U.S. hardware manufacturer

Inventor: Ian MacDonald
Invention: hydraulic table stabilizer
Created: 1999
Origin: developed independently, marketed by Table Shox (Port Coquitlam), sold to Jacon Holtz Co. (Philadelphia)

Ian MacDonald was having a beer at Chicago's O'Hare International Airport one day in 1999 on his way back to Vancouver from a business trip. A minor slip combined with a wobbly table sent the beer directly into his lap. Sitting there in a pair of soggy trousers, the businessman decided there had to be a better way.

"Here I am, I'm a bit ticked off and embarrassed on the plane. I said, 'I've got four or five hours to kill; how do you solve this?'" MacDonald recalls. "It was one of those eureka moments."

On that plane, he came up with an invention to fix wobbly tables everywhere, he says, and the sketch he drew now sits framed in his office. The invention is a small hydraulic shock absorber, and when four of these are fixed to the legs of a restaurant table they give it automatic stability.

"Technically it doesn't stop it from wobbling," he explains. "It slows it down so much that you don't even notice the table wobbles."

It took him more than a year to act on the idea, he admits, but after sharing it with enough friends he eventually found a team who believed they could pull it off. After gathering some start-up cash, making countless drawings and putting in many weary hours in the machine shop, MacDonald and his team had a handful of shocks to show off at the 2001 National Restaurant Association trade show in Chicago.

The concept sold. It took the small company about three and a half years to sell its first million shocks and another year to sell a million more, reports MacDonald. The gizmos are now being manufactured in China and are sold directly to table manufacturers.
Servers love the invention, he says. "They have to get down often on their hands and knees to fix the wobbly tables for customers; they hate that."

Subway Restaurants, Starbucks Corp. and Tim Hortons Inc. are among MacDonald's biggest clients. He was rewarded with the ultimate gratification a couple of months ago when an American competitor, Jacob Holtz Co. of Philadelphia, agreed to buy the product line for an undisclosed sum.

The sale grew out of a casual and friendly conversation in the hallway of a convention last May. "They had a competitive product, and ours had been out there taking a big chunk of their market share over the years," MacDonald explains. The deal closed September 28 when MacDonald shipped the production tools and remaining inventory to Philadelphia.

"It's kind of gratifying to have had this little eureka idea several years ago… then get to the point where it's attractive enough to an American manufacturer of other types of hardware that they want to put it into their stable of products, and they pay you a lot of money to not do that anymore," says MacDonald.

Now all that remains is to repeat the success with another of his inventions, what MacDonald calls the first-in, first-out sauce dispenser. The invention, already picked up by Subway, is a plastic squeeze bottle that unscrews from the top and bottom, enabling restaurant workers to fill ketchup and vinegar bottles from the bottom, rather than the end with the nozzle. This keeps the sauce fresh, reduces waste and makes them easy to clean, says MacDonald.

Inventor: Andy Hoffer
Invention: walking-assist implant
Created: based on 30-plus years of research
Origin: began at SFU, developed at Neurostream Technologies Inc. (Port Coquitlam), sold to Victhom Human Bionics Inc. (Quebec City)

in stride: The Neurostep implant, a nerve-communication device invented by Andy Hoffer, has already helped one paralyzed man walk

The first person to receive a Neurostep implant could initially walk no more than 10 metres at a time, and then only when supported by his wife and using a cane, an ankle brace and a knee brace. Six months after having the electronic nerve-communication device implanted in his thigh, the 70-year-old Langley man was walking 250 metres every day to get his mail using just the cane, says Andy Hoffer, the SFU kinesiology professor who invented the implant.

The man had suffered a stroke years earlier that, as often happens, disabled one side of his body, leaving him dragging his unresponsive leg in a condition known as foot drop. His damaged brain could no longer send signals to command his foot to take a

step, Hoffer explains. His implant was designed to do that job.

The device is connected to two nerves in the leg with a pair of sleeve-like cuffs. Through one of these nerves, the device reads signals from the foot. Through the other one, it triggers the muscles that control the foot.

“It senses nerve signals to control what it does,” Hoffer explains, “and this electrical stimulation kind of replaces what the brain used to do; it actually becomes the controller for walking.”

The implant surgery is simple, Hoffer says; a six-centimetre incision is enough to insert the cellphone-sized device, and the nerves, which are as thick as pencils, are easy to find.

While the Neurostep resembles a pacemaker, Hoffer insists it’s the only implant of its kind. It works with electric nerve signals more than a thousand times weaker than those managed by a pacemaker.

“Those tiny signals are immersed in a sea of electrical noise produced by the surrounding muscles,” he says.

The technology was bought by Quebec City-based Victhom Human Bionics Inc. in 2004. The company will be putting it through its first clinical trial this year, Hoffer says, and U.S. trials may start after the following year.

While this device targets people with a very specific disability, Hoffer hopes to see the technology tackle a wider array of cases. “All the elements are there that are required to provide function to a paralyzed person,” he says.

Powered up: Max Donelan’s knee-brace generator produces electricity from the simple act of walking

Inventor: Max Donelan
Invention: biomechanical energy harvester
Created: over the past seven years
Origin: developed at SFU, continued at Bionic Power Inc. (Burnaby)

Speaking with Max Donelan, one gets a new appreciation for the term “alternative energy.” Donelan, assistant professor of kinesiology at SFU and chief scientific officer at Bionic Power Inc., isn’t working with wind, water or sunlight; he’s interested in walking.

People are excellent sources of energy, he explains. The amount of energy our bodies can produce out of some stored fat is roughly equal to the energy in a stack of batteries weighing 100 times more. While we won’t be powering cities anytime soon, Donelan is working out a way for us to self-power our cellphones, MP3 players, laptops and medical devices.

Donelan and his team have developed what they call a biomechanical energy harvester to grab hold of some of this energy, he says, producing power from a person while demanding no extra effort. Their invention is a high-tech knee brace that grabs energy from a walking person.

“We want to do it in a smart way, which is called generative braking,” he says. It’s much like what a hybrid car does when it uses energy from braking to recharge its battery, Donelan explains. The brace does the same thing with legs. In every stride there is a distinct moment when our muscles put on the brakes. The device uses this force to spin a generator and produce electrical energy.

“While the idea is kind of simple,” Donelan says, “the implementation is a bit more complicated. It requires some good engineering skills and also some good physiology. You need to know about how people walk to do it properly.”

You wouldn’t want a machine to take energy from you when you stand up from a chair, he says, but it can grab a lot of energy from you when you sit down that you won’t miss at all. The current model generates about five watts without requiring any extra effort from the walker, Donelan says, enough to run about 10 cellphones. Bionic Power was spun out of SFU this year and is still working on gathering core funding, Donelan says, but potential clients have already come knocking. Makers of medical devices and prosthetics are interested because they’re moving toward more sophisticated computerized devices, Donelan says, and their big hurdle is power use and battery capacity.

“The future of this, one of the directions, is a fully implantable version that would power implanted biomedical devices,” Donovan predicts.

Another excited observer, and one of Bionic Power’s first investors, is the Canadian military, he says. The modern soldier packs an average of half a kilogram of batteries to feed his or her growing digital arsenal. Anything that can help the military reduce this burden, increase battery reliability and save money is definitely on their radar.

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