[Original publication: InPittsburgh Weekly, June 1998]

Vital Organs

Heart researchers know: Biology plays a key role in our lives. But what key is it playing in?

by Stephen H. Segal / segal@earthlingcentral.com

The heart is an organ. So is the harmonica.

Huh?

One is a fist-sized lump of muscle resting within our chests. It pumps blood throughout our bodies; it is the center of our tenuous grip on existence. The other is a 4-inch long musical toy. It toots.

Again: Huh?

Obviously these are two very different sorts of things. And yet they're categorized together: as organs.

"But wait," you protest, "they aren't the same kind of organ. The heart is a *biological* organ -- a structure made of tissue that fulfills a specific task in the functioning of the body. The harmonica, though, is a *musical* organ -- an instrument that makes sounds by forcing air to vibrate through a series of tuned metal pipes or wooden reeds."

Well, yeah, there are biological organs and there are musical organs. But that's the point: Why are they called the same thing? What on earth could the two possibly have in common?

The northern shore of the Monongahela River might seem an unlikely place to look for an answer. And yet: Where once stood rows of belching smokestacks, now stands a sleek gray computer chip of a building, its highlights painted a green so fluorescently vibrant it seems on the verge of bursting into life. The architects had a mighty good sense of metaphor. This is the University of Pittsburgh's Center for Biotechnology and Bioengineering, home to several high-tech medical research initiatives. The one that's relevant to the question at hand is the McGowan Center for Artificial Organ Development.

If you were curious enough, you could sneak into the McGowan Center's research corridor, stand amid the labyrinth of offices and laboratories and loudly cry, "How is a heart like a harmonica?" For here, it would be no riddle. Any one of McGowan's scientists, students or administrators could stick their head into the hallway and give a simple, practical answer:

"Hearts and harmonicas? Jim Antaki has redesigned both."

* * *

Jim Antaki's office resembles nothing so much as the inner sanctum of some errant time traveller -- *Quantum Leap's* Dr. Sam Beckett, perhaps. One wall is covered with paintings and photographs of streamlined locomotives from the early 1900s. On another hangs a *New York Times* article with a futuristic illustration showing how most of the human body will soon be replaceable.

Swaying by a bookshelf is a mechanical dancing Elvis; on the shelf stands a model human torso, cut open to reveal the internal organs. The desk is covered with tiny pieces of plastic and metallic doohickery. From the ceiling hangs a gargantuan harmonica -- closer to foor *feet* long than four inches.

Antaki's business card, however, gets right to the facts: *Assistant Professor of Surgery, Mechanical Engineering and Bioengineering. Director of Artificial Heart Research.*

It might well add: *Needer of clone.*

"There's only so much of me to go around," he says, raising his hands plaintively, "and I'm getting tired. I'm putting in 80- and 90-hour work weeks -- and there's a point of diminishing returns. Still, I feel like as long as I'm accomplishing anything at all, I should keep going."

Simple workaholism? No. This is the life of a medical researcher responsible for a big project, fueled always by the mantra: *The more we get done today, the quicker we'll finish and the sooner we can start healing sick people.*

Antaki's project, in terms of potential impact, is one of the biggest. Heart disease is the leading cause of death in the Western world, and the donor organs available for transplantation are scarce. If the McGowan Center's small team of engineers, physicians, modelers and grad students can successfully implement the radical artificial-heart pump they've designed, dubbed the Streamliner, countless lives could be saved.

After some of his 90-hour weeks, though, Antaki can't help but remember that, in the final analysis, no life can be extended indefinitely. "If we build a heart that never fails," he says, "that means you won't die of heart disease. But you'll have to die of something. That presumes there's something more desirable from which to suffer our demise. And boy, I'd hate to die of a big prostate cancer."

Yet he keeps at it. Because as his boss -- Bartley Griffith, the McGowan Center's director as well as head of cardiothoracic surgery at UPMC-Presbyterian -- says, "It's probably with misguided hubris we think we can replace god-given organs with man-made ones. But when we see those organs damaged, we can't help it: Our survival instinct kicks in."

Designing the Streamliner heart device required overcoming another instinct. Most artificial organs to date, such as the pioneering Jarvik-7 artificial heart, were the result of trying to replicate the basic shape and mechanisms of the natural organs they were meant to replace.

Antaki, a mechanical engineer by training -- not an M.D. -- insisted on a more abstract design principle: *Form follows function.* In other words, first figure out what the organ's fundamental task is, then build something that will achieve that task in the simplest manner.

In the case of the heart, says Antaki, "When you take a blank piece of paper and say, 'What is the problem?' -- it's to produce pressure and flow."

Instead of a literal piece of paper, Antaki and his design team used custom-made computer modeling software to mathematically render the problem facing them. Putting aside preconceived ideas of how a heart is "supposed" to work, they concluded that the most efficient ***man-made*** device to create that sort of pressure and flow would be the classical propeller.

Hence, the Streamliner is one of a few artificial hearts in development around the world that works as a spinning rotor rather than as a contractile pump -- which means the people who'll eventually rely on it will feel a steady, continuous whir of blood through their veins rather than the familiar "lub-dub" of nature.

What's more, the Streamliner overcomes the Achilles' heel suffered by other research teams that have tried to design propeller pumps. The problem: Blood clots tend to form at the contact surface between the spinning rotor and a stationary bearing. Antaki's team came up with a solution: Do away with that contact surface by suspending the rotor in a magnetic field.

Griffith smiles at the thought of what they might achieve. "Jim Antaki told the rest of the world, 'We're going to eliminate the bearing problem!'" he says. "The rest of the world said, 'You can't!' Well, we're pretty close."

Sitting in his office, weary from a late work night, Antaki seems almost afraid to admit out loud how well the recent lab testing went. "It works, to our astonishment," he says, his voice cracking slightly. "It worked on the first shot. The level of blood damage is only one-fourth that of the next best model out there."

The next stage is animal testing -- which could begin as soon as next month. "We're at kind of a turning point," Antaki says wryly. "We're all set for either dramatic growth and stellar success, or monumental disaster."

* * *

Despite carrying the weight of the Streamliner project on his shoulders, Jim Antaki is not all heart.

His *other* business card doesn't bear the McGowan logo. In fact, there are only three words on it: ***Turbo Dog, Harmonicologist.*** And thus is his interest betrayed in another kind of organ entirely: the mouth organ.

"I'd been at harmonica camp for about two weeks," he says as he roots around in the back of his shelves, frowning, "and I decided, 'Hey, I'm getting pretty good at this, I should have one of these cool musician nicknames.' So I called the office and left a message saying, 'This is the engineer formerly known as Jim Antaki. From this point on, I am to be addressed as Turbo Dog.' When I came back, they'd changed all my nameplates."

With an "Ah-hah!" he finds what he's been looking for -- a videotape, which he sticks into a nearby VCR. "You'll love this," he says.

The monitor springs to life with an image of a white-haired doctor in a lab coat: Henry Bahnson, who reigned as head of Pitt's Department of Surgery for 24 years until retiring in 1987, and who performed the first heart transplant in Pennsylvania back in 1968. Bahnson is pointing to an anatomical chart of the mouth and throat, naming the different structures.

Suddenly the genteel surgeon is replaced by a humongous pair of wet lips filling the entire screen. Watching, Antaki bursts into a sputter of laughter as a colossal tongue appears and begins slopping back and forth to the sounds of whining harmonica chords.

"That's Howard Levy," says Antaki, still snickering. "He's an instructor at the Augusta music school in Elkins, W.Va., and he's arguably the world's greatest harmonica player. Hank [Bahnson] was taking lessons there, and being a doctor, was intrigued by what this guy was doing physiologically with his vocal cords to produce these sounds. So he lured him to Pittsburgh for a laryngoscopy."

Antaki's trying his hardest to sound matter-of-fact rather than gleeful as the grotesque, slimy image keeps jiggling to and fro onscreen. "We have pictures of Howard's uvula dancing as he plays," he says casually. "We've put probes in his nose, done ultrasounds of his mouth."

All just fun and games? Not entirely. As Bahnson explains a few days later in his office at Presby, he attended the Augusta school after retiring from practice, and learned there that "there are missing notes in the harmonica scale. Advanced harmonica players can reach most of them by a technique they call 'bending' notes -- but no one could really tell us what to do to ***do*** that. And three or four of the notes require a technique even more advanced than bending, called 'overblowing.'"

Curious as to how these acoustic feats were being achieved, Bahnson searched in vain for a physiological study of harmonica playing. Finding nothing, he took the project on himself. In 1990 he enlisted Antaki -- then a grad student at Pitt -- to help with the physics and engineering aspects.

"It occurred to me," says Antaki, "I had an instrument in the lab to measure vibration -- it was meant for blood vessels. I pulled the thing out, built a little gadget and sure enough, you could watch the harmonica reeds vibrate on the oscilloscope."

Over the course of the next several years -- it took so long because Antaki was busy with heart research all week long and could only do harmonica research on Saturdays -- the two organ scientists continued their collaboration. Eventually, it bore tangible fruit.

In 1992, Bahnson applied for a patent on his new invention: a harmonica with an extra slide mechanism that would dampen the reeds, making it possible for novices to overblow and reach the final missing notes. Hohner, the world's largest harmonica manufacturer, has expressed interest in the instrument.

"Experts would not use this device," says Bahnson. "They prefer to be unencumbered by artificial devices. But for most of the world, this slide makes it easier."

After suffering some bureaucratic snafus at the U.S. Patent Office, Bahnson's overblow harmonica was finally patented in April 1998 -- the same month the Journal of the Acoustic Society of America published Bahnson and Antaki's paper detailing their musical research.

What's next for the duo? Well, there's the matter of getting the final patent approval for Antaki's own invention, which could revolutionize rock 'n' roll: the electric harmonica.

Yes, electric. Forget about Sam Beckett -- Jim Antaki's video alter ego seems to be more along the lines of Buckaroo Banzaii.

"You can plug it into an amp, like a little Mr. Microphone," he says. The instrument, which has electric impact sensors glued to each reed, has been complete since 1996, but Antaki hasn't had time to hound the Patent Office about it.

"I've been busy," he pleads, "I've been so busy. I have to write this budget, plan this meeting -- design this artificial heart. I need to unload project management, marketing, p.r., fabrication, regulatory affairs -- these are things I'm doing poorly, but I'm the only one responsible. Meanwhile, I have ideas for dozens of new projects. I have a scrapbook full of things I want to patent -- " he picks it up and waves it wildly -- "and it's taken me two years to patent just one! It's like giving birth to a porcupine!"

A melancholy look crosses his face as he flips the pages of his notebook. "The days of Thomas Edison, Nikola Tesla -- they're gone. Why? I'm not sure -- " His musings are interrupted by the ring of the telephone. He sighs. "That's why." He picks up the phone, and in an instant has sunk back into the world of biological organs, for the moment leaving his dreams of musical organs behind.

* * *

And yet -- are those worlds really so far apart?

Antaki's colleague George Fechter, who came to the McGowan Center three months ago as its CEO, doesn't think so.

"Any given Sunday morning," he says, "hundreds of thousands of Pittsburghers are uplifted by the air that's mechanically transported through the pipes of church organs to make music to sustain the soul. Likewise, artificial organs transport gases and liquids through pipes to sustain the body. The church organ's pipes, if not properly tuned, will make bad music. Artificial organs, if not properly designed, can destroy blood, cause clots and result in death."

The reason this analogy holds together is simple: The two usages of the word *organ* do, in fact, have a common origin.

Way back when -- like, sometime around the dawn of civilization -- it all started with the Indo-European word *worg,* which meant, roughly, "work."

Worg found its way into ancient Greek both as *ergon,* which also meant "work," and *organon,* which meant "instrument of work" or "functional tool."

Now it starts to make a bit more sense. Biological organs are all functional tools that work together to keep the body alive. And just as the word *instrument* can refer to either any old tool or, specifically, a musical tool, the word *organon* -- and later just *organ* -- came to do the same.

So that's why both hearts and harmonicas are organs. But wait a second -- isn't there something deeper happening just below the surface here? Isn't this also the origin of one of human society's most fundamental metaphors -- namely, *organization?*

The word is hurled around without a thought every day -- the company you work for is an organization, a baseball team is an organization, you can't find anything on your desk unless it's got some kind of organization. But back away a moment and look at the word as if for the first time.

Organ-ization. It means, literally, "making into an organ." That's what you do when you go to your job -- make yourself into an organ, an instrument of work, that functions in concert with other such people/organs to keep the overall entity -- your company -- alive.

A humbling image? Maybe. Or maybe not. Bartley Griffith, director of the McGowan Center, finds it poetic.

"Each scientist is a cell," he says thoughtfully, "and each team of scientists represents a different function that needs to be accomplished: the artificial heart team, the artificial lung team..."

The imagery leads him to an intriguing concept: "It's very important that this center have a soul."

It would be impossible to try to point at the soul of the McGowan Center, just as it would be impossible to point at a person's soul: It's not a single organ.

But if you walk out of the Pitt Biotech Center on a Sunday morning and cross the highways, you'll find yourself striding up into the Hill District. Walking down Crawford Street, as you approach Saint Benedict the Moor Catholic Church, you might catch a strain of organ music coming through the door. And if you step inside, you'll hear the voices of the church's gospel choir blending in harmony with the organ, each filling its own role in the organized arrangement of notes that forms a greater whole than any of the individual parts on its own.

One of the singers -- a guy with a moustache -- is trying to run the mixing board at the same time. And he's got a harmonica tucked away just in case he finds occasion for one of his rare solos.

Good Lord, doesn't Jim Antaki get enough of organs during the *other* six days of the week?