



IONAT ZURR

# Tissue Culture

The line between art and science blurs when two artists hang cells in galleries.

By Lori Andrews

"Semi-Living Worry Dolls," 2000. The "dolls" are fixed and preserved in formaldehyde.

*Art is science made clear.*

*Jean Cocteau*

The now-iconic 1997 photograph of a mouse with a human-shaped ear growing on its back stimulated the development of tissue engineering, both among basic researchers and among entrepreneurs. But it also had a profound effect on two Australian artists, Oron Catts and Ionat Zurr. They looked at the ear, created by seeding bovine cartilage cells on biodegradable scaffolding,



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and said to each other, “That’s sculpture.” Now, a decade later, Catts and Zurr run the only academic department in the world that offers a program in tissue culture art. Coming full circle, their art projects have inspired scientists and venture capitalists to develop new products.

For Catts and Zurr, a married couple, moving from paints and clay to polymers and cells while in their twenties took training. They first talked their way into positions as artists in residence at the School of Anatomy and Human Biology, University of Western Australia in Perth. There, they learned the basics of tissue culture and tissue engineering. The idea of artists going this deeply into the science was sufficiently novel to earn them an invitation to speak at the Massachusetts Institute of Technology’s Media Lab. Joseph (Jay) Vacanti, who, along with his brother Charles, had created the mouse with the unique dorsal appendage, attended their talk and invited them back to his Tissue Engineering and Organ Fabrication Laboratory at Massachusetts General Hospital in Boston.

There, he showed them computer models

of his latest project—a complex, engineered circulatory system. The artists realized that the system Vacanti was creating would not only pave the way for whole organs to be grown in the lab but would also provide the means of sustaining large, living sculptures. They convinced Vacanti to let them join his research team at MGH as artists in residence the following year.

While there, Catts and Zurr began a project based on tissue culture that also—being art—offered commentary on public anxiety about the safety issues and ethical questions associated with cutting-edge biology. “We decided to do a project called ‘Worry Dolls,’” says Catts. The inspiration came from the Guatemalan tradition of giving children a box of six small dolls made of cloth. Children tell the dolls their worries before going to sleep, place the dolls under their pillow, and in the morning the worries have vanished, as goes the custom.

When Vacanti entered the lab one day, he saw his artists working under a hood with tissue cultures. “I thought they would be taking pictures, doing drawings and building sculptures,” he says. “Instead, they were

Bio-artists Oron Catts (*left*) and Ionat Zurr (*right*).



AXEL HEISE

Through the looking glass: A peek at the worry dolls grown in a bioreactor vessel.

acquiring the lab skills for their art. They were changing the conversation about what was living and what was not living.”

To his credit, Vacanti encouraged these budding tissue engineers. “Over time,” says Vacanti, “the artists began helping the scientists.” In 2000, Catts and Zurr established a functioning, sterile laboratory in the gallery at the Ars Electronica exhibition in Linz, Austria. The artists created biodegradable polymers in the shape of small dolls, seeded them with endothelial, muscle and osteoblast cells, and put

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*Oron Catts, SymbioticA*

them in culture in a bioreactor. When the finished, semi-living “Worry Dolls” were publicly exhibited, visitors could type into a computer the worries they had about biotechnology—anything from concerns over Frankenfoods, to the commercialization of life, to the uber anxiety about scientists playing God. “We emerged with a fascinating document that sets forth the apprehensions of the human race in the twenty-first century,” says Catts.

C.P. Snow’s *The Two Cultures* fingered the lack of communication between science and the arts as a barrier to solving the world’s problems. But Catts, 39, and Zurr, 37, speak both languages. They are stylish and well-read, attractive and analytical, creative and empathetic. When they returned to Perth in 2001, the two established a unique artistic research lab, SymbioticA, at the School of Anatomy and Human Biology. Artists and scientists from a broad range of disciplines now conduct research in the art-science laboratories at the university. The art they create will affect not only what we see in galleries, but also the types of medical treatments and consumer products we will be offered. One SymbioticA artist, Adam Zaretsky, stimulated *E. coli* cells to produce more antibiotics by exposing them to Engelbert Humperdinck songs. But musical tastes aside, this is serious stuff: The art projects must gain the approval of the university safety and ethics commissions, just as if they were purely scientific research. With enough commitment, participants in the program can earn a master’s degree in Biological Arts, which is granted by the university as a science degree.

In 2002 in a Perth gallery, Catts and Zurr created a large, black, bubble-shaped bioreactor room within a larger exhibition space. From the second floor of the gallery, viewers could look down into the black bubble, as if looking through a microscope. At 3:00 p.m. each day, the artists would enter the bioreactor in laboratory clothes to feed the tissue culture.

That project was inspired by what they saw as the hype surrounding the first,



rough draft of the human genome. Nobel laureate James Watson, the co-discoverer of the structure of DNA and the first head of the Human Genome Project, declared, “We used to think our fate is in our stars. Now we know, in large measure, our fate is in our genes.” While Catts, Zurr and their colleagues applauded the advance, they considered the language overblown, the implied genetic determinism unfortunate, and some of the potential being discussed fanciful at best. Their skepticism coalesced around the expression, “When pigs fly.”

For background, the artists headed to Harvard University’s Museum of Comparative Zoology to study the skeletons of birds and bats. On a computer, they developed a three-dimensional program for the structure of wings, and used it to create biodegradable polymers. They seeded the polymers with bone marrow stem cells from a pig, which then multiplied.

Once the cells fully developed into the shape of wings, the artists photographed them under colored LED lights on a microscope stage and displayed the cultures and the photos in the gallery. The exhibition, “If Pigs Could Fly,” suggested both the possibilities of biotechnology, and its limits. Some people came to the gallery expecting to see



TISSUE CULTURE & ART

Art is not necessarily the creation of an object, it’s enough to create a situation.

*Oron Catts, SymbioticA*

actual pigs that could fly—instead they saw tiny sculptures grown from pig tissue.

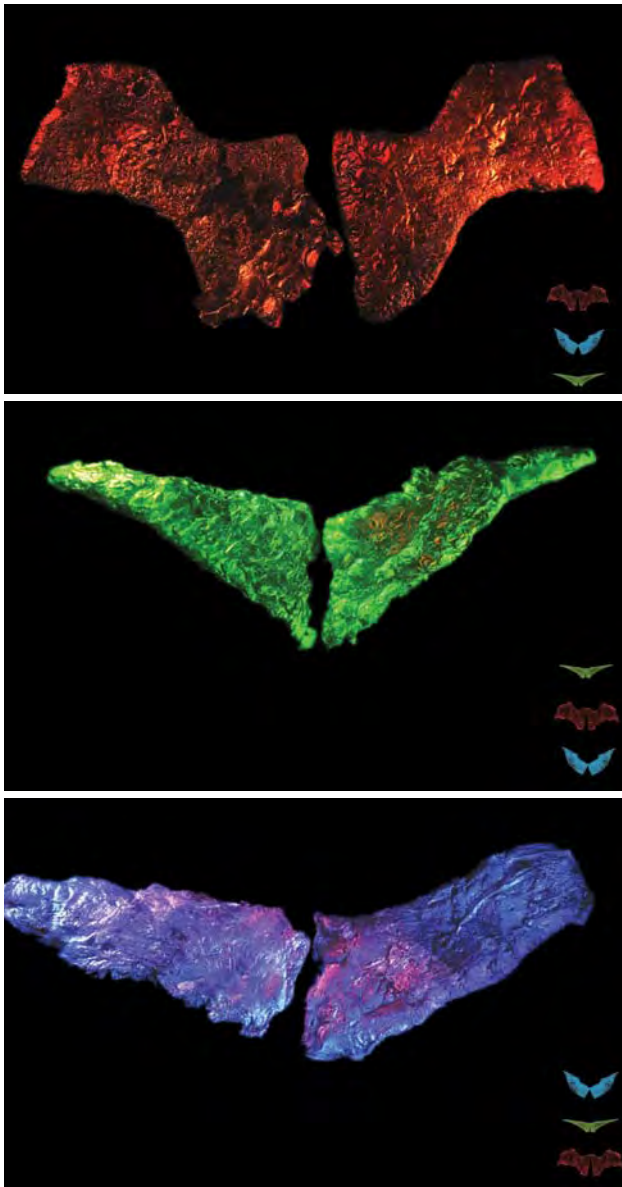
Like all of the art Catts and Zurr produce, these “wings” were living tissue that needed to be fed. Each day when they refreshed the medium, Catts and Zurr wore black lab coats, a nod to Alexis Carrel, the Nobel laureate who was the godfather of tissue engineering. Since Carrel’s laboratory at Rockefeller University had windows that created a huge amount of glare, he made the laboratory workers wear black.

The artists’ homage to Carrel expressed both the possibilities and potential hazards of scientific advances, calling attention to a moment when science went too far. In 1908, Carrel devised methods for transplanting whole organs. In 1910, he demonstrated that blood vessels could be kept for long periods

“The Stone Age of Biology” installation. The artists grew mice muscle and fish tissue over hydrogels in the shape of miniature prehistoric stone artifacts.



TISSUE CULTURE & ART



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"Pig Wings," 2000-2001. The artists grew three sets of wings out of pig mesenchymal cells (bone marrow stem cells).

of time in cold storage before transplantation. Along with pilot Charles Lindbergh, he created a perfusion pump that allowed living organs to be maintained outside of the body during surgery. But along with a landmark scientific treatise, *The Culture of Organs*, he also wrote a popular book called *Man, The Unknown* that touted a scheme in which criminals and the insane would be "humanely and economically disposed of in small euthanasic institutions supplied with proper gases."

Through tissue culture art that is living and

thus requires nurturing, Catts and Zurr try to promote an "aesthetics of caring." They also dramatize the extent to which many plants, products and (perhaps in the future) human embryos are rejected before an "acceptable" or "preferred" biological product becomes public. The cell lines they culture to produce art objects cannot be maintained indefinitely. "Generally we invite the audience, the curator and the gallery owner to take part in killing," says Catts.

"When I first saw the ear on the mouse," Catts continues, "I saw the possibility of integrating biotechnology into product design beyond medicine, with the aim of creating an environmentally friendly design. At the time I thought, naively, that we had to change the conception of our consumer society to one that is more concerned about its products, instead of buying and throwing away."

While working at MGH, the artists observed a tissue-engineering project that involved taking muscle cells from an in utero sheep fetus. The cells multiplied rapidly, so the scientist offered some to the tissue artists. "We were starving artists in Boston and her offer made us think of our mothers' advice not to waste any food," says Catts. "We asked ourselves, 'Why not grow food from these muscle tissues without killing an animal?'"

For the next three months, they grew mini-steaks, seeding sheep muscle cells over polymers. But, when it came time to try their culinary creations, they were impeded by the fact that the MGH lab didn't have a license to serve food.

But artists rush in where scientists fear to tread. And the next time such an opportunity arose, they were ready. A few years later, when Catts and Zurr were asked to participate in an exhibition of life science art in Nantes, France, they built a bioreactor in the gallery and used tissue engineering and stem cell technologies to create another type of cuisine—frog steaks. For two months, they went through their daily ceremony of feeding their own version of *les cuisses de grenouilles*. Then they removed the meat, marinated it in Calvados overnight, and cooked it in a garlic and honey sauce.

By candlelight in the gallery, with exquisite French wines, the artists and their guests served as the beta testers for what the two had dubbed "Disembodied Cuisine." There was discrete spitting into napkins all

around. “The polymers had not completely degraded, and because the muscle cells had not exercised, the steaks tasted like frog-gish jelly,” Catts laments.

Beyond issues of taste and consistency, when they calculated how much it would cost to grow, say, a gram of lamb meat, they realized it would top \$650. Moreover, given that lamb serum is required to grow lamb cells in culture, these “lab ranchers” would have to kill a whole lamb anyway. Nonetheless, the artists proved to be harbingers—which is part of their job. The director of an animal rights organization contacted them. Could they grow a steak out of the director’s own muscle tissue, to prove that it isn’t necessary to eat animals? “It was a little too much like cannibalism for us,” says Catts.

But Jason Matheny, a University of Maryland doctoral student, was waiting in the wings. He founded New Harvest, with the objective of funding research to produce meat in the lab. In an article he wrote for the journal *Tissue Engineering*, he acknowledged that the artists were the first to grow and eat tissue-engineered meat. “I’m delighted they got the recognition they deserved for their work in this field,” says Vacanti.

Vacanti had been so intrigued back in 2000 when Catts and Zurr did their meat experiment at Harvard that he’d encouraged them to write a patent application. They did and he took it to the Harvard tech transfer office. But the office decided it did not want to incur the costs of filing the application. In 2005, a group of Dutch researchers filed a U.S. patent application, “Industrial Production of Meat,” for a process similar to that pioneered by the artists.

Like Omar Khayyam’s “moving finger,” this innovative pair, “having writ,” simply moved on. They are currently engaged in a project called “MEART—The Semi Living Artist,” which asks whether a tissue culture itself can become an artist. This project was inspired by the work of Steve Potter at the Georgia Institute of Technology, who cultured live nerve cells from embryonic rat

cortex in his neuro-engineering lab. He was trying to determine whether these isolated nerve cells, grown over an array of 60 electrodes, could form a rudimentary brain and communicate with each other.

Catts, Zurr and bioartist Guy Ben-Ary convinced Potter to collaborate with them long-distance. They proposed to photograph a hu-

man face in a gallery in Perth, send the image over the Internet and have Potter transform the picture into electrical signals through the electrodes to the neurons. The electrical impulses the neurons then generated in response would be transmitted back to the gal-

lery, where they would cause a robotic arm to sketch colored lines on a piece of paper. The project thus involved wetware (the neurons), hardware (the robotic arm) and software (to translate the impulses). In essence, the tissue culture itself became the artist.

So far, the neurons in the Petri dish may be outperforming both biotech companies and human artists. Last year, four of the drawings created by MEART were sold to a museum in Spain.

Catts delights in the fact that tissue culture art has sparked discussion among the public, the research community, venture capitalists and bioethicists. “Art is not necessarily the creation of an object,” he says. “It’s enough to create a situation.” TJOLS

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*Joseph (Jay) Vacanti, Tissue Engineering and Organ Fabrication Laboratory at Massachusetts General Hospital*

From October 25, 2007, to January 6, 2008, the work of Oron Catts and Ionat Zurr will be exhibited in the Yerba Buena Center for the Arts in San Francisco as part of an exhibition on biotechnology and the arts, “BioTechnique.” See <http://www.ybca.org/>.

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*Lori Andrews, a law professor at Chicago-Kent College of Law, and the author of the genetics thriller The Silent Assassin (2007), has been up close and personal with the worry dolls, pigs wings and artistic neurons in Austria, France and Australia.*