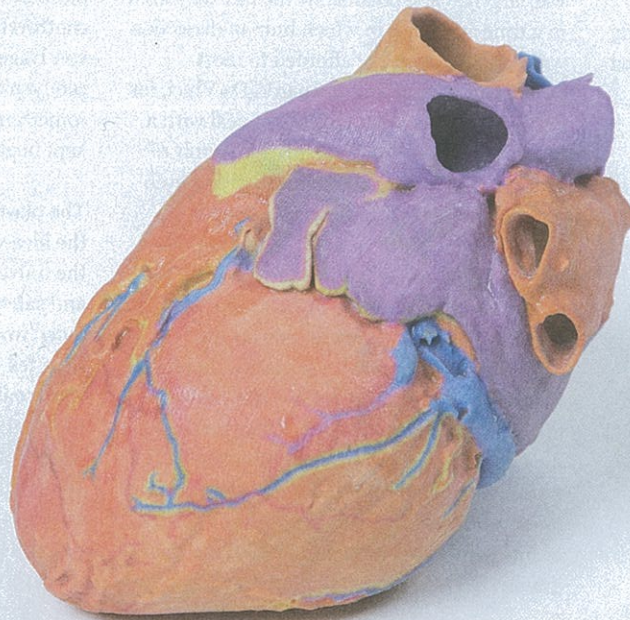


# super models

THE CADAVERS THAT MEDICAL STUDENTS USE TO LEARN ABOUT THE HUMAN BODY CAN BE DIFFICULT TO SOURCE AND STORE. THANKFULLY, AN ANATOMY PROFESSOR IN MELBOURNE HAS FOUND A SOLUTION.

*Writer Dyani Lewis Photographer Peter Tarasiuk*



“WHAT’S IN HERE?”

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That’s the question custom officials shot at Paul McMenamín when he landed in Liberia recently with five carefully packed boxes. The professor of anatomy had just caught the red-eye from Melbourne, and was keen to get out of the airport as quickly as possible. The question didn’t come as a surprise, though. He knew his unusual cargo would probably require some explaining.

Under the watchful eye of the officials, McMenamín opened one of the boxes and reached inside. Carefully, he removed a bubble-wrapped human heart.

“Body parts,” he replied.

The men who had seized the boxes recoiled. Their fearful looks quickly turned to curiosity, however, as they peered closer. The heart, which was etched with twisting blue veins, was in fact an ultra-realistic plastic replica.

McMenamin was waved through – along with around 60 kilograms of 3D-printed body parts. Each was an exact copy of an embalmed specimen stored at Monash University. There were hands, feet, arms and legs. Skin was removed to reveal bands of muscle and tendons, networks of nerves and blood vessels, bones and cartilage. The largest item was a man’s torso, hollowed out so that the muscles lining the back of the abdominal cavity and the arteries that feed oxygenated blood into the legs were in full view.

McMenamin had come to Liberia to personally donate the models to the country’s only medical school, the AM Dogliotti College of Medicine.

Why? The college has historically struggled with one aspect of training that many medical institutions take for granted:

cadaver dissection. In fact, by the time McMenamín arrived, the practice had been put on hold indefinitely, largely due to Liberia’s devastating Ebola outbreak. Even before then, however, things were pretty dire. Bodies were poorly embalmed and students could only dissect them in short bursts – after a few minutes in the unventilated dissecting room, the fumes would make their eyes tear up and their noses sting.

To administrators at AM Dogliotti, McMenamín’s ultra-lifelike models represented something exciting; they represented a solution: an opportunity to properly teach anatomy without the headaches of storing and preserving dead bodies.

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Anatomical dissections have been a mainstay of medical curricula for centuries. The practice goes all the way back to the ancient Greek physicians Erasistratus and Herophilus, who are said to be the first to argue that consciousness stems from the brain, rather than the heart. Their groundbreaking research was largely made possible by the fact they lived in a time and place in which human dissection was legal; a luxury not afforded to most pioneering anatomists. Leonardo Da Vinci, for example, had to strike up a secret deal with a local hospital director to secure his supply of cadavers for dissections. Other surgeons even resorted to employing grave robbers.

Today, the situation couldn’t be more different. All dissections in Australia, as in many parts of the world, rely on the generosity of donors who bequeath their body to a university prior to death – the “ultimate gift” as McMenamín calls it. When a donor dies, their family or doctor notifies the university and an undertaker is commissioned to deliver the body to an anatomy lab. Litres of formalin-based embalming fluid are then gravity-fed into the femoral artery in the

groin. It takes six months for the chemicals to gradually infiltrate the entire body, by which time every cell in every organ is preserved, and the washed out, latte-brown body is ready to go under the knife.

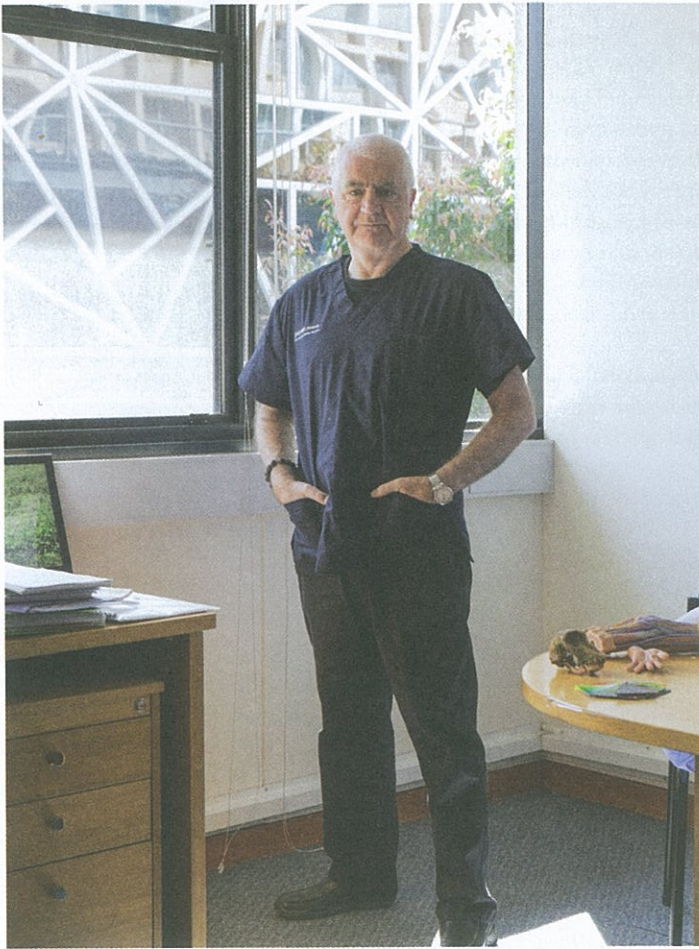
Increasingly, dissection classes are becoming something that many institutions can no longer justify, especially in poorer countries. It’s not cheap to collect and preserve a 70 or 80 kilogram human being. In many places around the world, cultural and religious beliefs also influence cadaver availability; practices such as burying a body within 24 hours of death, as happens in both Muslim and Jewish traditions, can be major obstacles.

These challenges were part of what led McMenamín to start printing his replicas. As the Director of the Centre for Human Anatomy Education at Monash University, he oversees the teaching of anatomy to some 320 first-year medical students each year. His ambition, when he arrived at Monash in 2010, was to introduce a technique called plastination. The process, which preserves a cadaver by impregnating the tissues with plastics, was developed and made famous by controversial German anatomist Gunther von Hagens. With plastination, body parts can be picked up and handled by students – something that isn’t possible with specimens kept in glass tanks.

The plastination facility never did go ahead; the idea was thwarted by the cost of meeting the university’s rigorous occupational health and safety standards. But as one plan faded from McMenamín’s view, another soon fell into his lap. It happened while he was speaking to a colleague named Colin McHenry. At the time, McHenry had been using a 3D printer at the University of Newcastle to print lizard skulls. The pair got talking about alternatives to plastinating body parts. “He said, ‘Why don’t we just 3D-print all of this?’” recalls McMenamín.

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Page 115  
A model of the heart

Page 117 Clockwise  
A deep dissection of the foot

A bronchial tree, which is essentially the airways of the lungs

'Buster' the head, neck and shoulder model, dissected to reveal various internal features

Blood vessels (veins in blue, arteries in red) that supply the brain

Left  
Paul McMenemy at Monash University

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It wasn't something McMenemy had considered, but it was worth a shot. Turning to the university's collection of historical specimens, which are stored in individual glass tanks filled with formalin, he chose a carefully dissected hand to test the idea. With a bit of tinkering, he and McHenry scanned and rendered it, and hit 'print'.

The next morning, all they could see in the printer was a mound of white powder. Beneath the mess: a hand. "We thought, 'Shit, it's actually worked! I don't believe it!'" says McMenemy, laughing.

Just two-and-a-half years after that first hand was printed, McMenemy has partnered with a German company called Erler-Zimmer to commercially produce over 50 different 3D replicas. Instead of the months it takes to embalm and dissect a real human body part, Erler-Zimmer can usually produce a lifelike copy in less than a day.

The detail captured in these models is staggering. Look into the face of one of McMenemy's head, neck and shoulder

models (he's affectionately nicknamed it 'Buster') and it's clear that it came from an elderly man. His partially closed eyelids, sunken cheeks and mouth that rests slightly open – as if he has fallen asleep watching a late-night movie – imbue him with a pathos absent from the vacant stare of a regular anatomical model you might see in a doctor's office. McMenemy's models are far more intricate, too; veins and arteries can be printed as delicate arboreal networks, unsupported by surrounding muscle. They can't be cut into with a scalpel, but, like von Hagens' plastinated parts, they can be picked up and closely scrutinised – "3D textbooks," says McMenemy.

It's somewhat ironic, then, that McMenemy has come up against criticisms that the replicas are not lifelike enough. ("Neither is a cadaver," he rebuffs.) Traditionalists have also decried his idea as the end of a time-honoured rite of passage, a view McMenemy dismisses as "melancholic nostalgia".

"I'm just not as wedded to one mode of learning being the best and the only mode,"

he says. "There are a lot of medical schools that teach very, very good doctors and they don't dissect." Indeed, for the last 15 years that he taught at the University of Western Australia before coming to Monash, medical students didn't dissect cadavers. "Do I think they were bad medical students? Absolutely not!"

The depth of respect and gratitude that McMenemy feels towards the hundreds of men and women whose bodies have furnished his dissecting rooms throughout his career is palpable. "We live and breathe it, and we sometimes forget the sensitivities," he says, "but these are people's mums and dads and aunts and uncles and grans and granddads."

While he'll never be able to personally repay his body donors for their precious gift, being able to impart his technology to the enthusiastic students of AM Dogliotti has given him a level of satisfaction that he didn't think possible.

"They were all so grateful," he says. "It was just so moving." •