UNLOCKING THE CELL

Carlo Ventura's research into living cells is at the frontier of microbiology, but has implications far beyond. His work could liberate the language of science, and lead to a 'third culture' of collaboration with the arts. By Jonathan Bastable

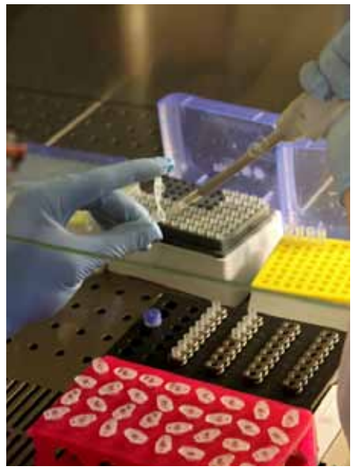
One of the peculiar and attractive things about Bologna University is that it is an ultra-modern institution with a distinctly medieval face. Behind many a porticoed facade or ancient wall, all manner of contemporary art projects or innovative scientific research programmes are going on, more or less unnoticed by the people who walk the street outside. The VID lab, for example, consists of a rambling suite of rooms in a large 16th-century palazzo on the Strada Maggiore. It shares the building with lawyers' chambers, doctors' surgeries and private apartments. Near the front door of the lab is a little kitchen that looks like no-one has touched it since the 1920s. Further in, the corniced ceilings of the larger rooms are decorated with Baroque *trompe l'oeil* paintings. Dotted around the place are glass jars and pulleys. For reasons that are not immediately apparent, an 18th-century loom stands in one corner, a half-finished piece of fabric stretched across it like the skin of a drum. In another room there are some actual drums, a full set of orchestral timpani. You cannot help but wonder what these objects are doing here, and so it is reassuring to find that one of the smaller rooms contains some impressive-looking scientific apparatus: a 'stericycle CO2 incubator'– a tall fridge connected to a laptop that sits on a battered butcher's block; and on a bench next to it a sterile 'hood', a closed environment for growing cell cultures, that looks like some kind of over-engineered pizza oven.

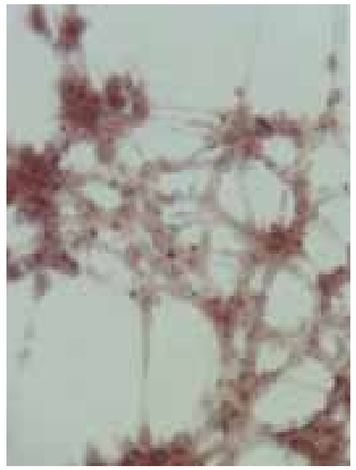
All this is the strange domain of Carlo Ventura, Professor of Molecular Biology at the university's School of Medicine. 'I like this space precisely because it isn't sterile, in any sense of the word,' he says. 'The rooms are interesting, and that promotes creative thought.' He launches straight into an explanation of the astonishing research that he conducts here. 'Ten years ago we were studying stem cells with a tiny probe, the tip of which is the width of a single atom. When you use such an instrument, you cannot see the contact that you are making with an individual molecule, and it is hard even to visualise it. You are like a blind man, touching a large object with the tip of his finger. But with our probe, we discovered that cells vibrate in a range of frequencies that the human ear can detect (so long as you boost the amplitude). We invented a word, sonocytology, to describe this new field: the study of the sounds that emit from cells. We suspected that somehow the sounds were telling us something about the state of health or disease of the cell.'

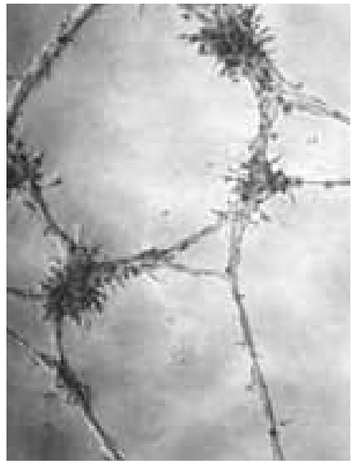
Ventura at VID. The acronym stands for Visual Institute of Developmental Sciences, but also nods to the Sanskrit root-word 'vid' or 'ved', denoting both 'seeing' and 'knowing'

Professor Ventura went to his computer and played some cell-music to me. One sonorous cell held a continuous reedy note, like a finger holding down a key on a Hammond organ. The second was rougher, but a harmonious third above the first. The next gave out a high-pitched whistle, like a domestic fire alarm. Then he played me the sound of a dead cell: white noise, like the hiss that issues from a TV set with no signal. So it seems that live stem cells chirrup like birds. And as with birds, their song betrays what kind of thing they are, or are in the process of becoming. But that is not the half of it. Ventura found himself wondering if cell-song was a two-way thing, if sound could be used to communicate with stem cells and alter their cytological destiny. His research has shown that this is indeed the case. 'For decades scientists have used only chemistry to talk to cells and change their path,' he says. 'We have used physical means, and shown that the alteration of cell behaviour through sound is a scientific fact. It is possible to record a kind of symphony of the sounds that growing cells make, play those nanomechanical vibrations back to undifferentiated cells, and by so doing re-programme them. This could lead to a new cell therapy that would be so much better than using chemicals, because it costs half a billion dollars to bring a drug market, whereas sound costs almost nothing.'

But how far can this go? Would it be possible to communicate with microscopic cells by, say, banging on those big old ▷







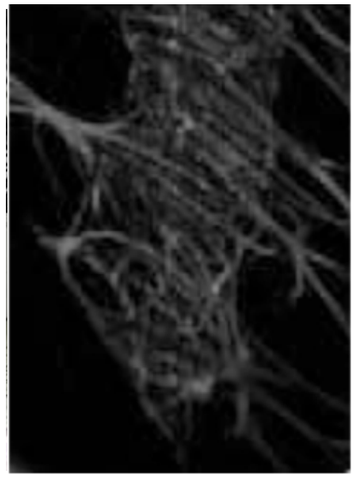
kettle drums in the corner? It turns out that this is not so fanciful as it seems. Professor Ventura tells a story about Milford Graves, the pioneering jazz percussionist. Graves recently fell very ill with severe arrhythmia, an irregular heartbeat. He was keenly aware of the irony: having made a career out of rhythm, he seemed likely to die because his heart had lost its own. Some instinct made him want to record the sounds that hearts make, his own and healthier ones. He made a series of recordings using a sophisticated atomic stethoscope, and realised that the sound of his arrythmic heart was lacking in certain harmonics when compared to the sound of a regular heartbeat. So he applied electrodes to acupuncture points on his skin, and played a recording of the normal cardiac bi-boom-bi-boom to his own ailing heart. Remarkably, his own arrhythmia went away, and he had a similar result with other people suffering from the condition...

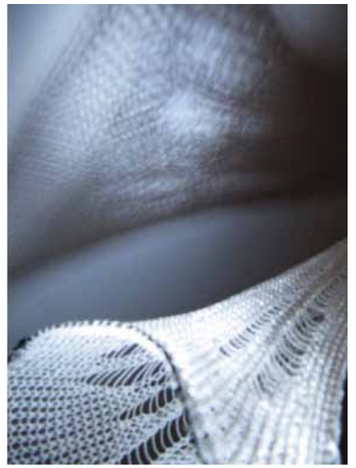
'When I heard what Graves had done I wanted to meet him,' says Ventura, 'because it seemed to me that he was using sound to restore the ability of a cell to repair tissue. There is a myth that only embryonic cells can do this, but it is not so: that is not their job. Embryonic cells do not know the story of an organ, because there is no organ yet; only the adult cells know the story. We now know that the ability of cells to repair and rescue is due to an instruction that a transplanted cell somehow passes to resident cells, allowing them to re-learn their ability to heal.' Graves now collaborates with VID in an ongoing investigation of the heart's micro-rhythms. Ventura played me several recordings of these visceral tattoos: urgent, palpitative beats like a speeded-up samba band. Then he ran an algorithmic fusion of them all: it came out as a melodic electronic riff over two or three bars, like the opening of some ambient piece by Brian Eno.

But hold on. Is it possible for a single cell to know a story, to convey a message or learn a lesson? This surely implies some sort of awareness, a level of consciousness that single cells – even human ones – cannot aspire to. 'That is a major recent issue, the consciousness of cells,' says Ventura. 'We tend to believe that consciousness resides only in the brain, but the brain elaborates many different measures to create consciousness. Many studies – not just our own – have shown that there is a sort of neural network of dynamically entangled

The team at VID is generating new views of the nanostructure of cells, among them extreme close-ups of stem cells derived from vascular tissue (left). Ventura has compared images such as these to fractals or to 'their 3-dimensional equivalent, which is the hologram. It is possible to think of a single cell as a fractal part of the entire individual.'

The artwork (far right) was created by Julia von Stietencron (below). Its shadowy form resembles some of the subcellular images (near right) that Ventura has seen in his microscope. 'She didn't know about this picture,' he says. 'I said: do what you want as a textile artist, and she seemed to anticipate what capillary vessels formed in vitro would look like.





information that is being exchanged every second within a cell. A cell is a tiny brain; it is somehow involved in thinking.'

There is contained in this speculative line of thought an almost Buddhist concept: that consciousness is holistic, that every atom of the body is involved in it, and that the mind ought not to be conceived of as something separate from the physical self. It was no surprise to see on Ventura's desk a copy of the Dalai Lama's *How To Be Happy in an Imperfect World*. It was becoming clear that much of the work of the lab was about intellectual integration and cross-fertilisation, that Ventura's journey into the invisible nano-realm of microbiology was beginning to raise questions more usually asked by psychologists and philosophers.

And also by artists. One of the core aims of the VID lab is to foster collaboration with the world of the arts. Ventura has coined another new term, 'the third culture', for scientists' experimental interface with creative artists. 'VID is about seeing things with different eyes,' he says. 'Science and culture have been too separate for too long. We must find a means to retell our story in different language. The tools that we scientists have to describe what we are seeing are poor. We have no option but to borrow words or analogies from humanistic culture to describe what we are perceiving at this very low level. But the magical thing is that, once you move away from classical scientific language, you can arrive at new hypotheses simply by talk about your experiments in different terms. You create possibilities for taking the science further.'

The VID lab has an art director, Julia von Stietencron. She is a fashion designer, and also an artist who uses textiles as her medium. Ventura has clear scientific reasons for choosing to work with this kind of sculptor. He shows me a short film of the surface of a single cell. It is covered with a web of shimmering, twitching filaments like taut strands of knotted silk caught in a light breeze. Suddenly I feel I am looking at the infinitessimal fabric of my own being, the very warp and weft of humanity. For Ventura this is no metaphor. It is a simple fact about the architecture of living things. Here at last is an explanation for the looms that populate the lab. They are no less a part of the laboratory apparatus than the centrifuges and microscopes. So von Stietencron's sculptures (they resemble beautifully contrived fishing nets) are scientific experiments as well as works of art, for both entities are a way of making things seen and understood. The VID lab's collaborations with Graves and other musicians tie in with this too – because what are musicians but sound-weavers, plaiting euphonic threads and aural yarns into pleasing patterns?

Ventura points out that weaving was one of humanity's earliest creative activities, and says that those first fabricators, with their primitive spindles and spinning wheels, were perhaps subconsciously expressing a deep truth their innermost structure. This wonderful notion sparked a memory in me, a half-remembered line of poetry. I found it later in Rupert Brooke: 'These hearts were woven of human joys and cares… had seen movement, and heard music…'