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Now for a full body overhaul

The potential to create a bionic eye in Australia is a serious prospect. What it needs is funding, writes Mark Metherell.

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When Kevin Rudd heard the 2020 call for an Australian-developed bionic eye, he joked that his expertise was in classical Chinese poetry, "but it sounds like a good idea to me".

The ambition to restore 20-20 vision by 2020, sounded like another of the catchy, slightly unreal ideas the Prime Minister latched onto at his gathering of visionaries last weekend.

What Rudd might not have known is that artificial sight is now not only a serious prospect but the potential creators are at an Australian institute that occupies an exclusive spot in the bionic world.

The creation of the bionic ear in Melbourne 30 years ago and later refinements have spawned the development of not only a highly profitable multinational, Cochlear, but also an international edge for Australia in the development of electronic gadgetry that can mimic bodily organs.

The Bionic Ear Institute, which with government funding hopes to transform itself into the broader area of medical bionics, says it is "poised to deliver" not just on the bionic eye, but on a range of other concepts out of science fiction.

These include "targeted drug delivery systems" which transport medicine through the body to the disease site; brain implants that could pre-empt and suppress epileptic seizures; and a "high-fidelity bionic ear".

The last illustrates the unending advance in bionics. For the first time, the bionic ear provides an artificial means by which the profoundly deaf can hear.

But because of the limited number of electrodes in the implant, the range and pitch of sounds the artificial Cochlear picks up, means that while it enables people to hear speech, listening to music is usually unpleasant, a clashing of noise rather than a melody.

This is because the implant relies on 22 electrodes to receive the whole pitch range, compared with the 1500 hair cells which do the job in a normally functioning ear.

The institute says its experience with the development of today's bionic ear, in scientific and importantly in organisational terms, is now being deployed with promising results on the eye project.

Vision may appear to be a completely different world to hearing but there are fundamental similarities in the technology required - the delicate electrodes that transmit the signal to the brain, electrical stimulation of neural tissue, and an array of medico-mechanical challenges.

The institute's director, Professor Robert Shepherd, says the institute has applied many of the lessons in developing the ear to the eye and other projects.

"We know how to safely stimulate neurons which carry the information to the cortex where we interpret sound, vision, smell," he says. "The neurons are our highway to the brain's central computer - the cortex."

The bionic eye comprises a miniature video camera mounted on the bridge of the spectacles. A wireless processor inserted in the spectacles' arm converts the camera images to digital signals that are then sent to a bionic implant attached to the retina.

The implant, a chip with 1000 electrodes, stimulates the optic nerve behind the eye which then transmits electrical impulses from the retina to the brain. The visual centre of the brain translates these impulses into the images we see.

The team hopes to have a model ready by 2010 for human trials of a bionic eye that would enable formerly totally blind people to see in dim outline the world around them and help them to live independently. The early prototypes are not expected to enable people to read. That may come later.

The scope of this multidisciplinary science reaches into other faltering mechanisms of the body and brain and opens the way to harnessing the brain's electrics to combat not only epilepsy but also Parkinson's disease and spinal cord injury. It could eventually be applied to other neurological disorders such as depression, anxiety and stroke.

David Martin is working on what he calls the Six Million Dollar Man project, to create artificial arms and legs. It is funded by the US Army to the tune of, yes, $6 million, says Martin, a professor of biomedical engineering at the University of Michigan.

He says his young students look strangely at him when he jokes about the *Six Million Dollar Man*, the bionic icon of the 1970s.

His particular focus is developing the special materials, such as "organic metal", needed to unite the living tissue and the artificial implant or limb.

One project involves the creation of an organic join between living skin and the polymer type material of an artificial arm. This includes a device which he says squirts tiny

amounts of "gloop", like natural mucous, to help the skin to continue to grow over the join.

Martin says that the Melbourne institute is a world leader in the bionic ear business. As for the bionic eye, he says several of America's leading research establishments, including the University of Southern California, Stanford University, Johns Hopkins and Massachusetts Institute of Technology, are throwing big efforts at creating arti- ficial vision.

The Melbourne institute says it is ahead of work at a unit at Stanford, which aims to restore the ability to read large print to people with macular degeneration. It says that its project represents "a technology leap" over the Stanford work in terms of numbers of electrodes, wireless technology and manufacturing ability. Initially, however, it ex- pects that recipients will not be able to read large print. But they will be able to live independently.

The Bionic Ear Institute says its strong position gives Australia a chance to secure a decent slice of the global medical bionics market, estimated to be worth $US213 billion ($225 billion). It wants a $100 million injection over five years from the federal and state governments and forecasts that it would be self-funding after that. "Rapid expansion is essential to reach the critical mass necessary to be competitive and capitalise on the institute's lead in this field," Shepherd says.

The pioneering work of Melbourne ear specialist Graeme Clark, who was joined by Shepherd in 1975 in developing the multi-channel Cochlear implant, led to the establishment in 1982 of Cochlear.

Clark has estimated that over 30 years the cost of developing the bionic ear was about $30 million. Early developments were helped with a grant from the Fraser government.

The institute believes it has a strong case for federal funding again. The bionic ear success is one of several home-grown medical breakthroughs such as Tamiflu and the cervical cancer vaccine that have strengthened Australia's once indifferent performance in turning discoveries into sales.

Professor Garry Jennings, president of the Australian Association of Medical Research Institutes, says the hope is that the Rudd Government will at least maintain research funding.

He says the role of governments in picking the most promising research projects is getting tougher because of the range of world-standard projects in Australian laboratories.

"There is still the 'chasm of death' between a great idea and the ability to get it to a stage where a major commercial organisation picks it up," Jennings says.

With the ageing of Western populations, the demand for synthetic body parts from the baby boomers is set on an exponential growth path.

Today Cochlear is in the top 100 Australian companies, a $3 billion enterprise, rivalling such long-time industry heavyweights as CSR in market value.

The bionic ear costs about $25,000 for the implant and the 22 electrodes surgically inserted into the inner ear. The bionic eye is expected to have a similar price tag.

About 110,000 people worldwide can now hear because of the bionic ear.

The development has substantially opened opportunities for smart technology and Sydney has been the big beneficiary of Melbourne's invention.

As a result of the availability of a medical technology plant in Sydney, the Cochlear implant is manufactured at Lane Cove, and 1000 of Cochlear's total staff of 1700 are based there.

Biomedical scientists at the graduate school of engineering at the University of NSW are also playing a significant role in developing the minute electrodes attached to the faulty retina.

The bionic project in Australia involves the collaboration of a disparate range of experts - eye and ear specialists, neurologists, biomedical engineers, neuroscientists psychologists and audiologists, polymer scientists to name a few. These experts are scattered throughout a range of institutions, including Melbourne University's medical, science and engineering faculties, the Royal Victorian Eye and Ear Hospital, Melbourne's St Vincent's Hospital, UNSW, the ***University of Wollongong***, the Centre for Eye Research, National Information Communications Technology Australia and La Trobe University.

That list serves to underline what the Bionic Ear Institute argues is the strong suit of the Australian bionics effort.

"Europe and America are beginning to invest significantly in medical bionics, including the important areas of nanotechnology and nanomedicines, but not specifically into an institute that has the capability of converging all areas of expertise," says the institute in its case to governments.

"A significant opportunity now exists in the field of medical bionics, for substantial benefits to be gained in the health/social and economic context. These international organisations are clambering to lay the foundation Australia has established."

Can you hear, Kevin Rudd?