Photography Chris Crerar

SEEING THE LIGHT

CAN LIGHT THERAPY – AT ITS SIMPLEST, A BUCKET FILLED WITH BULBS AND PLACED ON THE HEAD – REALLY TREAT PARKINSON'S?

By Suvi Mahonen

On a crisp and clear autumn day two years ago, when the sun was high in the sky but the air was cold on the ground, retired federal politician Max Burr was sitting in front of his computer at home in Launceston, desperately seeking some help.

Burr, a federal Liberal MP from 1975 to 1993, had been diagnosed with Parkinson's disease in 2012 and required a steady increase in medication. The disease had affected many aspects of his life: his balance was uncertain, he could no longer write or play the piano, and he'd lost his sense of smell. "And my voice was very timid – imagine that for a politician," Burr says.

To his dismay, he had recently been told by his geriatrician, Dr Frank Nicklason, that his condition was deteriorating and he needed to increase the dose of his medication. Concerned about potential side-effects, Burr refused. "I said to Frank, 'No, I'll find other methods'," he tells me.

With the tenacity of a seasoned politician, Burr, 78, opened his laptop and began to search. Before long he had found a research paper on the use of photobiomodulation – the term for light's ability to modulate key biological processes at a cellular or even genetic level – in animal testing for Parkinson's disease, published by Sydney University's Professor John Mitrofanis. "The paper showed that the use of 670-nanometre red light was protective of neurons in Parkinson's," Burr says. "So I sent John an email and said, 'Look, this is all very interesting, I wouldn't mind having a crack at it'."

Parkinson's disease – first described by English surgeon James Parkinson in his 1817 work *"An Essay on the Shaking Palsy"* – is a combination of movement disorders including tremor, muscle rigidity, impaired balance and slowness of movement. It can also cause neurological problems such as depression, poor sleep, memory loss and confusion. It is estimated to affect approximately 70,000 people in Australia and to account for more than 1700 deaths annually. Its cause remains a mystery but it is known to be associated with dopamine depletion (dopamine helps regulate movement and emotional responses) and loss of neurons in the basal ganglia region of the brain.

The current mainstay of treatment involves physical therapy as well as medications to increase dopamine levels in the brain. These medications can provide significant improvements but their effectiveness tends to wear off with time and they can cause a number of side-effects. In addition, they treat the symptoms only, without actually slowing, or reversing, the course of the disease.

One avenue of research that has shown unexpected promise in the quest for more effective treatment is light therapy, using red and near-infrared light. It's been known for some time that controlled exposure to these wavelengths of light appears to improve wound healing and reduce inflammation and pain. Over the past decade studies have been published showing it may also decrease the level of damage and improve motor function in animal testing for Parkinson's.

Mitrofanis, Professor of Anatomy at the University of Sydney's School of Medical Sciences, has spent two decades trying to find effective methods to protect the brain against degeneration and is considered a luminary in Parkinson's research. Despite being excited by the laboratory results on light therapy he had no choice but to tell Burr that all the work was pre-clinical, and he couldn't recommend it to humans yet.

Aware that his condition would not wait while scientists went through the long process of obtaining approval for human trials, Burr told Mitrofanis that he was going to try the light therapy anyway. "John replied by email and said, 'Well, good luck, I'll keep my fingers crossed, but I hope you don't fry your brain'," Burr tells me, laughing.

With the help of two friends, medical practitioner Dr Catherine Hamilton and her physicist husband David Hamilton, Burr built a homemade device from an aluminium-foil-covered lampshade lined with strips of LED bulbs that emitted red light at a wavelength of 670 nanometres.

Before he began to use it he completed a baseline report for Nicklason and Mitrofanis, outlining the severity of his symptoms. Once he started using the device – which rested on his head, with the lights switched on, for 20 minutes twice a day – he did a fortnightly report detailing the changes he was experiencing. "It was incredible," Mitrofanis says. "Much to my surprise, Max started getting some positive results."

Burr's description is even more remarkable. "I recovered my sense of smell, my writing is now firm and concise, my gait has improved and I can climb stairs," he says. "From week to week, it might have only been a subtle change, but the cumulative effect over the months has been quite significant. Now I regularly give public addresses, I play bowls, I do tai chi twice weekly." Though he remains on medications, Burr now views his Parkinson's as little more than an inconvenience.

For sceptics, it is certainly possible that Burr's improvement has been at least partially due to a placebo effect. Burr, however, believes there are more tangible physiological factors at work. "The benefits of the red light must be being transferred by a mechanism in the body – either by the vascular system or by the immune system," he says.

Dr Daniel Johnstone, 35, a medical scientist and lecturer at the University of Sydney's medical research centre the Bosch Institute, agrees with Burr's reasoning. Johnstone has been involved in a number of animal experiments on the use of photobiomodulation for Parkinson's and believes red and infrared light therapy can provide benefit. "The exact mechanisms are still not totally known, but we do know that there's a key enzyme in the cells that absorbs light at certain wavelengths and triggers this intracellular cascade signalling that seems to collectively lead to a protective effect," he explains. "Light is actually a low-level stress to the cells, and when you deliver this stress, it either stimulates repair processes or it conditions the cells to upregulate a lot of stress-response systems that conditions that tissue against a more severe insult down the line. Almost like a vaccination, where you're giving a low-level pathogen as a way to stimulate your body's own defences against a more severe exposure."

A vital component in Parkinson's research is the chemical 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP). This potent neurotoxin was accidentally discovered in the early 1980s when a number of intravenous drug users developed severe Parkinsonism at a very young age. Further investigation revealed that MPTP – a by-product of synthetic opioid production – crosses the blood brain barrier and is metabolised into a compound that destroys dopamine-producing neurons in the substantia nigra, part of the basal ganglia.

Johnstone has utilised this unfortunate side-effect of MPTP in several experiments. In one, 40 mice were divided into groups. Half were injected with MPTP and were given either no infrared light, bursts of infrared light to their head and body, or to their body alone. Six days later, all were euthanised and their brains were examined.

As expected, the researchers found that mice injected with MPTP had increased neural cell loss in the substantia nigra, compared to mice that had not been injected. But this loss was significantly reduced in mice exposed to infrared light. Interestingly, this benefit was also seen in the mice that had exposure to their body only, although to a lesser extent than the mice who had head and body exposure. This lent support to the theory that infrared light therapy can work via direct stimulation as well as through the release of as yet unknown circulating protective factors. "Similar findings are coming out from researchers all over the world," Johnstone says.

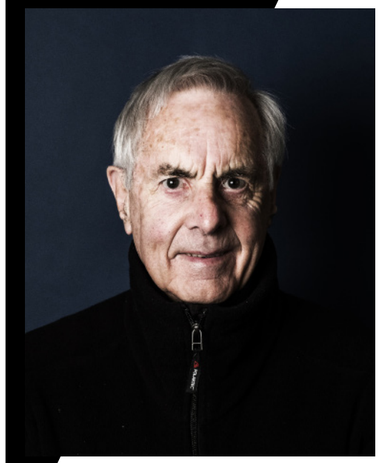
His supervisor at the Bosch Institute, executive director Professor Jonathan Stone, first heard about infrared light therapy 13 years ago when he was presented with data from work NASA had done in the 1990s showing that it could be used not only to help grow plants in space but also to speed the healing of wounds. Since then, Stone has been researching light therapy in his own laboratory and has observed similar interest in other research centres across the globe.

"It is clear to me that the pace of studies on photobiomodulation is increasing exponentially," Stone, 74, says. "Despite a lot of scepticism, people are being drawn into it by the fact that it works. There's growing evidence that it works against depression and stroke and in the cognitive aspects of Alzheimer's disease. And it's so blessedly free of side-effects that you can use it without having to know down to the last molecular detail how it works."

Although most studies on photobiomodulation have been performed on animals, to date there have been nine human studies, as well as numerous case reports, published in peer-reviewed journals on the use of red and infrared light therapy for various neurological conditions including stroke, traumatic brain injury, Alzheimer's disease and depression. The only human trial on photobiomodulation for Parkinson's disease that has been reported so far has been a small, non-randomised University of Arizona study where eight volunteers with Parkinson's received daily light therapy to their head. All subsequently reported an improvement in their symptoms. Encouragingly, there have been no known complications from the use of photobiomodulation in humans.

"Given the huge health impact of Parkinson's and other neurodegenerative diseases like Alzheimer's, and how safe and easily administered light treatment is, I didn't see what we had to lose by pursuing research in this area," Johnstone says. "There's no guarantee it will work yet, but I can pretty much guarantee that it's not going to cause any harm."

In the course of his research Johnstone travelled to a primate research facility in France in order to conduct more experiments. Initially, a small number of MPTP-infected macaque monkeys had an infrared light source implanted into their brains. "The results were extraordinary," he says. "We found that infrared light treatment offered really strong neuroprotection, and reduced clinical symptoms of Parkinsonism in the monkeys." In a further experiment in 2015, three MPTP-infected macaque monkeys received external infrared light therapy to different areas of their bodies. Remarkably, the monkey that received light therapy to the legs showed no signs of Parkinsonism by the end of the three-week experiment. "It was pretty amazing," Johnstone says.



Convert: Max Burr (also pictured on the opening page, wearing his home-made light unit)

Max Burr's geriatrician, Frank Nicklason, is a staff specialist at the Royal Hobart Hospital. He sees many patients with Parkinson's disease and other neurological conditions. He advises prudence but sometimes provides research information about light therapy to his patients. To his knowledge a dozen or so have given it a try. "Changes are often subtle and tend to be noticed by spouses," Nicklason tells me. "Reported changes include a better sense of wellbeing, better sleep, less anxiety and improved mental clarity. Given that non-motor symptoms like anxiety, depression and confusion are major drivers of reduced quality of life, even minor improvements are likely to be valuable." But not all of Nicklason's patients' changes have been subtle. A member of Tasmania's informal infrared light therapy group is Peter Cheatham, 58, a former mountaineer and rescue-work trainer who was diagnosed with Parkinsonism following a series of strokes in his basal ganglia. A vocal light-therapy advocate, Cheatham is using one of several mobile infrared light devices produced and marketed by Vielight, a company based in Canada.

Cheatham's device delivers infrared light via something that looks like an oversize pair of headphones connected to a clip that he attaches to the inside of his nostril. "Within a couple of weeks of usage my twitching stopped and I started remembering things I had forgotten," Cheatham tells me. He has a strong, steady voice and when I phone he is out collecting donations for the Salvation Army. "Now I can hold a conversation again and I can write legibly, too. I've come off a lot of my medications and everything around me is clearer."

Gold Coast GP Dr Mark Jeffery is a clinician with more than 30 years' experience who has a number of patients with Parkinson's disease in his practice. A native Zimbabwean who migrated to Australia, he first came to learn about photobiomodulation through his use of lasers for pain relief. Although Jeffery believes patients with Parkinson's as well as Alzheimer's could potentially benefit from infrared light therapy, he is cautious about recommending devices such as those produced by Vielight, due to the tricky nature of what he calls "off-label" prescribing. "If you don't investigate a patient properly and they deteriorate, it would be hard to justify in court that you prescribed a device that wasn't proven to help," he says. "The science behind light therapy is amazing, but it will not be part of mainstream medicine until we get conclusive, evidence-based studies."

Vielight founder Lew Lim, a self-described "naturopathic doctor" and engineer, is eager to argue that there is evidence behind his devices. He claims his company, which has sold more than 30,000 units, has done studies showing their neuroprotective benefits. "We've had some really dramatic, positive outcomes," he says. "People have told me this has literally saved their lives."

When I ask him whether all his customers have noticed a benefit he is more circumspect. "It really depends on the person," he says. "We have had people who have contacted us to say, 'We've had this for months and nothing's happening' and they are entitled to return the device."

PHOTOGRAPHY: STEVE BACCON

Promising results: Dr Daniel Johnstone is investigating red and infrared light therapy

Mitrofanis says the Bosch Institute is collaborating with Lim for future clinical trials to test the Vielight unit's effectiveness against both Parkinson's and Alzheimer's. "People have been using these devices and the company has published a study on the effectiveness against Alzheimer's disease. It's not a rigorous study, but it's positive nonetheless," Mitrofanis says. "We are putting a team together which will include Frank and Catherine from Tasmania and hopefully some interested neurologists from Sydney and Melbourne."

Professor Simon Lewis, a consultant neurologist at the Royal Prince Alfred Hospital and Professor of Cognitive Neuroscience at the University of Sydney, advises that more studies are needed before photobiomodulation is used as a treatment. "It's encouraging research, and in the absence of a cure we shouldn't disregard any suggestion, but we must strike a balance between hope and hype," says Lewis, who is also director of the Parkinson's Disease Research Clinic at the Brain and Mind Centre. "The concern is that people might go out and buy a device which might be expensive, whereas in reality they may be better off spending money on proven therapies, such as exercise therapy or speech therapy, which are definitely going to help everybody with Parkinson's."

Despite his note of caution, Lewis believes that photobiomodulation is an avenue of research that should be pursued. "The bottom line is, there is very reasonable science behind infrared light therapy, and I think we should be very open to conducting a well-constructed clinical trial."

Unfortunately there is a major impediment to commencing a large, scientifically rigorous study of red and infrared light therapy in humans and that is funding – or more specifically, the lack of it. "We are in the process of trying to get funds for the human trial but it's difficult because a trial like this costs $5-6 million," Mitrofanis says.

Nevertheless, he remains optimistic about the long-term future of light therapy. A career-defining moment came for him recently when he travelled to Tasmania to meet the people with whom he had been corresponding for more than a year. "It was a wonderful experience," Mitrofanis says, recalling the emotional meeting where those affected by neurodegenerative disorders told their stories about light therapy and how it had improved their lives. "No one can say the light treatment has completely reversed all their symptoms, but they're all showing signs of improvement.

"I've been in the laboratories for 30 years now and to see everything that I've ever worked for come to this, to see these people experiencing improvements, it's just been immensely satisfying. I'm sick of treating mice. I'm sick of treating monkeys. I want to focus now on getting this out there and helping people with Parkinson's."

Max Burr believes Mitrofanis has already helped him immensely. He is aware of Vielight's infrared therapy units but has no intention of giving up his own homemade device. He has been using light therapy for 18 months now and has not required any increase in his anti-Parkinson's medications. In the meantime, his LED unit has received an upgrade. "We've made it out of a bucket from Bunnings," he says. "We've also added 810-nanometre LED lights as well as the 670-nanometre lights. Both LED wavelengths are in alternate rows, and each wavelength has its own switch. So I do 15 minutes on one wavelength and then 15 minutes on the other wavelength."

There's another reason why Burr has stuck to his own device. "The Vielight can cost up to $2500. A plastic bucket from Bunnings costs three bucks," he says with a chuckle. "Which one would you use?" ●