Australian Government

Chief Scientist

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Rotary Club of Melbourne

Thomas Baker Oration

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Tribute to Peter Rogers

Let me begin by acknowledging the prime mover of today's event, my great friend Peter Rogers, 99th President of the Rotary Club of Melbourne, who stepped down in June.

Peter also has the distinction of being one of Monash University's first graduates, having enrolled in its first year – and I won't say which year that was (but I am confident that the Rotary Club of Melbourne is older than Peter).

After graduating with his engineering degree, Peter began what would become a twenty year career with Imperial Chemistry Industries, better known as ICI, moving up from a domestic chemical engineer position to spend five years at its head office in London.

An engineer is a valuable thing – something his employers obviously realised.

Peter then went on to be a Director for a number of ICI's international subsidiaries, as well as becoming a director of a London-based consultancy firm.

But Australia's charms can't be overstated, and he returned to the world's number one most liveable city - Melbourne.

And Melbourne has welcomed him with open arms.

In 2009 Peter was appointed as the Chairman of the Monash Engineering Foundation. I was Chancellor of Monash University at the time and it was an eye opener for me to me to see Peter apply his tireless energy to diplomatically and strategically raising more than $25 million for the Engineering Faculty

through strong emphasis on industry engagement with the University.

Peter was also one of the self-styled pioneers who banded together to raise money to commission a magnificent statue of General Sir John Monash, a commemoration that was sorely lacking from the University till just last year.

Keyways and cornerstones

Of course, Peter belongs to a long Rotary tradition of influential engineers.

In fact, the impact of the engineer is built into the heart of the Rotary brand.

It's easy to miss – but if you look closely at the famous Rotary wheel, you see that the innermost circle has a tiny bump at the top.

Let me tell those of you who don't already know, how that bump came to be.

In 1923 Rotary officially endorsed the wheel emblem, as a symbol of progress and endless potential.

And then in rode a delegation of engineers, deeply concerned that the wheel as drawn was not mechanically sound.

It had no keyway – the little slot required to lock a wheel into its power-shaft securely!

And without a strong power-shaft – or a stable connection – that wasn't a system an engineer would trust.

So forceful were these engineers that the addition of a bump was agreed.

This, ladies and gentlemen, is an organisation that takes the trouble to get things right.

Thomas Baker: A fellow-traveller

Now I am confident that if the question had been put to Thomas Baker in the Australian chapter of Rotary at the time, he would have endorsed the bump.

After all, he started life as a wheelwright– like his father before him.

And I look at his extraordinary winding path through life, and I can't help but doff my cap to a fellow engineer, come academic, come entrepreneur.

His story will be known to many of you here today who still see the daily impact of his legacy. As the inaugural Thomas Baker orator it behoves me to say a few words about him.

Born in Somerset, England, in 1854, Thomas Baker came to Australia as a lad of 11 in 1865. On finishing school, he worked first alongside his father, as a blacksmith and coachbuilder, and later as a pharmaceutical chemist.

He married Alice Shaw, his partner in life, in business and in philanthropy, in 1877.

The Bakers moved to Melbourne in 1881, where Thomas had a go at studying medicine – but was distracted by the new craze for photography, just teetering on the brink of the mass market.

He saw his opportunity. He set up as an importer and producer of photographic materials and rode the boom in amateur photography to stunning success.

In just thirteen years, he opened 14 stores: in Melbourne, Adelaide, Brisbane, Hobart, and Sydney.

And let's not forget – he made the first X-ray film in Australia, in 1924.

So Thomas Baker made his fortune in high-tech devices, and his fame in X-rays, with the instincts of a born engineer.

And my path is more or less the same – at least if you squint a bit.

I was never a blacksmith, but I did take my degree in engineering, before turning to neuroscience for my PhD and postdoctoral research.

Then I made my own ocean crossing, to Silicon Valley, to set up in business. My company made precision tools for diagnostics and research. We ended up not in X-rays – but making their descendants, scanning imaging systems for reading the gene expression off DNA microarrays.

Thomas Baker was also known for tooling down Swanston Street in a Rolls Royce.

Today – well, he'd be like me, and he'd glide down the main street in a Tesla electric car!

And I, like all of us here today, would be very proud to depart this life with a legacy half as rich he left behind.

Thomas and Alice Baker were born with the Rotary ethos in their bones – service above self. And it shines through every chapter of their lives – from their contribution to the war effort; to their generous and anonymous bequests; to the national treasure they built, in the form of the Baker Institute.

This city would not be the great hub of biomedical innovation we know today were it not for leaders of their calibre.

This country would not be a global player in medical science and an important partner in global health.

And we would not set out on life with the expectations of health and longevity that we do today.

A woman born in Australia in 1900 could expect to live to 57; and a man to just 54. And no – that figure doesn't include the lives cut short through war. A person living out their life in the ordinary way wouldn't, on average, live to see 60.

In just four generations, we have added more than 25 years to the average female life, and close to 24 years for males. Even better, as our lives extended, so too has the period we expect to enjoy without disability.

It would not be possible without medical science, and those like Thomas and Alice Baker who helped to fund it.

Nor would it be possible without people like the Rotarians, spreading the fruits of progress right across the world.

There is no better contemporary example than the quest to eradicate polio, which Rotary and the Gates Foundation lead today.

So in honour of Thomas Baker, and all Rotarians past and present, I've been asked to give a small taste of the future in medical sciences.

Introducing… THE BRAIN

I can't do justice to it all – so I've chosen to focus on that stretch of the horizon that excites me the most. [Or it would excite me the most, if I wasn't Chief Scientist, and obliged to be permanently excited about everything.]

The quest I want to talk about today is the drive to understand the human brain: to map it, to model it, to re-build it.

Why does it intrigue me?

I've been watching this field now for forty years.

In that time I have developed an empirical rule, a bit like Moore's Law about the rate at which computer chips improve.

My empirical rule is that whatever we know about the brain at a given moment in time, it is only about 1 per cent of what there is to know.

In other words, the brain is so complicated that knowing how it works is a moving target, always receding into the future. (The more we learn, the more we learn there's more to learn.)

But just look at the relentless determination with which we are pursuing that target today!

Two years ago a group of scientists trawled through the massive database of all the research papers published since 2010.

They identified 1.8 million papers on the brain.

Of every six science papers published on any topic whatsoever, one was about the brain.

But that's not surprising, because researchers learn to be very good at following the money.

The Americans have a Human BRAIN Initiative. In this financial year alone, they'll spend $565 million AUD on that program.

And this program is not to be confused with the Human Brain Project – the billion Euro project from the European Union.

Or the Brain Institute – a private initiative backed by half a billion dollars from Microsoft co-founder Paul Allen.

In nation after nation, brain research is the hot button field – including our own.

And even if you don't read scientific papers you can't miss the interest in the mainstream media today. The promises I see in the headlines are certainly enticing!

We'll have cures for dementia – tomorrow!

We'll have temple-to-temple electronic brain-zappers to speed up our thoughts!

We'll have chips in our brains that make us demi-gods communicating by telepathy, and lifting objects and bending spoons with our minds!

Or – in the greatest dream of geekdom in our time – we'll be able to upload our brains entirely into an ultra-powerful silicon computer.

If achieved, our bodies might decay – but our minds would be immortal!

This is no exaggeration of the reports in the media today. There are people, even as we speak, downing a cocktail of pills in an effort to extend their lives, so they are ready when the day to be uploaded comes.

The scale of the challenge

However, the reality is that we are generations, if not centuries, away from the knowledge to even contemplate that path to immortality.

Let me put it this way.

Last week the Allen Institute for Brain Science released perhaps the most detailed map of an advanced mammal brain ever created.

It shows the electrical activity in a tiny portion of the cortex of the mouse.

There are 18,000 brain cells in that map. It took more than 100 researchers more than four years to create it. And it has been hailed across the world as a major triumph.

Now hold up a finger. Look at the top segment. Think of a piece of human brain tissue about that same size.

Instead of just 18,000 cells, a bit of human brain tissue that size contains around 50 million electrically active brain cells and close to a trillion connections between them.

Then imagine your adult brain: 100 billion cells, quadrillions of connections, and constantly changing. Connections form and dissolve. Neurons re-train for different jobs. Growth hormones ebb and flow through the network.

Are we close to understanding it? No.

Now let’s return to the great dream of immortality by uploading your brain into a silicon computer. To start, you would have to scan a brain such as yours at molecular detail to capture every single connection between your brain cells, and to identify the exquisite unique chemistry and electrical activity that makes you, you.

The trick is to do that while your brain is still healthy, and to do the scan without having to sacrifice your existence to the process.

Do I recommend this? No way.

I’m a techno-optimist, but not a fantasist.

The process would be gruesome. It would start by using an ultra-sharp diamond blade to shave your brain into slices.

Each slice would be as wide as your brain, about half the size of a sheet of paper. But in thickness each slice would be thinner than a thousandth of the thickness of the sheet of paper.

All up, there would be 10 million slices of brain tissue. Your brain tissue.

Then we’d use an electron microscope to image each slice, stack up the ten million layers, and hey presto – a map of your brain.

Of course, we still wouldn’t understand the operating code – the processes which underpin memory, thought, dreams, and your sense of self.

And we still wouldn’t know how to build a silicon computer with a fraction of the processing power your brain packs into a cubic centimetre of tissue.

Even if we did, with today’s technology it would occupy dozens of hectares and consume enough electricity to power the Melbourne CBD.

So, any volunteers?

But before you put your hand up, I warn you: like Humpty Dumpty, all the king's horses and all the king's men couldn’t put your ten million brain slices together again.

Well then, friends – we'll have to forego our bid to be gods. But nevertheless we have the privilege of living in fascinating times. And we and our children will be the beneficiaries of technologies that were themselves the stuff of fiction when we were young.

New breadth of opportunity

The progress in bionic devices in the past two decades has been extraordinary.

And this city can take a great deal of credit for the poster child of this golden age: the Cochlear implant.

It stands amongst other breakthrough bionic technologies on the market today:

- Spinal cord stimulators for the treatment of chronic pain
- Nerve stimulators for the control of epilepsy
- And Deep Brain Stimulation for eliminating tremor in conditions such as Parkinson's disease.

I am very proud to be one of the philanthropic contributors to the next-generation technology: the Bionic Eye.

The bionic eye in development at Monash University uses a camera to see the world, and around 600 electrodes planted into the visual cortex under the skull, deep in the brain.

The quality of the image is spotty, but it will get better with time.

Beyond the bionic eye: the multi-lane highway to progress

I'm not just inspired by the promise of restoring vision to the blind, although that alone would be reason to support this research.

But for me, and for Australia, there is the excitement of standing on the great frontier – in the company of fellow thinkers across the world.

Just think of all we need to accomplish to make bionic vision – great bionic vision – a reality.

- We need to work out how to process colossal volumes of data in wearable devices.

- We need to develop new materials to make implantable devices that are strong, light and durable.

- We need to develop new methods of manufacturing to make electrodes that work with phenomenal precision, even as the brain tissue tries to reject them as foreign bodies.

- We need to accelerate the development of artificial intelligence and machine learning, to make sense of a constant storm of visual signals.

And let's not forget the cybersecurity threat. We know that Mark Zuckerberg, founder of Facebook, puts masking tape over the camera on his laptop. Why? For fear it will be captured by hackers.

Imagine if your bionic eye was internet enabled – to transmit data to your doctor, and perhaps to download upgrades – just like my Tesla car.

What if hackers could see through your eyes? What if hackers could control your eyes?

Let's move on.

The upshot is that building a bionic eye means building the potential for many other breakthrough solutions – from computer processing to super-durable materials.

And it's not just the bionic eye.

The next most exciting development is a means to restore full movement to the paralysed limbs of paraplegics and quadriplegics, which is still at a highly experimental stage in Utah.

Deep questions – complex answers

All of these technologies raise hard questions for our society – questions that will only become more complex over time.

Today, there is the problem of misinformation, and the people who seek to profit from it.

I am speaking of those snake oil salesmen who offer false hope to desperate people.

I am speaking of the shoddy pseudo-science that we see presented as ‘neurological research’, to flog a self-help book or back up a dubious opinion.

And I am speaking of the trouble we often have as a society in separating the hype from the reality, when a complex field of knowledge is moving fast.

How are we going to disentangle what is from what will be, with so many hucksters to mess up the threads?

On the horizon, I can see other questions that will emerge as the science progresses and our technologies improve.

We know that all cutting edge technologies are expensive – and the Cochlear implant is a good example. An implant and speech processor can cost up to $30,000. The surgery and clinical costs add to the bill.

And that’s the start. Like any consumer device, you have the lifetime costs: upgrades, new batteries, routine maintenance, perhaps repairs.

It is still much cheaper than the lifetime costs of a severe hearing impairment – but it adds up. And that is evident in the take-up rates for the Cochlear implant across the world.

In Australia, almost every child who would be clinically eligible for a Cochlear implant receives one: a coverage rate of 97 per cent. In the United States, the coverage rate is 50 per cent – which means that one in two children will miss out.

But even countries like ours, with a strong public healthcare system, have to prioritise access to the resources – and

because we prioritise children, adults go to the back of the queue.

Adult coverage is less than 10 per cent in this country, and everywhere in the world.

If we can give sight to the blind, who would deny it? But wouldn't we say the same of technologies that might save lives, cure depression, allow the paralysed to dance?

So how will we prioritise our resources to support the research, and then maximise the access to cutting-edge care?

Then there are the even more mind-expanding questions, as the technology tips from treating problems, to enhancing people.

How long until we see bionically enhanced athletes?

How long until we see the early adopters of the world line up for superhuman hearing and vision – or super-strength arms and legs?

How long until parents treat their children as works in progress in every sense – from gene editing before birth to regular bionic upgrades during life?

Perhaps a century – perhaps a generation.

But all along the way, with every new technology, we will be asked again and again to think about drawing the lines.

Are we ready for the challenge that presents?

Revelling in the tides of progress

There are already calls across the world for humans to put the wheel of progress into reverse.

I'd say that's about as likely as holding back the tide. It can't be done.

That doesn't mean we can't enjoy a day at the beach.

And perhaps we can take a lesson or two from the fine Victorian surf lifesaving tradition, as we wade into the churning waters ahead.

How do we keep people healthy, happy and safe?

We educate them on water safety – so too we can educate ourselves in science, technology, engineering and maths.

We build a water-safe, beach-loving culture – so too we can get people interested in new technologies.

We study the mechanics of the tides to get better at seeing the rips – so too we can learn a great deal from studying both the present, and the past.

We get the best weather forecasts – so too we can cast our minds forward, with the help of scientists, economists, artists, and many others, to prepare for the developments coming our way.

We put out flags – and so too we can develop sensible regulations that enable progress while ensuring safety and equity.

And most of all, we don’t lose sight of the reason we go to the beach in the first place. Because it’s fun. Because it makes life richer. Because it’s in our blood to hear the call of the sea!

So too we must not lose sight of the reasons we embrace progress. Because it makes us healthier. Because it increases our prosperity. And because it is in our blood to learn, invent and discover.

And friends, it’s also in our nature to reach for the better way.

To imagine it – and to realise it – just as Thomas and Alice Baker set out to do, all those decades ago.

So let’s celebrate their great legacy today – and keep turning that great wheel for tomorrow.

After all, I’m an engineer – so I know that the Rotary wheel is sound.

Thank you.