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"Passion for science and why Australia's
future depends on it"

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DR HOWLETT: Members and guests, Australians have made many significant contributions to science, particularly in the fields of medical, research and astronomy. In the last 15 years Nobel Prizes in physiology or medicine have been awarded to Professor Peter Doherty, who addressed the society in 2003, Professor Barry Marshall and Dr Robin Warren and Dr Elizabeth Blackburn. Earlier this year the Nobel Prize in physics was jointly awarded to Professor Brian Schmidt, an astronomer at the Australian National University.

The Australian Academy of Science, located in the distinctive shrine dome in Canberra, has promoted science in this country since its foundation in 1954. The academy was modelled on the Royal Society of London which at 351 years of age is the oldest scientific academy in continuous existence.

It gives me great pleasure to introduce the President of the Australian Academy of Science, Professor Suzanne Cory, whose address to the society is entitled, "A passion for science and why Australia's future depends on it".

Professor Cory is one of Australia's most distinguished molecular biologists. Born in Melbourne, she graduated in biochemistry at the University of Melbourne before gaining her PhD from Cambridge. She continued her studies at the University of Geneva before returning to Melbourne in 1971 to a research position at the Walter and Eliza Hall Institute of Medical Research. She was Director of that Institute and Professor of Medical Biology at the University of Melbourne from 1996 to 2009.

She is currently a Vice-Chancellor's Fellow of the University of Melbourne and an Honorary Professorial Fellow in the Molecular Genetics of Cancer Division at the Walter and Eliza Hall Institute. She was elected President of the Australian Academy of Science in May 2010.

Professor Cory's research has had a major impact in the fields of immunology and of cancer. Her scientific achievements have attracted numerous honours and awards, including the Burnet Medal of the Australian Academy of Science, joint recipient of the Australia Prize and the Royal Medal of the Royal Society in 2002.

She was elected a Fellow of the Australian Academy of Science in 1986, a Fellow of the Royal Society in 1992, a Foreign Member of the US National Academy of Sciences in 1997, a Foreign Member of the Australian Academy of Arts and Sciences in 2001, an Associate Foreign Member of the French Academy of Sciences in 2002, an Academician of the Pontifical Academy of Sciences in 2004, and an Associate Member of the European Molecular Biology Organisation in 2007.

In 1999 she was appointed Companion of the General Division of the Order of Australia, and in 2009 she was awarded the decoration of Chevalier of the Legion of Honour of France. Please welcome Professor Cory.

PROFESSOR SUZANNE CORY: Thank you very much, Dr Howlett, for that generous introduction. In fact we could just have dinner, couldn't we, because you have outlined a lot of what I'm going to speak about tonight, because a sort of subtitle of the talk might be how I got from there to here. I'm going to tell you a bit about my scientific career and the passion that drove it, and also discuss with you a little bit towards the end about why I consider that a greater investment in science is so crucial for Australia's future prosperity. Just before I begin, can everyone hear me? Great. Thank you.

It's a pleasure to be amongst you all here tonight. It's good to be inside, too, out of this wet weather. So first my career. When I was a child here growing up in Melbourne, in East Kew actually, if you told me I would become a scientist I would have laughed. From the very earliest time I can remember I lived in a world of books, and I was determined to be a great novelist.

My seduction by science was not a sudden revelation, rather it sort of crept up on me. Like most scientists I know, in fact, my interest was first sparked by one particular teacher, one remarkable teacher. Mine was Ms Laura White. She was my general science teacher in year 9 when I was at Camberwell Girls School. Why did she make such a difference to me? I think it was because she showed herself such a sense of wonder and passion about the natural world. It was really infectious.

But the die was not cast and I was still determined to do arts actually at Melbourne University, but towards the end of my high school years I didn't really know what I wanted to do with an arts degree and it seemed more practical to do science. But I wasn't really hooked until a lecture in my first year at Melbourne University. I was doing a classical genetics course, and I confess I was struggling somewhat. Then came the lecture that was literally to change the course of my life.

Our professor was normally a very reserved man. But this day he simply ran into the lecture theatre waving a scientific paper in the air and literally shaking with excitement. He told us that day that it had been just discovered that each of our chromosomes was composed of a single giant molecule of DNA. The concept of this continuous ribbon of thousands of genes obviously blew him away, and he imprinted on me that day an enthusiasm and an awe about the nature and organisation of our genes that has never left me.

As you heard, I went on to major in biochemistry, and there I learnt about the elegant double helical structure of DNA discovered in Cambridge in 1953 by James Watson and Francis Crick, names that I'm sure everyone in this room is well aware of.

My lecturers told me that the genetic code had just been cracked and that a new science, molecular biology, had sprung up to unravel the molecular secrets of the life process. I became more and more fascinated. I ended up doing a masters degree and I caught the research bug, and I decided I would need to do my PhD, but not in Melbourne. I wanted to spread my wings and go abroad, another of my very early dreams.

So I'm actually amazed when I look back and consider how naive I was, but I decided that I would apply to Francis Crick in Cambridge to do his PhD in his department at the mecca of molecular biology, the very best place in the world, and to me my idol. Amazingly he said yes. I have no idea why he said so. Perhaps it was so unusual at that time to have a request from so far away at the bottom of the world.

So where I went, the Laboratory of Molecular Biology, or we called it the LMB, and it is still called the LMB, was an absolutely amazing place; still is. Of the six founding fathers, five were still there and four had already won Nobel Prizes. Indeed Fred Sanger, who became my hero, was to win two, another one after I left.

The lab attracted the brightest and the very best postdoctoral fellows from all around the world, like bees to a honey pot, and one of them, Jerry Adams, who had come from Jim Watson's lab in the US at Harvard to work with Fred Sanger, was to become my scientific and life partner. I'm pleased to say he is here with me tonight, so you are getting two for one. So this is his story as well as my story.

Scientists at the LMB worked with a dedication that I had barely glimpsed before here in Australia. They were in a race with the rest of the world to unlock the secrets of life, and they intended to get there first. These lessons became indelibly imprinted on my consciousness. It no longer seemed worthwhile to dabble in science. One had to ask the big questions and be engaged full force or not do it at all.

My PhD project was to purify and sequence a transfer RNA, which is one of the adaptor molecules that decode the language of DNA into the language of proteins. This task was quite trivial by today's standards, but in fact at that time the sequence of the first of such molecules had only just been published and it had taken several years by a team of very experienced biochemists in Germany to do so. I had some very rocky times and sometimes a PhD seemed a long way into the distance, but eventually I succeeded thanks to the new technology that Fred Sanger had just developed for sequencing RNA.

After Cambridge, Jerry and I went together to the University of Geneva for further experience, and there we started working together and we have actually done that ever since. People sometimes think we are crazy, but we actually like sharing the same passions. I can't imagine not being able to go home and talk about what in your professional life had excited you about that day. We also started sharing our lifelong passion for travel and hiking and skiing and good food and wine, which we are sharing here tonight as well.

So after Geneva that was a big crossroads for us because we had to decide where we would set up our own lab, that's the next stage after our training process of course, and the obvious path, Jerry being American, was to go to the US. But I was very lucky. Jerry decided that we should give it a go in Australia. But we were both very clear about this: we would only come if we could find a place of world standing like the LMB at Cambridge.

We found this place in Melbourne at the Walter and Eliza Hall Institute of Medical Research. It's a big mouthful. We call it WEHI for short and I will be calling it WEHI the rest of the night. This institute was already world renowned for its work in immunology. Macfarlane Burnet - I'm sure that's a name that all of you know as well - had been the previous director and he had won the Nobel Prize in 1960. The new director - who I know you know very well - Gus Nossal, was also of course a world leader in immunology.

So we met with Nossal and we managed to persuade him that this new molecular biology, which was very different than his kind of science, would help him solve the major questions then being asked by immunologists, questions such as: how does the body generate the billions of different antibodies that it uses to fight off disease? So he took a gamble and we took a gamble and we joined the institute in 1971 and we have been there ever since, and we have been very happy there ever since.

I have to say that the early days were a real challenge. There were virtually no other molecular biologists in Australia then and the Hall Institute had none of the relevant reagent bottles, let alone the sophisticated equipment that we had been used to for the work we were doing. But, with Nossal's strong backing and with financial support from a grant from the US National Institutes of Health, we started to make headway and we just made it by the skin of our teeth. We managed to get our first major publication out in Nature just before we had to put the competitive renewal in for that grant. If we had not got that grant again I'm not sure we would have been able to stay.

So the pace of science then started to really pick up because of this amazing new technology. Recombinant DNA technology - some of you may know it as genetic engineering - was born in California through the work of Boyer and Cohen in the early '70s, and labs around the world, including ours, raced to set up this technology which basically lets you isolate a single gene from a complex organism, such as a human being or a mouse, install it into a bacterium and then use the bacterium as a factory to produce large amounts of the mammalian gene to study its sequence and its function, what it does.

Some of you present may remember how controversial this technology was at the time because of the fear that one might inadvertently create a dangerous new strain of bacteria. There were even marches in downtown Boston and even hostile meetings here at Melbourne University. I remember Jerry having to confront - what was it called - the assembly at Melbourne University to defend going into this kind of work.

The fear of super bugs was to prove unfounded, but scientists voluntarily imposed a moratorium on all such work at the time until appropriate guidelines and containment conditions had been developed. Then of course eventually in Australia that was enshrined in law and we now have the Office of the Gene Regulator. We call them the gene police.

We were the first in Australia to use recombinant DNA technology to isolate mammalian genes. In fact it was very frustrating at the time because the guidelines had to be developed around us and we had to sort of wait until they had been put into place and wait until these fancy super labs had been built, these containment labs.

In Switzerland Susumu Tonegawa had no such restrictions because Switzerland hadn't moved into setting up the regulations yet, and it was he who won the race to understand antibody diversity for which he was later awarded the Nobel Prize. I wanted to tell you about this because it was such an astonishing and world-breaking finding at the time. To everyone's amazement he found that, unlike other genes, unlike all other genes, antibody genes are encoded in our genomes as bits and pieces.

Therefore the cells that make antibodies, which are called lymphocytes, have to actively assemble a complete gene from these individual bits and pieces by cutting and pasting their DNA. Because so many different combinations are possible, the total number of antibody specificities that can be generated by the total population of lymphocytes becomes billions, and that's how we can make so many different antibodies. An amazing evolution.

Our major contribution in this very exciting period was to show that another major process in immunology called class switching - and it doesn't really matter tonight what that is - that involves another remarkable DNA cut and paste job, and that is important but what I want to say in a few minutes. We also helped enumerate the exact number of these antibody gene elements.

Then after about 10 years in this field Jerry and I totally refocused our program and we switched from immunology to cancer. Why did we do that? Well, we had been electrified, really literally electrified, to learn that Harold Varmus and Michael Bishop, also in California, had found that every mammalian cell contains genes that are very similar to genes found in leukaemia viruses and known in the leukaemia viruses to cause cancer. These leukaemia viruses were from rodents and cats, but in the cells of all mammalian creatures like us there were very similar genes. This again was another watershed discovery and it won them the Nobel Prize. Because, you see, the implication was that each one of us harbours the seeds of cancer; genes that can turn rogue if they are mutated or expressed in the wrong cell type or at the wrong time.

So we became very excited about that, began reading voraciously in the new field, very keen to become part of it. We became aware from our reading that a kind of lymphoma, called Burkitt's lymphoma, that's very common in Equatorial Africa and Papua New Guinea, also found in the Western communities but not so prevalent there, anyway, this lymphoma and an equivalent tumour that's found in mouse carries a genetic abnormality in which two chromosomes are broken and rejoined to the wrong partners. So you create by that process two hybrid chromosomes. That's known in the trade as chromosome translocation.

As we were doing this reading we were riveted to learn, it just had been published, that the locus for antibody genes had just been mapped near the break point of one of the chromosomes involved in this Burkitt's translocation. So, to cut a long and very exciting story short, we hypothesised and went on to prove that the Burkitt chromosome translocation was in fact an antibody gene rearrangement gone wrong. We had cloned the interchromosomal junction and we found that the antibody gene locus on one chromosome had been accidentally linked to an already-known cancer-provoking gene, a gene called myc. It doesn't matter why it is called myc.

This gene encodes a protein that's required for cells to divide and multiply. It's normally very tightly regulated, but when it became linked to the very strong on signals from the antibody genes control is lost and myc just keeps driving cells to proliferate even when they should stop. Now it seemed highly likely after we had made this discovery, and it was made simultaneously by several labs in the US as well, that this linkage of myc to the antibody gene locus was the root cause of Burkitt's lymphoma.

But at this stage it was only guilt by association. Our final proof was to generate mice carrying the altered myc gene, and every one of these mice born with this gene came down with lymphoma before they were 12 months of age, every single one of them. I will never forget the excitement of the day that the first mouse was diagnosed. So that was a really important discovery.

Our myc mouse - as we called them; that's an irony, that - became a very powerful cancer model that's been used all around the world. The myc translocation became a paradigm for isolating other cancer-provoking, we call them oncogenes from different kinds of lymphomas and leukaemias.

We ourselves went on to study several such oncogenes, but one in particular stands out because it shifted our research interests yet again. This is a gene called bcl-2. Even our daughters, one of whom became a lawyer, know the words myc and bcl-2 very well. We must have talked about it very much at home.

This had been a gene that had been cloned from another kind of human lymphoma called follicular lymphoma. It had been cloned in 1984 by some US researchers. But the function of this gene had remained a mystery because it didn't give out any clues about its function from its sequence until David Vaux, when he was doing his PhD studies in our lab, found out that bcl-2 was a very different kind of gene. It's a gene that promotes the survival of cells; not the multiplication of cells but the survival of cells.

Again we created a mouse model and went on to show, with our colleagues Andreas Strasser and Alan Harris, that over-expression of this gene bcl-2 also provokes lymphoma, especially when it is associated with myc. This was a really major discovery, the very first time it was realised that cancer development involves not only genetic accidents that promote cell proliferation but also genetic accidents that block the normal cell death process.

Bcl-2 proved to have many relatives and some of them, like bcl-2, promote cell survival. Some of them do just the opposite; they promote cell death. Together they interact with each other and fight it out and determine whether at any moment a cell should live or die in response to the very complex signals that it is receiving either from within or from its environment.

Bcl-2's family is still our central scientific passion and over the years we have formed a consortium with many other labs at the institute to work out in molecular detail how this switch works. We are now using this knowledge to help develop much more effective drugs to use against cancer cells to invoke the natural process of cell death by mimicking the natural proteins. Indeed some of these compounds have now gone into clinical trial and they are looking very encouraging.

So that's enough real science. I'm going to talk more about my professional life as Director and now President. In 1996 both of our lives were turned upside down when I was asked to become Director of the Walter and Eliza Hall Institute. I had not sought this position, and in fact I never contemplated this kind of leadership. In fact it was one of the most difficult decisions of my life. The others were getting married and having children.

I was very reluctant to accept at first because my research was going very well and I loved working at the bench. And can you imagine following in Gus Nossal's shoes? A really hard ask, that one.

So why did I do it? Well, when I was in Cambridge it had seemed to me that I had very little chance of pursuing my career in Australia. But WEHI had enabled me to do just that. It had ensured that Jerry and I could pursue our careers here at the highest international level. So 24 years later when I was asked to become Director I accepted because I felt that by taking on this responsibility I could pay back a huge debt that I owed to the institute for enabling me to fulfil my scientific dreams here in Australia rather than in exile overseas.

The first 12 months was certainly a trial by fire for this novice director while I learnt the ropes. One of the most challenging periods that I thought would interest both the lawyers and the doctors here tonight came like a bolt from the blue. At one in the morning on Tuesday 10 June 1997 our press officer was woken up by journalists at the front door, knocking on his front door at 1 o'clock in the morning, asking him to comment on articles that were running on the front page of the Age that morning. The banner headline said, "Babies used in experiments", over a story that was about clinical research on infectious diseases carried out 50 years earlier in orphanages in Victoria. The article named CSL, WEHI and Burnet, and over ensuing days things went from bad to worse. On the 13th, for example, the headline in the Australian shrieked, "Vaccine trial in breach of Nuremberg code".

So you can imagine here was I barely 12 months into the job having to face that. It caused us tremendous distress, but it also caused a lot of distress to those who were now of course well grown up but had been in care at that time in the orphanages. We had to do a lot of research into a lot of the documentation, and that was quite something, digging it all up.

The truth of the matter was that viral and bacterial scourges were still rampant in the '40s and '50s, especially in the overcrowded conditions that were in schools and orphanages. Researchers at the institute and CSL had simply responded to appeals for help from the orphanages, and all tests had been carried out with the approval of legal guardians and responsible medical officers. So of course we had to take professional advice to manage this situation, but you can imagine how much energy and anxiety it caused combating it.

So there were many other difficult tasks to tackle over the 13 years of my directorship, but they were also wonderful times, wonderful opportunities to take initiatives which did require a lot of work and energy, but are so immensely satisfying to achieve. For example, one of the ones I'm most proud of is recruiting back from Boston two young people and persuading them to switch from studying haematology to studying breast cancer. Now that team, they are still at the Hall Institute, are leading the world in understanding breast cancer and stem cells that create the breast. So watching other people flourish is a great satisfaction. Eventually I also helped build a new wing that's doubled the size of the institute.

In June 2009 I stepped down from the directorship and happily resumed the simpler life of leading just my own laboratory. But soon another major challenge emerged and I was elected, as you heard, as the President of the Australian Academy of Science, a position I took up in May last year. It is a four-year position.

So not all of you, I think, are as familiar with the academy as your President. It is based in Canberra. It's in an iconic building designed by Roy Grounds. The Canberran taxi drivers often call it the Martian embassy because it is shaped somewhat like a flying saucer. It was established in 1954 by Royal Charter and it is modelled, as the President said, on the Royal Society.

So really it's not just a building. It's a group of about 440 of Australia's most eminent scientists from all branches of the physical and life sciences and mathematics. Each year we elect 16 new Fellows based on their outstanding internationally recognised contributions to science.

We see our responsibilities as an academy as fourfold: nurturing and recognising outstanding contributions to science, improving science education and public awareness of science, promoting strong government science policy, and nurturing international scientific relationships.

Holding this office has provided me with a far greater appreciation of the depth and breadth of

Australian science and it has caused me to reflect more deeply on the place of science in society and politics. One of the recent high points for the academy of course was the announcement of the Nobel Prize for physics to Brian Schmidt. That was a really exciting week up there when we were celebrating Brian and his outstanding discovery that the expansion of the universe is actually accelerating; nothing that we all in this room have to worry about however. I forget how many billions of years off it is before it is gone to nothing.

I have also as President appreciated being able to work through the academy to foster international science networks. For example, just a couple of weeks ago I was in China to meet with the new President of the Chinese Academy of Sciences and attend with him a joint Australia-China symposium where they were talking about the development of nano particles and cheaper diagnostics for medicine, new materials for clean energy and recycling technology.

The academy works very hard to contribute scientific evidence to political and community discourse in Australia. I will just mention one highlight of this year has been our very influential booklet, "Questions and answers about climate change", which has now been downloaded from our website - I checked this just before, yesterday - over 250,000 times, which is pretty impressive. We distribute that in hard copy to all politicians in the country, state and federal, all councils, all secondary schools and many other people besides. If you are interested in reading it, it's very short but it is really very good. It took 1,400 person hours of work to put it together to arrive at a succinct summary of the facts as are known and that are really solid today. You can find it at our website, at the academy website.

We also have a very experienced secretariat in Canberra and we make many submissions to reviews and inquiries from government; for example, the recent reviews of bills about stem cells and patenting genes.

I want to turn now in the last few minutes to the importance of investment in science and science education for the future prosperity of this nation. If you reflect on it, we live in an age in which virtually every aspect of our lives is determined by science in one way or another. When so many pressing global issues require science for solutions - issues such as infectious diseases, obesity, cancer, population pressure, environmental degradation, climate change, food and water security and clean energy production - to tackle such challenges we need creative researchers and engineers drawn from many disciplines and we need a technologically skilled workforce.

As you all know, Australia has a very rich heritage of scientific endeavour. We have given the world the black box flight recorder, the bionic ear, the influenza drug Relenza, Gardasil, wi-fi, and just recently we celebrated the polymer chemistry that's transformed the plastics industry around the world that won the Prime Minister's Prize for science this year. That's just a few of the outstanding successes in Australian science.

In fact I'm confident that the scientific potential of this country has never been greater, but our ability to realise this potential is not assured. I think there are three things threatening our present and future potential to discover and innovate. As a consequence, they also threaten our economic security and ongoing prosperity. These are the level of our investment in research and development, our capacity to lever this investment by engaging effectively with the global science effort, and the poor science literacy of our workforce and our community.

Let me just touch briefly on each of these in turn. So first of all level of investment. Australia spends around 2.2 per cent of its gross domestic product, that's around $900 per person per year, on research and development. This puts us at only 14th amongst OECD member countries. Top of the list is Israel with 4.6 per cent spending, followed by Finland and Sweden which each spend 3.6 per cent. South Korea is aiming for 5 per cent.

Furthermore, worryingly, Australia ranks well beneath the bottom half of OECD countries when it comes to the number of graduates emerging with a science or engineering degree. These are sobering statistics.

As we embrace the challenges and rapid developments of the 21st century past success, policies and attitudes are no guarantee that Australia will be able to continue to deliver internationally competitive R&D. That's why the Australian Academy of Science has called on state and federal governments and on industry to create a sovereign fund for science to secure the future prosperity of the nation. We want Australia to set itself the goal of increasing its investment in research and development to at least 3 per cent of GDP by 2020.

Turning now to international linkages, even if we have very good support and investment by government, the capacity for Australian R&D to flourish and feed our economy will be severely limited if we operate in isolation because, if you think about it, we can only produce 2 per cent of the world's science knowledge. To access the remaining 98 per cent we need to be well connected to the global science network. If we don't keep ourselves on the global stage, we'll lose scientists and ideas to other countries and we will forgo the opportunity which we have at the moment of attracting the best and the brightest from elsewhere to work here. We will also forgo the economic benefits that flow from R&D.

The global scientific landscape is rapidly changing and Australia has a unique opportunity because we have a foot in both West and in Asia. We need to maintain and build on our already very strong links with Europe, the UK and North American science, but we also need to forge strong scientific connections in Asia.

Asia understands well the importance of investment in R&D for economic competitiveness. While our attention in Australia is being distracted by the mining boom or maybe we are being lulled to sleep, our major partner economies in Asia are in the middle of a science and innovation boom. The OECD reports that China's investment in R&D accounted for 13 per cent of the OECD total in 2008, up from 5 per cent in 2001, and this rapid growth shows no signs of slowing. I have seen it with my own eyes. India, South Korea, Singapore and Malaysia are all also showing very strong R&D growth.

Our ability to link with the science and innovation organisations in those countries will be critical for our future business engagement with them. We have a window that's open at the moment and we have good relationships, but the window for engagement will not remain open for long. China is going so fast it's going to dominate the world and be totally self-sufficient before too long.

The academy has worked assiduously over many years to foster and encourage international connections for Australian science. In partnership with the Australian government, we have been proud to facilitate international workshops for young people and mature scientists across disciplines and around the world. However, the ability for the academy to do that depended on a grant from the government that's been operating for 10 years. We were devastated to learn that in the last budget that funding program finished.

We think this is too important an area to neglect. So, even though the program has finished, we have been working very hard to make sure that the relationships, especially with China, have not been severed. But we need a new program urgently, and on Tuesday we will be launching a paper calling for immediate further investment by the government in our nation's international engagement in science.

Turning to my final point, people who understand the economy much better than I, economists and industrialists, agree that the future prosperity of all nations is going to depend on a skilled workforce, innovation, entrepreneurship, high productivity and the creation of the kind of knowledge intensive goods and services that can only result from robust R&D.

However, worryingly, Australia is in danger of progressively deskilling its workforce, not upskilling it. Already many skills are in short supply, and in fact the Industry Skills Councils found that there is an alarming deficit in even the most basic language, literacy and numeracy skills amongst our workforce.

The workforce of tomorrow will be drawn from the students of today. If we don't equip these students with the right skills, we will find ourselves in the near future with a very lacklustre economy and a dangerous paucity of skilled workers. That's why the Australian Academy of Science believes that quality science and maths education in our schools is the single most important factor in determining Australia's readiness for this growing technological age and its ability to prosper into the future. Without a strong and inspiring science and maths education system it will be impossible to generate an internationally competitive workforce.

But Australia hasn't been doing terribly well on this front in recent decades because our secondary students, all the statistics tell us that they are continuing to lose interest in science and maths at an alarming rate. In 1991 90 per cent of year 12 students were studying science, but just 10 years later that number had dropped to 76 per cent, and this year only 51 per cent of all year 12 students are studying science subjects.

Why is this happening? Most students get turned off by the way science is taught in school these days. It is still taught the old-fashioned way of chalk and talk lessons at the blackboard, the way that we were all educated. That's just not good enough these days.

When it is taught properly science can be exciting, dynamic, tactile and empowering. It is really important not just for students who are going on to do science, it is important for everyone, because it equips students with critical skills in reasoning and problem solving and it equips them for life for many fields of endeavour.

So it is vitally important that we shift the way that science is taught in this country. That's what the academy is trying to do. We have two science programs that we are very proud of, one called Primary Connections, where we train primary school teachers in how to teach science and we give them very comprehensive curriculum resources, and another one called Science by Doing for junior secondary school students.

Both of these programs are designed to enhance the teachers' skills, give them confidence, but also they emphasise inquiry based learning and draws strong links also between science and literacy. They are incredibly popular in schools and they are incredibly highly rated internationally. In fact Primary Connections is now in more than 50 per cent of Australia's primary schools, and my goal is to have it in 100 per cent.

Unfortunately Science by Doing is at a much earlier stage of development. We have completed a very successful pilot program, but unfortunately we can't go any further because the government again stopped funding that in the last budget. We determined, however, to complete the units that are required for years 7 and 8 and then we want to go further up to year 12. So we are urgently seeking other support. Any ideas anyone has in this room, I will be very happy to receive them.

There are many passionate and inspiring people in Australia working to reinvigorate high school science in Australia. My hope is that, whatever the mechanism, this is achieved and that many more Australian students experience the wonder and the joy of scientific discovery that I have experienced in my life. I hope that some of these students go on to become the researchers of tomorrow. I hope that all of the others will use this spirit of inquiry every day in their profession or trade, whatever that might be. I also hope that by having a scientifically literate community and parliament we will be able to make sensible decisions about the big issues that are facing us as a nation in the 21st century. Thanks for your attention.

DR HOWLETT: Professor Cory has very kindly agreed to take some questions from the floor. If you would preface your question with your name for the benefit of the sound recording. I might make a start.

Professor Cory, you mentioned an emphasise on encouraging students at a very early stage, at school in fact in year 7 and beyond. Did you have a science teacher when you were at school who was an inspiration to you?

PROFESSOR SUZANNE CORY: Yes, I told you about Ms White in year 9. So she started the hook for me. But I think actually primary school is where we have to start, and there it's easy. You all know from your own kids how interested young children are in the world around them and in their own bodies. They are just naturally curious.

What's been going wrong in primary schools is that the primary school teachers have not had the confidence because they have not done science themselves, so they have not had the confidence to teach their children science.

So that's why our Primary Connections program is so powerful, because what it does is it gives special workshops to the teachers, gives them the confidence and gives them materials that they can just go out and do experiments with the primary school students that the students just love. I have been into some of these classes and it's amazing what a buzz there is in these classes when the kids are doing science. You can link science and literacy. So you can teach them everything they need to know by teaching it through science.

QUESTION: Do you have any comments about how we may further capture the attention of both government and industry in the investment that we need to embark on?

PROFESSOR SUZANNE CORY: So we have on the one hand a really strong reputation in scientific discovery. But where are the businesses flowing from those discoveries? We are doing a lot better in Australia than we used to do thanks to investment by governments such as - well, successive state governments in Victoria have been very well aware of that.

The problem has been the availability of venture capital in Australia and experience in entrepreneurships, the spin-out companies. This is where the scene is so different than in California, for example, where there is robust science being done in the universities and academic sector, and then that's very naturally flowing out into start-up companies, some of which go bust, but many go on or get bought by the big pharma companies.

We have improved. We have got bionic ear. We have got Cochlear. We have got ResMed. Of course we have got CSL. So we are starting to develop the companies. But we have got a long way to go. Australia is still pulling itself up by the bootstrap. We are much more aware at protecting our IP than we used to be. Of course you can only afford to protect it for so long because the fees become too big unless you have got a company that takes over that responsibility for you. So Australia often has to sell off its intellectual capital to a bigger company overseas. But that's okay, so long as we can keep going further along the chain and get some benefit back from those companies overseas.

So I see real progress has happened in the last 15 years, but we need to have much more. I contrast that with the situation in Singapore, for example, where they are just so good at going from the basic discoveries to companies.

LAURENCE HAREWOOD: Professor Cory, thank you for your presentation tonight. It has been excellent. As best as I can determine, when you started your career the big question was to ask the role of the double helix of DNA and of molecular biology. What would you see now as the big question? In other words, if you had a young person come to you now and say, "I want to win a Nobel Prize," what question would you set them to answer?

PROFESSOR SUZANNE CORY: What area of research? Of course I would have to say cancer because that's my field and there are so many compelling questions still to answer there. So there is a big opportunity there. But if I'm totally honest with you I think I would say the brain, neuroscience. I think there is so much to be learnt there. I think the 21st century is going to be the century of neuroscience where we will look back in amazement at where we are now and how little we understand.

QUESTION: I thought almost the most worrying thing is the decline in the number of (inaudible).

PROFESSOR SUZANNE CORY: Indeed.

QUESTION: (Inaudible).

PROFESSOR SUZANNE CORY: I think climate change is a very good example there. Haven't we seen some dreadful things published as if they had equal weight to the science that's telling us that climate change is real. So we try. I think you have to have a multifaceted approach. I think the citizenry needs to feel more confident about science. So they need to be scientifically literate, as I have argued.

I think our journalists need to be competent in science. It is amazing when you go to New York and you read the New York Times there is page after page of the most sophisticated science articles. Those are devoured by the stockbrokers because they are interested in the companies flowing out of this science. So the level of sophistication in this country in terms of science reporting is not anywhere near that.

I think this is the era of instant gratification. Science is hard. It takes hard work. I think we have got to approach it from different levels. We have to teach it differently, not just regurgitate facts at students, we have to engage them in finding out facts themselves.

We could do a lot more on TV than we do in terms of amazing programs on science that are incredibly captivating and very educational. Just think what David Attenborough has done for an appreciation of the natural world. So I think it's many things we have to do.

Certainly the academy tries very hard to explain science to the public. We have one web based program called Nova, for example, that tries to explain current news, the science behind the news, and deliver it in packages that are suitable at multiple levels for teaching in schools. That's one way we try to make science approachable to our community and to the school children in particular.

DR HOWLETT: One final question.

QUESTION: (Inaudible) regarding the decline in interest in science in students, one consideration (inaudible) and in this era of IT and finance - - -

PROFESSOR SUZANNE CORY: And law and medicine.

QUESTION: Law and medicine, yes. I think that is probably one of those aspects through the education system that we are pushing children in the wrong direction in making choices about what values they should uphold (inaudible). Having talked to young children (inaudible) and ask in general to find out what they are interested in, even at a very early age without parental input they are commenting on things like, "You'll get a really good job through law or you'll earn a lot of money through stockbroking or banking." Children are making these decisions very early on and the driver is (inaudible).

PROFESSOR SUZANNE CORY: And they are learning that every day from TV and the advertisements are in front of them. So, yes, we do have to combat that. I think law and medicine are great professions. So I would never not want to encourage children into those.

Science leads to many different kinds of jobs, and I don't think that that's appreciated very much by teachers and certainly not by our children. It sounds so esoteric in a way. We need to be much more practical at telling what kind of jobs lead from an education in science. They are multiple in both companies and academia. Also our young people are thinking of it only in the academic stream. We need to have many more of them going out with a scientific mind into many different kinds of careers.

DR HOWLETT: I call upon Dr Fabris, member of the committee, to give the vote of thanks.

DR FABRIS: Thank you, Glenn. I had planned before giving the vote of thanks tonight to quote from Professor Cory from various articles and things I found when I Googled her recently, but she has stolen my thunder a little bit because she has basically touched on a lot of these areas. They were significant developments in her life. It was things like, "I don't know how I could have been so naive" when she wrote to Professor Crick as a young and antipodean no less student wanting to work in his laboratory. Others were about the inspiration she drew from her biology teacher in year 9 and her university lecturer which inspired her to go into science.

Another one was, "I imagined myself as Emily Bronte or Jane Austen." Again she has told us how she wanted to be a writer when she was a young girl. She said to the National Press Club a few months ago she was basically rescued from a mediocre writing career by again the inspiring biology teacher.

But there is one quote that is about something Suzanne hasn't talked about tonight, and it's as follows, "It's the colours, the light, the space. It's really very deep in my soul." This was a reference to the Australian landscape, which Professor Cory I understand loves to explore - she is a keen bushwalker, along with Jerry - and also to photograph. This is one of the things apparently that, along with family and the Aussie sense of humour, drew her back home to Australia and to Melbourne.

I think we are very fortunate that Professor Cory did come home and we got Jerry as a bonus; as Suzanne says, two for one. So thank you very much, Professor Cory, for sharing with us tonight your obvious enthusiasm and passion for science and science education. Please accept this token of our appreciation. Can we all thank Professor Cory in the usual way.

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