

REPORT OF PROCEEDINGS BEFORE

STANDING COMMITTEE ON STATE DEVELOPMENT

**INQUIRY INTO SCIENCE AND ITS COMMERCIALISATION IN
NEW SOUTH WALES**

At Sydney on Monday 18 August 2003

The Committee met at 9.00 a.m.

PRESENT

The Hon. Tony Burke (Chair)

The Hon. Patricia Forsythe (Deputy Chair)

The Hon. Tony Catanzariti

Mr Ian Cohen

The Hon. Melinda Pavey

The Hon. Christine Robertson

CHAIR: Members of the media, the Standing Committee on State Development has previously resolved that the press and public be admitted to proceedings of the Committee, and that the media may broadcast sound and video excerpts of its public proceedings.

I point out that, in accordance with the Legislative Council's guidelines for the broadcast of proceedings, only members of the Committee and witnesses may be filmed or recorded. People in the public gallery should not be the primary focus of any filming or photographs. In reporting the proceedings of this Committee you must take responsibility for what you publish or what interpretation is placed on anything that is said before the Committee.

The inquiry into science and its commercialisation in New South Wales came to this Committee at its first meeting as a reference from the Minister for Science, Frank Sartor. As the Chair of the Committee we then advertised for submissions, and I am grateful to those who have agreed to appear as witnesses before the Committee.

RICHARD FREDERICK SHELDRAKE, Director-General, New South Wales Department of Agriculture, 16 Linden Avenue, Orange, and

HELEN SCOTT-ORR, Executive Director, Research Advisory and Education, New South Wales Department of Agriculture, 161 Kite Street, Orange, sworn and examined:

REGINA MARY FOGARTY, General Manager, Strategic Review, New South Wales Department of Agriculture, 95 Hill Street, Orange, affirmed and examined:

CHAIR: If you should consider at any stage during your evidence that certain evidence or documents you may wish to present should be seen or heard in private by the Committee, the Committee will consider your request. However, the Committee or the Legislative Council itself may subsequently publish the evidence if they decide it is in the public interest to do so.

DR SHELDRAKE: New South Wales Agriculture has prepared a submission that responds to each of the terms of reference of the inquiry. Minister Macdonald has asked the agencies under his portfolio to prepare a joint submission, and this has just been finalised. I am unable to table the document today, but Minister Macdonald will submit this document shortly; directly to the Committee.

I welcome the opportunity to address the Committee and would like to open with a few remarks on science, and its commercialisation within my department. New South Wales Agriculture relies on science to develop and promote the changing practices in agricultural industries that will address the wider demands and needs of the community of New South Wales, in terms of productivity, profitability, food safety and quality, and environmental sustainability. These outcomes are encapsulated in the department's corporate goals, and form the basic drivers for all programs and projects whether research, extension, education or regulatory in nature.

This approach to developing and promoting changing practices in agriculture has been a very successful investment by the people of New South Wales. The Industry Commission has recognised that "productivity growth is the key ingredient in promoting sustainable economic growth and improving the material living standards of Australians". It has been estimated that 70 per cent of the value of agricultural production in New South Wales can be attributed to productivity growth.

The value of those productivity gains in Australian agriculture over the last 50 years is estimated at \$1,100 billion. In New South Wales those gains have been estimated at around \$300 billion over that 50-year period. Further, it has been calculated that of the \$300 billion, \$100 billion is due to imported technology, \$100 billion is due to improvements in infrastructure, for example, improved transport within New South Wales, and \$100 billion can be attributed to local research and development.

The introduction of new production technologies, including new species and varieties of plants and animals, is a critical component of that productivity growth. These technologies are a direct result of investment in agricultural research and, when combined with new management systems, increase the options available to the State's farmers, enabling them to respond to changing markets and greatly increasing their resilience. In the grains industry 70 per cent of productivity gain in the last 10 years has been due to management improvements, and 30 per cent due to technologies such as improved crop varieties.

New South Wales Agriculture has a clear mandate to pursue commercialisation strategies for appropriate technologies. The department actively encourages commercialisation revenues, and does in fact make allowances in its budget projections for the generation of intellectual property [IP] and its anticipated commercialisation. Last year, 2002-03, income from commercial activities associated with our scientific endeavours earned about \$6.5 million. In addition, scientific research and development undertaken by the department on a contractual basis earned the department a further \$28 million in 2002-03.

Commercialisation activities of value to New South Wales should not just be considered limited to the upfront generation of revenue. The department's plant breeding programs have an

impressive track record of delivering outcomes to the State. For example, we currently have 11 patented wheat varieties—among 38 patented crop and pasture varieties—and these varieties earn the agency either seed royalties or end-point royalties. The value of these royalties to the department, the government and ultimately the people of New South Wales is infinitesimal compared to the value that those crops bring on an annual basis to the economy of the State. Just one good example is durum wheat. The durum wheat varieties grown in Australia have all come from the department's Tamworth breeding program. Durum produces flour for pasta manufacture which is of such high quality that it is actively sought by Italian importers. Durum wheat production is currently worth over \$200 million annually in farm gate sales, with over 80 per cent of that produce shipped to high-quality international markets earning the State valuable export dollars. The area sown to this high-quality wheat variety has the potential to expand greatly in the next five years to post-annual farm gate sales of around \$1 billion.

Direct returns to government through royalty payments on plant varieties are, and will always be, insignificant in comparison to the benefits to the State's community and economy from the uptake of new varieties that either open up new export markets or provide better nutritional value, cheaper food or address environmental degradation issues in the landscape. The department's approach to commercialisation is heavily focused on developing partnerships with other government and private bodies and its use of extension and education in the delivery of the outcomes on behalf of the people of New South Wales. Forging these relationships allows the department to expand its capacity to solve the problems affecting the agricultural sector; to synergistically build intellectual property on behalf of the people of New South Wales; and allows us access to private sector commercialisation skills.

Over the last 10 years the department has developed a sophisticated system for dealing with commercialisation processes. A legal and commercial technology transfer grid has prepared draft agreements dealing with complex intellectual property issues, including project agreements, licences, copyright agreements, confidentiality agreements and assignment agreements, which must be continually updated to incorporate changes to the law. Each proposal is considered on its own merits and officers are required to submit details of proposals to the project manager and to the legal officers in order that suitable documentation is prepared. The submission lists the commercialisation pathways the department has adopted, including patents, royalties, licences, consultancies, laboratory services, contract research, short courses, publications, use of trade marks and copyright.

The submission provides examples of outputs under each of these pathways and a number of publications will be tabled when Minister Macdonald tables his submission. The submission does not try to describe the full extent of the department's science. The Minister for Agriculture, Ian Macdonald, will be launching a more detailed publication tomorrow describing the science programs within the department. I will provide the Committee with a copy of this publication as soon as that is available. The New South Wales BioFirst strategy was an important and ambitious commitment to consolidating and enhancing the research capacity of New South Wales. NSW Agriculture supports the strategy and is committed under the strategy to a number of initiatives. Most of the focus and funding under this initiative has been directed towards medical biotechnology. In my view science research and innovation must be key drivers of public policy and economic development across all sectors. Thank you for allowing me to make this opening statement. My colleagues and I will be happy to answer any questions that members of the Committee wish to ask.

CHAIR: You have gone through a broad range of research programs. To what extent are those research programs designed to implement existing government policies rather than having commercialisation as the objective of the research programs?

Dr SHELDRAKE: The majority of our programs are geared to meeting the corporate goals of the department. They are either focused on dealing with growing agricultural productivity, environmental aspects or maintaining freedom of disease from New South Wales, for example, foot and mouth disease. We try to gear all our research development and extension programs around those goals, and program management is structured around that but if, at the same time, we are capable of offsetting some of the costs of undertaking those activities by either undertaking a piece of contract research so that the industry pays for it—and the citrus industry would be a good example to use—we would undertake a joint research and development program in partnership with the citrus industry to offset some of the costs or we undertake a commercial activity. That is the basis on which we would do that work.

We are focused on meeting our goals first. As an exception, if a private company were to approach us and ask us to undertake a piece of contractual work that did not meet our corporate goals, we would cost that out at the absolute fullest cost. We have software designed to meet the full cost of any research that we undertake and we treat that as a totally commercial business, but the number of those that we would undertake would be very few.

CHAIR: Is it something that is requested regularly and declined or they do not arise that often?

Dr SHELDRAKE: Perhaps Ms Scott-Orr might answer that. We do not get very many requests. The bulk of our research and development is in line with our corporate plans. For example, we have an income stream of \$28 million a year for joint research and development corporation contracted research. That is work where we are in partnership with those research and development corporations but it is contracted work to the research and development corporations and those programs meet our corporate goals.

Ms SCOTT-ORR: We are essentially co-investing in the research and development corporations. They provide anywhere between 30 per cent and 50 per cent of the project cost and we provide probably 50 per cent to 70 per cent of the project cost through in-kind contribution of staff and infrastructure. In that situation those projects are examined to make sure that they are in line with the corporate goals of the organisation, which are in line, in turn, with government policy. In regard to contract research, often the private sector sees that we have specialist skills and they aim to capture that. An example would be where veterinary drug companies might want a new drug to treat worms in sheep and we would charge that out at a full consultation rate, which includes a 10 per cent profit margin over our existing full costs, and that is what we would charge them. Those results would be confidential to the drug company probably because they are looking for registration of their drug. In other situations we aim to ensure that the information that is generated through research projects is made widely available, and that is one of the riders on our co-investment in the projects.

CHAIR: Organisations such as the Federation of Australian Scientific and Technology Societies [FASTS] refer to the need for greater co-ordination of scientific efforts through whole-of-government interactive processes through the Commonwealth, States and Territories. In your opinion is the need for a whole-of-government approach recognised by government agencies?

Dr SHELDRAKE: In Agriculture it probably is, and it is probably catered for by the standing committee process and ministerial council process. The primary industries standing committee co-ordinates national issues at a national level. For example, if you pick up on animal health or plant health issues, in conjunction with industry there are now two company structures—Animal Health Australia or Plant Health Australia. They are company structures set up involving the partnership of the State Government, Commonwealth Government and industry. A range of industries participate. If you look at foot and mouth disease, which must be treated at a national level—there is no point in New South Wales doing one thing and Victoria doing something different—I think that issue is dealt with effectively in that co-ordinated way. In September last year we undertook an exercise called Exercise Minitor, which was an exercise to test our preparedness for a foot and mouth disease outbreak. That involved all State agencies, the Commonwealth Government and industry. That is a good example that it is working in the agricultural sector probably better than some of the others.

Other examples of where it is working include the research and development corporations, which we have referred to. We get about \$28 million from a range of those bodies, set up under Commonwealth legislation. They have the ability to levy farmers and then allocate that money out on a competitive basis for contractual research and development. We are one of the providers of that research. A third example of it working is the co-operative research centre model. NSW Agriculture participates in 10 co-operative research centres and that enables us to interact with a large number of universities, the CSIRO in a number of divisions and other State agencies and industry. In Agriculture we are probably doing it a bit better than some of the manufacturing sector industries, which is probably what FASTS was referring to.

CHAIR: In terms of providing incentives or awards for people involved in research, does NSW Agriculture offer any incentives to scientists such as financial rewards or the option of equity in commercial outcomes?

Dr SHELDRAKE: No, we do not offer personal incentives, but we try to offer incentives in terms of the program within the department where they might be working. It is certainly recognised in the promotional possibilities within the research scale that they are employed on. They are employed on a scale called the Research Scientist Qualification Committee and Helen is on that committee process—and it might be appropriate for Ms Scott-Orr to comment—but that committee takes account of and recognises things like royalties and patent applications in their application when they are being assessed for their grading.

Ms SCOTT-ORR: For the information of the committee, research scientists have an industrial award that runs across a number of New South Wales government departments. New South Wales Agriculture, National Parks and Wildlife, the Australian Museum, the Royal Botanic Gardens, New South Wales Fisheries and other science-based agencies have scientists who have applied to get into that classification. Once they are in that classification, every three years they come before a committee headed up under the Premier's Department to assess their scientific progress. The classification allows them to progress, salary wise and in standing, through research scientist to senior research scientist to principal research scientist on the basis of their scientific outputs as opposed to having to go into management or administration. It is preserving the science base in New South Wales government departments. As Dr Sheldrake said, the opportunity exists not only for scientific publications and mentoring of other junior scientists and so on to be taken as part of the criteria, but also patents and other forms of commercialisation are noted.

The Hon. PATRICIA FORSYTHE: Is that system supported? Is that the ideal way in which we are protecting scientific research and, at the same time, offering them promotion?

Ms SCOTT-ORR: As a department, we support it very strongly. We have the largest number of people in that system. We have about 70 of our staff in that classification. We encourage our research staff to apply for that. Obviously, they have to meet a number of criteria even to get in. We encourage them to progress through it because it is an independent system that provides them with outcomes. From my experience of being involved with the committee for the past five years, I have seen a number of instances of individuals who have started to perform at a lower level who have not been approved for progression. They have been held at a certain level. That tends to make them sharpen up their performance, increase their productivity and then they come back before the committee at a later point. If they have not sharpened up then they will not be allowed to progress. In my experience it is a very salutary process for them, and it certainly stops people from going to sleep at the wheel. We have a number of people in both our department and others that are performing at a very high level, but they have to come back before the committee every three years to justify that. I have seen one instance of someone who was approaching retirement and who had gone to sleep at the wheel being told that he would be removed from the classification. That person took retirement as a result, which is not a bad outcome.

CHAIR: What level of advice does the department provide to researchers outside the department who potentially have new products?

Dr SHELDRAKE: People who are not our employees?

CHAIR: Yes.

Dr SHELDRAKE: The example I can think of is organisations, like the co-operative research centres, that provide partnership programs. We would give advice by assisting those scientists. If a patent application were being considered by, for example, the Beef Co-operative Research Centre, that research centre within the Beef CRC, even if it were a CSIRO employee, would be considered. We would happily provide advice from a legal team or our technical beef program. Outside of those sorts of relationships where, clearly, in that case there is a benefit and we are part of that process indirectly, we do not tend to get many requests from outside scientists totally unrelated to us or our work. Ms Scott-Orr might like to expand on that.

Ms SCOTT-ORR: The biggest service we provide is through our scientific publications. There is pressure on our staff to publish in the referred literature and attend conferences. We actively encourage them to participate so that we get maximum wide dissemination of information. I would not know how many actual individual conference attendances there are per year, but it would be over 1,000, and most of those people would give papers or posters. That is how a lot of the information gets out into the public domain. As I said before, their promotion is actively tied to that process. Where there is confidential information and the potential of a straight financial reward, obviously, once a patent is launched it also puts the information in the public domain, but it is patented, trade marked and sublicensed.

Dr SHELDRAKE: I may have misinterpreted the question. As Ms Scott-Orr has pointed out, where it relates to scientific information we make that freely available.

CHAIR: How important is it for individuals working in related science areas to have the skills and ability to move between industry and the public sector? Are there opportunities for that sort of transfer?

Dr SHELDRAKE: There are opportunities, but, interestingly, it probably tends to happen in the more junior years of a scientist's career rather than in the later years. Quite often the private and public sectors are different in the way they operate. When people are young scientists and still effectively working on science, they can move reasonably easily. Once people get locked into longer-term careers the movement probably becomes less so, which is one of the real pluses that has occurred with the co-operative research centre arrangements. We are in 10 and we have been in a number of others that have finished. The CRC has exposed public sector scientists to the way in which private sector businesses think about science. The boards of the CRCs comprise representatives from the private sector, and they certainly put a different focus on research and development programs undertaken by the co-operative research centres. In our organisation, for example, not a large number of people have come across from the private sector once their careers have been established. A number would have come across when they were younger.

The Hon. MELINDA PAVEY: You are saying that it is actually good for your scientists to be involved with the co-operative research programs and have more important relationships with the private sector.

Dr SHELDRAKE: I agree. Yes, that is exactly what I am saying. It is a good opportunity for them to see the drivers in the industry and the challenges that industry faces, particularly a market focus. The beef industry said that tender beef is the key market driver to get people in supermarkets to buy beef. The Beef CRC then moved towards a major research program, and our people were part of that, looking at the genetic make-up of cattle to find the gene sequences that impacted upon the tenderness of beef. I am suggesting that some of those things may not have happened had we not had private sector involvement. In that example the private sector did not have the capacity to undertake that work, nor did it want to do it on its own. We had the capacity—CSIRO, New South Wales Agriculture, the Queensland Department of Primary Industry, and the University of New England—to do that work for the private sector.

The Hon. MELINDA PAVEY: What percentage of scientists within the department meet the criteria to work with the co-operative research program?

Ms SCOTT-ORR: Now you are asking. I could add up how many people are formally listed in the CRCs, but if we are involved in, say, 10 CRCs there might be an average of 10 research staff.

Dr SHELDRAKE: Perhaps it would be better to take that on notice. A significant number of our staff would spend a proportion of their time, one way or another, in the co-operative research centre. The staff might be involved 20 per cent, 50 per cent or 100 per cent within the CRC, but that is something we can find out.

Ms ROBERTSON: Because the return was not worth the research investment commercially, commercial researchers did not want to become involved. I know that the good beef is worth it, but was it too much of an investment for them to deal with it commercially?

Dr SHELDRAKE: On a project like that the private sector simply does not have the capacity. To undertake a project that is looking at the molecular biology of the genetic make-up of beef cattle you are really looking at very specialised laboratories that can move from working on beef one day to sheep the next day to even pasture. Return on investment would not be great enough for the beef industry to set up its own facilities and undertake its own research. But a co-operative research centre, pulling together a range of scientists from a range of disciplines and organisations up and down the country, is able to do that work efficiently on a contract basis, effectively, for the industry. It came up with the results within four or five years. It is an efficient way of industry getting answers to very difficult long-term questions

Ms ROBERTSON: If the situation arose where that particular research was to be commercialised and charged back to the industry what would the outcome be? Would it still occur?

Dr SHELDRAKE: Ms Scott-Orr, who is on the board of the Beef Co-operative Research Centre, may like to answer. But my understanding is that that work is patented or is in the process of being patented.

Ms SCOTT-ORR: Yes.

Dr SHELDRAKE: The industry paid for that research through the levy process.

Ms SCOTT-ORR: There are various genetic markers for tenderness, which have now been defined. They have been commercialised through license agreements with what are, essentially, spin-off companies, that have formed as a result of the research. Those companies are now offering that testing service to the beef industry. Delivery has now reached a fully commercial stage where the beef industry would pay for it. But genetic markers are only part of the story. There are a whole lot of behavioural things about how animals are managed. There are also a whole lot of other genetic markers concerned with the temperament of animals that are still being worked out. There is a whole package of information. I do not have the exact figures in my head, but it might be worth \$90 million over seven years to the CRCs. The beef industry would have put in maybe \$10 million or \$15 million of that and the rest would be a combination of the various public sector agencies and the Commonwealth Government through the CRC program. But it would not have happened without the co-operative investment from all parties.

The Hon. PATRICIA FORSYTHE: Basically, as there is an increasing focus on the commercialisation of publicly funded research, what has been New South Wales Agriculture's involvement and how successful has the CRC program been to date?

Ms SCOTT-ORR: We think it is a very successful model. The CRC program has strong objectives about commercialisation of the research outcomes, and that may be through the patented or private company benefit route, or it may be through the widespread dissemination of results so that you get behavioural and management changes by agricultural producers in the case of agriculture. We are very supportive of that. We have played a major role in a number of CRCs, and continue to do so. Some of those, like the beef, rice and quality wheat CRCs, have a strong industry focus and, therefore, a more commercial focus. But there is still a very long lead time before the core science comes out, which is the argument for public investment.

There are other CRCs—the weed CRC and the CRC for plant-based solutions for dry land salinity—where most of the outcomes will not be by commercialising a patent. They will be by defining what needs to be done by land managers and to tackle these problems and improving them. So, the commercialisation there, again widespread dissemination of information and processes to get behavioural change of land managers.

The Hon. PATRICIA FORSYTHE: What is the process of accountability of CRCs back to NSW Agriculture and is it at an appropriate level?

Ms SCOTT-ORR: For all the CRCs we have an involvement in we have a member on the governing board of the CRC so there is an oversight of the major priorities, the strategic goal setting and also the financial administration. We are obviously overseeing a percentage of government

investment in that, and we sign off on that on a quarterly basis for our income and contribution. Our co-investment in the CRC is matched to the CRCs objectives and they are matched to our objectives.

The Hon. MELINDA PAVEY: In relation to dry land salinity, for example, what would be the proposition if, say, a couple of farmer organisations came to the Department of Agriculture and said, "We do not believe there is enough research into the natural level of salinity in the Murray-Darling basin. We would like you to do some research because there is not good research out there that all these assumptions are being taken from," where the results may conflict with government policy in relation to capping water supplies?

Dr SHELDRAKE: Perhaps if I can give the first response. For example, at our Wagga Wagga institute, where we have approximately 150 staff, we have a farmer advisory board to the institute. As an example, they had a meeting last week and the chairman of the board wanted to talk to me about the meeting and he rang me and we had a chat. The issue he raised was lack of soil science research. He was concerned that the department was not putting enough emphasis on soil science at Wagga Wagga. Soil science is fundamental to our agriculture production and there is always a shortage of soil scientists. It is one of those professions that people do not like doing at university, so there is always a shortage.

The Hon. MELINDA PAVEY: And we do not have a soil conservation service any longer, do we?

Dr SHELDRAKE: What he was really saying was that he would like to see the Department of Agriculture invest more in basic soil science research, which is analogous to the point I am making. I think it is up to us. I suppose one of the things I would say is that the CRC is a very good model—the co-operative research centre model is a good one—but it does not necessarily mean that all our research has to be done through the co-operative research centre model. It is important that we have other models operating in the department to address the issues you are raising. It is fair to say that our scientists would undertake the science totally independently and then it would be up to the department to try to give the best advice possible to influence government policy in a certain direction. But scientists do operate in a way that their work is peer reviewed. It cannot get published unless it is peer reviewed. We place a lot of emphasis on that because it is an independent way to make sure that the work and the calibre of the work that our staff are doing is at an international level. That is absolutely essential because the research scientists committee places a lot of credence on that.

Ms SCOTT-ORR: We also have a research code of conduct within the department. We have a code of conduct for all our staff but we have a special research one, and that prescribes, amongst other things, that one of the core elements is scientific independence. Obviously we do not try to manipulate the findings of our researchers pre-emptively in line with government policy but rather to have government policy informed by the results we generate.

CHAIR: Do you find a level of conflict between the scientific principles of peer review, providing information, against the need for confidentiality of intellectual property [IP] that the corporations you are dealing with would be seeking?

Dr SHELDRAKE: There was a real conflict in people's thinking 10, 12 or 15 years ago. The work of scientists and of committees like the research scientists qualification committee has come to addressing that as an issue. Before, the promotion of a scientist was totally dependent on the publication of peer review papers in internationally recognised journals. Now there is a recognition that a mix is appropriate. If something clearly cannot be published because the work has been done in partnership with a commercial company you have to recognise that work, and the committee—as Helen indicated previously—has come to recognise patents, income streams and royalty streams as yet another way of assessing. By the same token, you cannot use that as the only way. There will always be some scientist who will come up with a mechanism to put all his hard work down that pathway and not publish anything, and you really do need to have some independent assessment of the calibre.

Ms FOGARTY: A lot of our research funding comes from the industry funding bodies. If you look at the way they fund now compared with even 10 or 15 years ago, they are very much more farmer-focused driven, so a lot of the research is not pure research heading towards patents or some intricate piece of science that will be expensive for farmers to apply. It is what farmers want, so they

are driving a lot of the research and they are looking for research they can apply. So perhaps that issue is less now than it was. When we started to commercialise and make money out of that, that is when it became a big issue, but the way research and researchers in Australia are funded, particularly through those funding bodies, is much more farmer-focused than it would have been in many other industries.

Dr SHELDRAKE: It is a point worth making that the income stream in any organisation from things like royalties and IP is relatively small. The big payback is getting that science and technology adopted, in our case, by the farming sector. That is where the payback to the community is. That goes for both environmental research and production research.

The Hon. MELINDA PAVEY: So a lot of research on behalf of farm organisations would not necessarily end up being commercial in confidence, would it?

Ms FOGARTY: No. We spend our time getting that information back out to farmers through publications. As soon as we get a result we can sell, we put it back out as fast as possible.

CHAIR: In terms of employment with NSW Agriculture, has the drive towards commercialisation had any impact on casual versus full-time employment?

Dr SHELDRAKE: I do not think so.

CHAIR: The *BioFirst* program, you mentioned in your opening statement about having a strong focus on the health area. To what extent has it been of assistance with respect to agriculture?

Dr SHELDRAKE: Again I will let Helen answer the question largely, but we have one major project and there are two components to it. One major project is the New South Wales Agriculture Genomics Project in conjunction with the CSIRO and Macquarie University and us. Our component of the work is being done at the Wagga Wagga institute and that has been a very successful program. The work is progressing well and it is achieving outcomes, I think it is fair to say, if we had been working on our own and the CSIRO had been working on its own, we would not have been looking at some of the things we are now looking at. It has been a very collaborative effort on our part, pulling together those three organisations. Helen might like to add.

Ms SCOTT-ORR: Yes. The *BioFirst* strategy is a comprehensive strategy costing \$68 million over five years. It also, in the strategy, describes a much wider range of public investment in biotechnology than is encapsulated in that \$68 million. That money is only additional funds. Of that \$68 million, approximately \$8 million is going to agriculture and the rest is largely going to biomedical work, either directly to the Health Department for infrastructure improvements in facilities or to the Department of State and Regional Development for commercial incentives for companies, many of which are in the biomedical or medical device area. So, we have used the funds largely as Richard has indicated.

CHAIR: Is the liaison directly with the BioUnit of the department? Is it something that is regularly done or is the project set up and then goes off on its own way?

Ms SCOTT-ORR: No, there is a *BioFirst* officers group that the BioUnit co-ordinates. I am on that as an agriculture representative. Unfortunately they have a monthly meeting in Sydney of approximately one hour's duration so I do not always take the plane from Orange to attend that. I often attend by teleconference but I manage to keep abreast of what is going on. There is also a *BioFirst* awards committee. That is something I did not mention. There is about \$6 million in a strategy to encourage scientists to come into New South Wales. They can be agriculture or medical. So far, all these selected applicants have been medical but that depends on the state of the applications that are received. I am also on that committee as the sole non-medical representative. I am in regular contact with the BioUnit and I would say that the contact is quite adequate. We also have a regular reporting process on the projects that are funded.

CHAIR: The idea of the BioUnit with particular focus on biotechnology within the whole range of scientific research, do you believe that that concentration of resources is appropriate?

Dr SHELDRAKE: I think it is, given the nature and the stage at which biotechnology is at and the potential that correctly harnessing biotechnology has to offer the community, and also the potential cost of biotechnology in getting involved in all levels of science. If it is not handled correctly people could waste a lot of money being a bit repetitive in their investments. On the other hand, if it is done well—for example, the Wagga Wagga example again, we are not putting in a proteomics unit at Wagga Wagga; we are using Macquarie University's proteomics unit. That is probably one of the best in the world. It has a really top international reputation. Again, the CSIRO division of plant industry in Canberra has an international top-class reputation.

So, by us being part and being successful in getting the NSW Agriculture genomics centre up through *BioFirst*, it has been very effective in us being able to harness that technology. CSIRO and Macquarie University would have said they have access to some applied plant breeders at Wagga Wagga and biometricians—mathematical statisticians—of which the Department of Agriculture has the biggest group in Australia and who are again internationally recognised. Macquarie University and CSIRO have gained access to our breeders to get their genes out into rice crops and wheat crops quicker than they ever could have done if they had had to start their own plant breeding programs. So I think for those reasons it is appropriate to put a focus on biotechnology.

CHAIR: Are there areas of science where the department would like to be able to carry out more widespread research but the pot of gold is attached to the biotech?

Dr SHELDRAKE: I think if you asked every one of our scientists they would say yes to that question. I think you have to be fairly pragmatic and sensible in how you deal with funding science and technology. The way we are going about it now is saying that we recognise what our strength is, we recognise what our capacity is and what our capability is, and we know what CSIRO, Macquarie University and Charles Sturt University can do, let us look at ways of partnering, getting together and collaborating. That is the way to address that issue. For example, we have got a joint national wine and grape industry centre at Wagga with Charles Sturt University and the New South Wales wine industry. At the moment we are discussing at Wagga collaborating with Charles Sturt University with a view to looking at whether their whole agriculture faculty and our institute might come together. We have got a shared chair in dairy science at Elizabeth Macarthur with Sydney University.

The Hon. PATRICIA FORSYTHE: In relation to, say, the example you used earlier of you working with CSIRO and Charles Sturt was it?

Dr SHELDRAKE: Macquarie University.

The Hon. PATRICIA FORSYTHE: What about agricultural departments in other States? Have they got a share in that same research or do all farmers in other States still get the benefit of the money that you are contributing?

Dr SHELDRAKE: They get the benefit. The best example for us working in other States is a thing called Enterprise Grains Australia which pulls together a whole wheat breeding program: Western Australia's wheat breeding program, the Queensland program and the Grains Research and Development Corporation. We established it about a year ago. The issue was that we all had these three independent programs not really talking to each other. We were producing wheat for New South Wales, whereas Queensland could probably produce varieties that come down to New South Wales if we were sharing material. Certainly the cooperative research centres facilitate that but, at the end of the day, if a new variety of wheat comes out of Wagga with a gene inserted into it which does whatever, that wheat will be available to farmers in Victoria or South Australia.

Ms SCOTT-ORR: May I add to that response? There are a lot of collaborative projects which involve several or all of the State departments as appropriate. For example, there was a long-term project on feed grains for livestock and that was supported by a number of the research and development corporations—one of our scientists at Wagga was also the lead person for that—but there was involvement of other State departments. There is a lot of cross-border involvement in farming systems, research, climatology research, where Queensland has had a major investment and we have got a small unit at Tamworth.

In the horticulture field, the horticultural commodities have sort of been divided up around the States so that we are the lead agency for citrus. A lot of our citrus information would go out to the other States and we take the lead in breeding varieties and maintaining germ plasm. For potatoes it is either Victoria or Tasmania, and we have a very minor involvement in core potato research. For cotton we have a very strong relationship with QDPI, the Queensland Department of Primary Industries, and the cotton industry. At Narrabri we have our Australian Cotton Institute which is co-located with CSIRO and the cotton CRC. So it is very much horses for courses depending on the issue.

The Hon. MELINDA PAVEY: What about aquaculture?

Ms SCOTT-ORR: Aquaculture is fisheries. We do not do fish. We used to have fisheries in our department and then it was excised.

Dr SHELDRAKE: The one area where we do cooperate with fisheries is on fish health. Animal health and fish health are very similar. For example, viral infections in fish require some pretty specialist virology laboratories, so we do give assistance there. But largely aquaculture is the responsibility of New South Wales Fisheries.

Ms SCOTT-ORR: Now that fisheries and agriculture are back under one Minister, while they are separate departments we are now talking to fisheries about opportunities for any convergence in our scientific programs. In some areas like the management of wild catches and so on there really is not going to be a lot of overlap or research into fishing gear or something like that, but certainly I personally believe that aquaculture is a land-based industry and very similar to agriculture—it has all the same issues—but since fisheries was separated from the department they have proceeded separately, obviously.

The Hon. MELINDA PAVEY: So it might be better now? It may create more opportunities and sharing of knowledge?

Ms SCOTT-ORR: I think there are real opportunities there for sharing of knowledge. I do not think there needs to be structural change for that to occur.

CHAIR: Of the different CRCs that you have referred to—the committee will be involving itself in a number of site visits—I just wondered if the department would be able to suggest some specific programs that would be of use for the committee to visit?

Dr SHELDRAKE: We could take it on notice and give you a written recommendation, perhaps the reasons why. I think it would be good to look at some CRCs that have been in place for a period, perhaps some that are relatively new, and also the spread, as Helen referred to before, of industry focused CRCs versus environmentally focused CRCs. We will have a look and make some recommendations.

CHAIR: You mentioned earlier a couple of CRCs that had been discontinued.

Dr SHELDRAKE: Yes. Let me think, having said that. The one that was discontinued that I can recall was the wool CRC. There was a period when there was no sheep industry involvement in CRCs and there is a new CRC that has got up called the sheep—

Ms SCOTT-ORR: The Australian sheep industry—CRC for the Australian sheep industry.

The Hon. CHRISTINE ROBERTSON: So did it actually fall over?

Ms SCOTT-ORR: The previous wool one fell over. We were not a core party in that so we cannot claim responsibility.

Dr SHELDRAKE: It is probably best not to say why we think it fell over but it did fall over.

The Hon. CHRISTINE ROBERTSON: It did not have strong industry involvement focus?

Dr SHELDRAKE: It lacked an industry direction. It was based in Armidale and the contrast with the beef CRC out of Armidale was absolutely chalk and cheese. Whereas the beef CRC was very much driven by an industry board and high profile representatives, the wool CRC just did not ever get the momentum up. I think it was largely because the industry did not have the right makeup at the industry level. The new CRC around sheep that has got up subsequently has strong industry representation.

The Hon. PATRICIA FORSYTHE: May I ask a more general question? There is usually a perception that when government departments are doing their annual request for funding at their budget review that Treasury likes to see some indication of outcomes. On the other hand, scientific research is not something for which you necessarily get short-term outcomes and often research will take years. How do you justify to Treasury, or does Treasury have fairly high indicators that they are getting value for money when they are making their application?

Dr SHELDRAKE: That is really a very good question and I will answer it in two parts. In our annual report, which you may have had a chance to look at, we do try to give some easy to measure outputs and outcomes of what our research and development program is about. We do try to do it and we measure outputs—for example, the number of publications produced—we measure outcomes, things like trying to address soil acidity, which is a huge problem on the Southern Tablelands, southwest slopes, we try to measure things like tonnes of lime that farmers have applied, and we can do that through the sales of lime from the industry. So that is a measure of how effective we have been in convincing farmers they should be trying to increase the PH in the soil.

The other way, and it is something that I have actually targeted in the past couple of months, is to try to show to Treasury the real value of New South Wales Agriculture's research and development program. What we are going to do is keep it so that in future our annual report will have some case studies. Currently we are looking at five separate case studies, and we are doing those five because they are five that we have actually got some reasonably good data on. We are going to try to identify in those case studies the value of government investment in research and development and the return through industry or the return to the community, and just show in real live examples those benefits.

The other way to do it—and we will do it as a publication as well—is the sort of figures that I quoted briefly in my introduction, that is to say, we have got an economic scientist who is internationally regarded and has done some really groundbreaking work with some people out of the University of California on looking at the impact to an economy of research and development on productivity. A lot of work has been done in America but our fellow has done the work here so you can start quantifying what it means and what the impact has been by investing in research and development here. So what we want to say to Treasury is, an investment of one dollar in New South Wales Agriculture or an investment in CSIRO from the Commonwealth means this to the economy of New South Wales or to the economy of Australia, and show that there is a genuine, positive return on that. That is not just looking at returns to farmers' incomes but on the town. So if you look at a town like Griffith, that is a vibrant, absolutely humming economy, whereas if you look at another country town in New South Wales—

The Hon. MELINDA PAVEY: Armidale?

Dr SHELDRAKE: Armidale is okay but I was going to pick a town not as humming as Armidale and just show where you do not have a vibrant agricultural community the social structure is suffering. So it is not just money in farmers' pockets, it is the impact on the rural community. The third issue that we wanted to cover off was investment in things like preventative measures such as foot and mouth disease control or preventing plant diseases, fly blight coming in from New Zealand or plant diseases for the wheat industry, just to show the Government invests in New South Wales Agriculture to provide that protection to the economy of New South Wales. What we want to do is try to show what the benefit of that investment is to the community as a whole.

CHAIR: What do you see are the future opportunities for science innovation and the role that New South Wales can play in actually fostering those opportunities?

Dr SHELDRAKE: I think the future for the agricultural industries in this State and in this country are incredibly positive and they will be underpinned by those industries being able to tap into the latest research and development. If we do not have that research and development and that science and technology going on, industries will not be able to grow, they will not be able to expand their export markets, they will not be able to service their domestic markets.

From our point of view, I am incredibly positive about us playing a role in ensuring that the community of New South Wales has access to that science and technology. That does not mean it has to be done just by my staff; it means our staff working with universities, working with CSIRO, working with industry and working collaboratively to work out the best pathway to get that technology taken up. I think that is the flavour I have tried to portray or that we have all tried to portray here today. You cannot do this on your own. You have to work out the best expertise that you have got and use it as an effectively as you can, and where you have not got it, work with those sectors of the research and development community and industry that have got that capacity.

Ms SCOTT-OR: I would add to that that I think agricultural producers around the world are being subjected to an enormous cost price squeeze because of globalisation, so the challenge for many of our producers is how to maintain their farming viability to actually stay in production. They need new technologies to do that. The extra layer on that is the pressure on the environment. The pressure is to get bigger and to produce more from the same set of finite resources, such as land, water or air. The challenge is how to improve the use of the natural resources while driving the cost of production down. You cannot disassociate improvement of the environment from improving farm viability because the farmers control 75 per cent of the land in New South Wales. That has to be managed sustainably and they cannot do it by just concentrating on the environment. They have to think about viability. So a lot of the challenge for our applied research is developing solutions to that double equation. I think that is the big challenge for us in the future.

(The witnesses withdrew)

MARK SEBASTIAN WAINWRIGHT, Deputy Vice-Chancellor (Research), The University of New South Wales,

GILLIAN DIANA MARION TURNER, Managing Director, Unisearch Limited, 2 Kelburn Road, Roseville, and

WARREN DOUGLAS BRADEY, Director (Finance and Operations), Unisearch Limited, 66 Warragal Road, Turramurra, sworn and examined:

CHAIR: In what official capacity are you appearing before the Committee—as a private individual, or as a representative of an organisational business?

Professor WAINWRIGHT: As a representative of the University of New South Wales.

Ms TURNER: As a representative of Unisearch Limited.

Mr BRADEY: As a representative of Unisearch Limited.

CHAIR: If any of you should consider at any stage during your evidence that certain evidence or documents you may wish to present should be heard or seen in private by the Committee, the Committee will consider your request. However, the Committee or the Legislative Council itself may subsequently publish the evidence if they decide it is in the public interest to do so. Do you wish to make a brief opening statement before questions?

Professor WAINWRIGHT: I believe that the University of New South Wales [UNSW] has a very strong interest in this inquiry since we are perhaps one of the leading universities, particularly in science and technology. I think we need to look at science in its broadest form, from discovery science right through to applied science and then through to technological science. The university has the largest engineering faculty of the country. Engineering research is essentially engineering science. I think we need to look at science as engineering and technology in the broadest sense because that is where the university is in a rather unique position. We have a very large science faculty which embodies a wide range of schools and they cover both discovery science right through to technological science.

If I were to give a particular example it would be the school of biotechnology and biomolecular sciences, which goes from very fundamental biosciences through to biotechnology. It is this interaction that I think is the future of science. In other words, it is a blending of pure and applied science. I think we are in a unique position. The school was only formed at the start of 2002. I believe we did that to ensure that both the discovery sciences and the technological sciences could work together more closely. I think that that will result in much more commercialisation. I think that might be a good starting point.

CHAIR: Looking across the whole of New South Wales research that is being conducted, not only at the university, is there any area of scientific research that could be seen as the primary focus?

Professor WAINWRIGHT: Yes. In our submission I have made the point about our strengths, particularly in information and communications technology [ICT]. UNSW is particularly strong in information and communications technology, but other universities have major strengths in that area and we have partnerships in those areas. I would say that is a particular strength in this State. In its broadest form I think we can go from basic science through to applications. As I have put in our submission, I think it is essential that we have this research strength to ensure that the State of New South Wales continues to be a leader in ICT in the country. I think we are particularly strong in the biotechnology area as well. Once again, the linkages have been quite strong between the various universities, particularly the University of Sydney and Macquarie University and ourselves. I think they are particular strengths.

In the computing side, of course the Government's initiative at the Advanced Technology Park [ATP] with ac3 has brought not so much research but a level of utilisation of expertise and

translation of the benefits to industry in high performance computing. Of course almost every university in this State is involved in that. That has been a tremendous initiative that has drawn various players closer together, including the regional universities, such as the University of Wollongong, the Charles Sturt University and the University of Newcastle. I think it is in those areas of ICT and biotechnology that we have particular strengths in the scientific area across the State.

CHAIR: Do you believe that they are an appropriate area to have that focus in?

Professor WAINWRIGHT: I believe so. I think that ICT, despite the downturn in the dot com crash, is the future. Information technology is particularly important. Increasingly, as we see in our institution and in others, the cross-disciplinary research in ICT in other areas, such as iCinema where our computer scientists are working with people at the College of Fine Arts at Paddington, has been of interest and the State Government has had an interest in this with the Massachusetts Institute of Technology [MIT] media laboratory looking to come to New South Wales because of that sort of work. The other area is the area of bioinformatics where the school of biotechnology and biomolecular sciences [BABS] work closely with computer science and engineering. I think that is where we are really going to get the leverage. They will continue for some time except that they will grow into much more interdisciplinary activities.

CHAIR: How is research infrastructure funded in New South Wales?

Professor WAINWRIGHT: The bulk of our funding from the university perspective on the fundamental side is from Federal Governments initiatives, such as the Australian Research Council [ARC] and the National Health and Medical Research Council [NHMRC], but increasingly those granting bodies are looking for more commercial outcomes as well. In both those funding bodies, they are looking more for industry linkage grants and so they are putting a greater percentage of the grant funding into linkages with industry, leading in the future I believe to much greater commercial outcomes for the research. That is a large chunk of our money, but of course, increasingly, industry funding is important. But I think a lot of the industry funding is coming through leverage from grants such as the ARC linkage grants and NHMRC linkage. We are getting good income from industry.

CHAIR: A lot is said about Australia's performance in terms of research and development compared to other nations in the world, particularly in the OECD. In your opinion, what is the significance of this for publicly funded research in Australia and the drive towards commercialisation?

Professor WAINWRIGHT: The issue in Australia and the OECD is of course that government funding is quite high. Funding from the private sector is not so good. I think that public funding stands up well in terms of research and development funding in this country by those indicators. I think that the real dilemma is the industrial funding. Of course there is a Federal Government inquiry that Gary Nairn recently completed. We were asked to make submissions to that on how private funding can be increased. Of course one of the problems is that even in the ICT sector, companies such as Ericsson, which had significant research and development, pulled out as soon as things got tough and withdrew to their own countries. That is always a problem for Australia for multinationals that will invest. I think there are some very good ones, by the way. One that has been maintained here in Sydney that has been very good for this State is the Canon research institute at North Ryde. It is now the third largest research institute of Canon internationally.

They are here because our universities, in particular the University of New South Wales, have such outstanding graduates in ICT. That is acknowledged and it was acknowledged again the other day when the general manager of Canon Information Systems Research Australia [CISRA]—the Canon Research Institute—talked about why they were here and were growing. We have a chance to grow. With the ICT downturn funding has dropped. That is an issue for us.

CHAIR: What role should government, in particular the New South Wales Government, play in improving mechanisms that provide linkages between the private sector and universities and government research?

Professor WAINWRIGHT: I have alluded to that in our submission. I believe that even though the departments of regional and State development do a good job they could do better in bringing people together. The initiative of creating a ministry of science and medical research could

play a major co-ordinating role. One of the issues in New South Wales is that research organisations and universities do not have a real focus or anywhere to go to obtain help, in particular in relation to the leverage of funding. A lot of Federal Government funds are available. In earlier years—and this has changed recently—we did not have the same support as have, in particular, Queensland and Victoria. They have a more co-ordinated approach to assisting research providers in leveraging to get federal funding.

So I think a co-ordinating role is essential. We are not talking about large sums of State money because we realise that there are not huge sums available for investing in research and development. On the other hand, I think we need a co-ordinating role with some funding for leverage in the last round for centres of excellence and major national research facilities. We were able to get greater support through the departments of regional and State development. I think it would be better for all funding bodies in Canberra—and they are diverse for a wide range of activities, such as CRCs, major national research facilities, centres of excellence, federation fellows, et cetera—if we could get a more co-ordinated approach through one government ministry which could then help us through the others.

The leverage is really important and there are large sums of money to be made. We would grow in status and become a research-intensive State. I think that was recognised in Queensland by setting up the processes with significant funding for bids within CRCs. That is not to say that this State has not started to get actively involved, particularly in the ICT sector. As you will see in my submission, the Government got involved in a big way in the Smart Internet CRC. It has been helpful in one of the new centres for spatial information and it is also a major player in the national centre of excellence in ICT. There are other areas that it could be involved in.

The Hon. PATRICIA FORSYTHE: In your submission you referred to one of the specific challenges hindering commercialisation of research in New South Wales as the fact that research is being attracted to other States by the provision of better quality research facilities. Is that what you were talking about when you referred to Queensland and Victoria?

Professor WAINWRIGHT: In Queensland which is the centre for nano-materials, including biotech and other materials, we have had the experience of the State Government providing a lot of money, along with the Federal money with the Commonwealth Scientific and Industrial Research Organisation, to get an integrated major facility on the St Lucia campus. Many of our best people have been head-hunted to go there to head it up. At least three people that I know particularly well have been head-hunted. In fact, I had to get a joint appointment. The head of biotechnology at our university will be the director in Queensland. We could not afford to lose him. He has a start-up company through Unisearch. Another major medical researcher who has a start-up with Unisearch is being actively sought to go to Queensland.

You have to bear in mind that researchers are not always motivated by personal wealth. It is the facilities and so on that actually motivate them. I sometimes wonder with scientific researchers why they act the way they do because they generally are not concerned about the money but about the science. I think that is wonderful. It is one thing if we can keep them by the facilities. Of course, Sydney housing is having a big impact. Several of our major researchers have said, "Can we get the same sorts of deals?" At least one of the researchers that I just talked about has recently been head-hunted to New York and also to London. He is aware of the housing situation there. Those institutes will take an equity position in the housing and so on. I have talked to my vice-chancellor to try to get him to do a deal, but we have different taxation regimes and so on. All in all, I think it is really the facilities for research and lifestyle that will keep people here.

The Hon. CHRISTINE ROBERTSON: Was there anything competitive about the money being invested in Queensland, or was that a Queensland Government initiative?

Professor WAINWRIGHT: No. The Queensland Government put aside a fund several years ago when we were negotiating for one of the rounds of the CRCs. I believe that it had about \$15 million. I think the State Government here has more recently put not that sum of money but a significant amount of cash into several of the CRCs. But I think it was the co-ordination as well as the cash that were particularly important.

The Hon. CHRISTINE ROBERTSON: Where did the co-ordination come from?

Professor WAINWRIGHT: It came from a department within the Queensland Government, with officers specifically allocated to looking after CRCs.

CHAIR: I refer to the impact of long-term research on driving innovation. Has the focus on commercialisation had an impact on long-term research, which might not always have had the same level of industry interest?

Professor WAINWRIGHT: No, I do not believe so. I believe that, mainly because of the different methods of funding research, we will continue to have both. I think we could still focus on more of the technological sciences. I do not think people realise that that is great science as well. Let me just explain. Back in 2001 I was asked to combine our two science faculties. In January 2002 they came together. The biggest positive that I tried to promote in doing that was the advantage of having discovery science alongside technological science. But there is lack of mutual respect, as I put it to a lot of the academics, of those two extremes of science. If we can get over that we will go a long way in commercialisation and there will be a public benefit from research.

Discovery scientists tend to think that technological and applied scientists are doing low-level stuff because many of those discoveries have been made earlier. Technological scientists tend to think that discovery scientists are doing esoteric and irrelevant research. Of course, both are highly valid. As I said earlier, there is weak discovery science and there is strong technological science and vice versa. What we are talking about is quality, not the approach to science. Of course, things like biotechnology as opposed to very fundamental biosciences, genetics and so on should go hand in hand. I think that is the real issue. I think that those who get it right—and I hope our university is going down that path where we will have that mutual respect—will have a good balance between the shorter-term technological science and the longer-term discovery science.

CHAIR: You alluded to this fact earlier, but I am interested in exploring it a bit further. You referred to scientists not necessarily being so interested in pay rates as being the final determinant. What room is there in any organisation for incentives for scientists to commercialise their research?

Professor WAINWRIGHT: When you talk to my colleagues from Unisearch you will get a better feel for the commercial side. But we at the university have a history of being quite generous to our staff in relation to the commercialisation of research. In other words, Unisearch assists in the research through costs, patents and so on, and then shares the results of that commercialisation with the inventors. That is a university policy that is handled by Unisearch. I think some government departments have not been so enlightened in this area. That is one of the issues for us. I think you will get greater commercialisation of research if you can be more generous to scientists on the outcomes. Of course, not many of them will become fabulously rich by the commercial outcomes. A large number of inventions never generate a positive commercial outcome.

But I think we really need to provide incentives to researchers in the public sector for commercialisation. One of the areas I alluded to in our submission is the area in which we are doing collaborative research with health professionals in hospitals and so on. We are trying to have commercialisation as hospital people do not have the same rights to the commercialisation of IPs as do people in the universities. So we have people working in the same laboratories with different IPs of commercialisation outcomes for individuals. If we were a bit more generous to researchers we would all benefit.

The Hon. CHRISTINE ROBERTSON: Is that to do with competition amongst researchers, or is that to do with the fact that the intellectual property belongs to area health services, or both?

Professor WAINWRIGHT: It is not that the intellectual property belongs to the area health services. The intellectual property in our case belongs to the university. The university, through Unisearch, has the first right of refusal on IP. But when it is commercialised on behalf of the universities—although it varies a little and my colleagues from Unisearch will talk more about that if required—typically, the return is one-third, one-third and one-third on any royalty stream or commercial outcome. That is, is one-third to the inventors, one-third to the university and one-third to

Unisearch, which it ploughs back into new commercial opportunities by paying for patenting costs and for further research. So that model seems to work very well and everyone benefits.

The Hon. CHRISTINE ROBERTSON: I have a question for you about health services. I am interested in the health service issue that you put into your submission. You were referring earlier to the problems being experienced in relation to property rights. I know that South Eastern Sydney and Central Area Health Services, for example, receive a large amount of funds for health research from the New South Wales Government. I would have perceived that they would have organised in some way to have some ownership of the intellectual property rights. However, are you saying that when they are working with your organisation you have the intellectual property rights?

Professor WAINRIGHT: No. When they work with our organisation, they come under the South East Area Health Service, whereas our people—

The Hon. CHRISTINE ROBERTSON: So the difficulty is something to do with the way that Health has set up its property rights, is it?

Ms TURNER: Professor Wainright obviously described the situation with ownership of IP through the university. In many cases we are commercialising research that might have had part involvement from the hospital and part involvement from the university. Where it has any ownership from the university, it is quite clear. With the area health service, because they do not have, as I understand it, a formal IP policy, it is in evolution, we have a situation where we have to negotiate for every single project that we are working on with them, how the IP will be handled. Because in some cases there is no entitlement to benefit for the researchers who are involved, because of the area health service, they do not have the same incentive or, if you like, alignment of interests to be involved, so it involves a double step. First, there is not the incentive for the area health services for people to be involved in commercialisation because they do not have a clear-cut right or series of rights.

The Hon. CHRISTINE ROBERTSON: It is pretty clear cut that the area health service owns it.

Ms TURNER: Yes. However, there are some cases where we are commercialising for the area health service on specific projects where that is being negotiated, which has another set of possible problems at times because of the passing of legislation that they require another set of approvals, so it is very messy. One of the biggest problems in early stage commercialisation is that there is an awful lot of wasted effort on things that are not leading to productive outcomes, which are just sorting out legislative issues and ownership issues. It is not just with the area health service; it can be when we are dealing with another organisation that does not have a clear-cut policy. One of our biggest concerns is this waste of time at the early stage.

The Hon. CHRISTINE ROBERTSON: I think it is clear cut; I just do not think it is probably good for the university or tidy, or good for the researchers in the long-term, because it clearly states that the area health service owns it. That is really where the problem lies. It needs to be sorted so that the science people have a component. I have a personal belief that it should not be handed to the university.

Ms TURNER: I do not think we are asking for that, or even suggesting that. The issue of ownership is not the problem; it is whether there is a policy on sharing the benefits of it with the people involved. I do not think we are asking to own area health services of IP or anything like that; we are simply asking that they have a clear policy on how they share the benefits, so that when we do deal with them their people are fully aligned.

The Hon. PATRICIA FORSYTHE: You specifically referred the Department of Health and some of the area health services. In your work with other government agencies do you strike a similar problem, or is this something specific to the Department of Health?

Ms TURNER: We only have problems when we are dealing with somebody that we are collaborating with, where we need to negotiate who owns IP (for further commercialising it) if they do not have a clear policy of ownership, and also of rights to commercialise, and then who benefits from the commercialisation. So it is more likely to be applicable to an area health service, because we deal

with them more regularly, particularly through medicine and biotech. But it might apply to other research institutes, or even charitable organisations like cancer councils, which may not have it clear, or do not have a view on going forward with commercialisation.

The Hon. PATRICIA FORSYTHE: Do you have similar problems with other government agencies?

Ms TURNER: Yes, we have had problems negotiating with CRCs and the various organisations. It depends on each individual one. Yes, we have had significant problems in negotiating at times.

The Hon. MELINDA PAVEY: You said that the area health service is trying to fix up that area. How long has that been going on and where can you see some more efficiencies coming in?

Ms TURNER: I am not, obviously, privy to the inner workings of the area health service, but through my role as a director of a State company involved with health promotion I have had some other insights into that. But it seems that ever since I have been managing director of Unisearch, which is almost five years, there has been talk about sorting it out, and different bodies have been set up to do different things. But, again, I am not inside, so I cannot really comment on exactly what is happening.

The Hon. CHRISTINE ROBERTSON: It is to do with public sector employment. If you are a public sector employee, what you do belongs to that institution. It is sorting through that and actually changing it, which is a huge issue.

Ms TURNER: Yes; it is not simple. It is working out what you want to do, and then going out and doing it. And they are both complicated.

CHAIR: How do you resolve within the university between the university and Unisearch the relative roles between commercialisation involving IP issues and the general principle of the passing on of knowledge, the dissemination of knowledge and the different roles that would be attributed specifically to a university? How is that concept resolved?

Ms TURNER: If you are referring to the underlying issue of academics who want to publish, and IP companies that want to commercialise, and therefore want to protect it and perhaps keep it secret, there is a much greater focus on commercialisation within the university. That is fairly well understood. I think if any academic published something that could have had commercial value, the university would come down on them pretty hard these days.

In terms of the respective roles of the organisations, certainly to me it is quite clear that the university funds research; Unisearch only invests in commercialisation of research. So, if we make an investment in something—we might do that up to \$1 million or so in particular projects—it will be to undertake a particular set of activities which will help commercialise that research. It might be to develop a prototype, or it might be to do some applied research. For instance, as one of the compounds that has been discovered that has a potential anti-cancer effect. We are trying to develop a group of chemicals that broaden the area that the patent can cover. Unisearch is paying for that work, because it is part of protecting the intellectual property position; it is not research that the researcher would necessarily have taken out to go further down the path.

From that point of view it is quite clear where we focus. Inevitably, where you have issues of collaborative research—where it is still very early and commercial outcomes are terribly hazy—sometimes it can be a bit of a crossover between Unisearch and the research office, but we base managing that on good relationships. Relationships in this area of the market are so critical, because it is not a technical role; it is having people understand where people are coming from, and speaking together.

CHAIR: What is the order of events in terms of the direction of research being chosen, or it being seen that there are commercial opportunities and therefore the direction of research goes along that path?

Professor WAINRIGHT: Perhaps I should answer that. Increasingly the universities, including my own, will be interested in perhaps a greater focus on our research efforts. Let me explain. I think in the past there has been a culture in which the term "let a thousand flowers bloom" perhaps applied more. With the greater cost of doing research and so on, we need to focus on our strengths and look to the future with perhaps a greater focus within our universities.

If I take the University of New South Wales, I would say that in the past we have focused much more on our teaching activities, even though we are a research-intensive university. In the area of science or engineering we have probably said we need to cover all these courses in our undergraduate program. So we do not have the mass of researchers in a specific area of science or engineering to form a big group, and that is the way you get good scientific research done. You have to back a few winners in all of this and look to the future. My view is that people can do an excellent job of undergraduate teaching quite broadly in their discipline, but you cannot have people who can do that in research. In other words, we might have a department with 20 staff with 20 different areas of research. That is just not going to work in the future, because they have 20 different courses to teach in an undergraduate program.

I think that is where the direction will come, in terms of where we want to be. Ultimately we would discuss that with Unisearch, but really that is a decision for the university in its forward planning as to what we see as a research strength. Of course, in many of those activities we will be working in collaboration with other universities so we get the critical masses around the country. One of our very highly successful activities that I have referred to is Qucom, the quantum computing research activity that Unisearch is heavily involved in. That involves the University of Melbourne and the University of Queensland with separate nodes of activity, the major node being at the University of New South Wales. But increasingly we will see people with different strengths and critical masses pulling together on a major project. So within the university we will be setting the directions and we hope we get them right, and Unisearch will continue to assist us in commercialising any of the successful outcomes.

The Hon. CHRISTINE ROBERTSON: Recognising the competitive nature of resources for research is centuries old. How much influence does it have on the ability to collaborate? It is an extremely cut-throat competition.

Professor WAINRIGHT: I think it is changing a little, for the good. I firmly believe that. But we will still find individuals, and in my role I get some of the so-called prima donnas of researchers who do not really want to collaborate much. But most scientific researchers are now realising that the big outcomes are going to come from collaboration and getting good groups. At the moment we have two Federation Fellows within quantum computing at UNSW, Bob Clark, who has been the founder of it, and Michelle Simmons and a Federation Fellow at the University of Queensland who is working on a different area of it. Those people have all benefited much more than if they had perhaps said, "We will go it alone." They are now part of the biggest research activity in the country, and they have all been rewarded personally for their achievements within the overall program. I think that is becoming recognised. We have a young researcher in polymers at our university, Tom Davis, who has brought along two or three people from around the world who are now going to grow it in the same way as Bob Clark did with the centre for quantum computing technologies.

So I think the world is changing, and for the good. We will still have people who are the prima donnas, and they will still benefit. If they can get research funding, that is fine, but I think the real funds are coming to group research and most funding agencies are looking to that, including funding from the private sector. They want to see the critical mass of people there to do research.

The Hon. PATRICIA FORSYTHE: In relation to the Co-operative Research Centre program, which clearly shows a concentration of research and commercialisation between universities and industry, how successful do you think the CRC program has been to date?

Ms TURNER: I will pass the question to Professor Wainright, but I will just make one comment. We are not experts in the CRC program. We have some dealings with them from time to time, and how successful they are depends on how well the industry partners are aligned to the basic research and also how clear cut the ownership is. Certainly our experience in dealing with a few is that

if no-one has a big enough stake in it to drive it, it just becomes a pool of funds in research and does not necessarily go anywhere. But if you have individuals who are really driving it and the ownership is quite clear, you can have different outcomes. From my experience it really depends on the individual CRC rather than the program as such.

Professor WAINWRIGHT: I have a bit of experience, having been a director over the last 12 years on the board of at least nine CRCs at various times. It is all very mixed, of course. The ones that I have been involved in have all been in the technology areas. We have never looked at it as providing a strong commercial outcome for the universities. It is the research that really has been important, as well as the research training. I think in the very good CRCs we have turned out to a lot of new PhD graduates who do understand commercialisation by the time they get their PhD. I think they are the future. It is the different experience that the PhD students in those programs have had in working with industry partners and understanding commercial reality that has been very helpful.

This has led to universities, particularly ours and others that are research intensive, looking to put more of that into PhD programs in science and engineering within our universities, providing courses for people like Unisearch to talk to our students during a PhD candidature about commercialisation and so on. That has been a big strength of the CRCs. In terms of commercial outcomes, we have not really made a lot of money. The Cardiac CRC, which generated some income for us and for Unisearch, was based upon IP that we brought to the party, really before the CRC. In general, we have not had big commercial outcomes, except the big one, the Eye CRC, which is for Eye research and technology, now has the largest funding for the new CRC, called Vision CRC, which is much broader than the current contact lens research. That has been a big commercial success through its soft contact lens work with Ciba Vision.

They are very mixed. From the State's point of view, the one I have been on since its inception is now into its third round, that is, advanced composite structures, which helped us become leaders in composite materials and develop expertise at Hawker de Havilland at Bankstown. That got big contracts for Hawkers with Boeing, and of course they were taken over by Boeing, but I think that has kept Bankstown going very well. That did not create any commercial success for any of the industry partners in terms of royalty streams or anything for the universities but it is established us as a leader and, of course, that was very good for the State. That CRC particularly turns out great PhDs.

The Hon. PATRICIA FORSYTHE: To whom are the individual CRCs accountable and what is the level of accountability?

Professor WAINWRIGHT: The CRCs themselves are accountable to a board of directors. Increasingly, the Federal Government—the CRC Secretariat and department—are requesting much more independence of the board. In the early years boards were based upon partnerships—all the partners in the CRC. I was on the board of one that had 20 directors—absolutely hopeless. Most CRCs are now looking for more independent directors. Universities have matured in their understanding of what CRCs are all about and we usually do not have a director, but through an electoral college we will have independent directors that we are comfortable with on the boards of the CRCs. The governance structure of CRCs has changed dramatically in the last 12 years since I first became a director of several.

The Hon. PATRICIA FORSYTHE: What risk assessment process would the university undertake before it committed funds to a CRC?

Professor WAINWRIGHT: Increasingly greater because of our accountability under the State Act and so on. In this current round I have taken over the last two months to the Finance Committee of our University Council four new CRCs. We do significant due diligence, both financially and governance wise and ensure that that is in place—the governance of these things is really critical—before we can give either cash or in kind, because the staff going into CRCs to conduct research can be the major component of our contribution, so it is critical. Due diligence is increasingly important. If we are unhappy with the particular governance structure, for example, we might simply go in as a supporting partner rather than a core partner when we think that it is not in the University's interest to be a partner. In a company limited by guarantee, for example, we would rather support that CRC if we were uncomfortable.

The Hon. CHRISTINE ROBERTSON: Does the emphasis on commercialisation have the potential to threaten long-term, non-commercial, perhaps public interest or discovery type research?

Professor WAINWRIGHT: Not at all. I believe that the Federal Government in its funding, which is still a major funding source for universities through the NHMRC and ARC still has a focus on long-term research, but the balance has changed—

The Hon. CHRISTINE ROBERTSON: So long as it is not rural.

Professor WAINWRIGHT: We do not have any activities in those research areas. In agriculture we have research in biotech. In terms of those other areas it is simply a ballot. Both industrially funded research and linkage research are still top-quality research that can push us ahead. Often I think researchers is missed out on being able to publish the great science behind some of those more applied work because they do not really take an interest in publishing the fundamentals behind it, which companies are quite happy about as long as it is not disclosing the actual work, but the fundamental science behind it can often be published. No, I do not have a real problem with the balance at the moment. I think the balance is good and was inevitable.

Ms TURNER: I wish to comment, because there is often an assumption that long-term research is not necessarily commercially focused. The project that Professor Wainwright mentioned earlier- Quantum Computing- is very much discovery long-term science but certainly with a good understanding of the potential commercial outcomes. It highlights one of the major issues for commercialisation that I would like to make sure that we leave squarely on the table; that is, the funding of the commercial nurturing of a lot of the research, and particularly the longer term research that has commercial potential is a real issue, because very little of the research granting that is available is made available for the commercialisation of this research. Yet there are patenting costs, costs of service that Unisearch provides. Maybe the cost of commercialisation support for Unisearch is not such a problem because we are a part of a large university, but the smaller universities cannot afford commercialisation support.

The longer term projects with commercial potential are the ones that are most likely to miss out. The shorter term ones are more likely to find a commercial partner because both the path to market and the relative immediacy of that path to market are more clear, and somebody in industry is more likely to step up to the plate and get involved. The longer term ones—and Quantum Computing is a good example—and the biotechnology ones, particularly those areas involving longer term trials involving phases one, two, three and four, with somebody paying for patenting and commercialisation support over many years, have the biggest danger of falling short in the industry generally. I am obviously concerned more about New South Wales because I live here. It is a problem that very few of the programs address that support, and very few universities can afford to pay for commercialisation support. The patenting for Quantum Computing is going to fall outside the prudential constraints of Unisearch very easily because of the sums that will be involved over a large number of patents over a long period of time. Unless you sell out early- if you can find someone who wants to buy out early- this is where we have a real danger of missing out.

The other problem is that although you have to nurture many areas of research, you do not really know the ones that will be of value, and you cannot make that decision early on. You can dismiss some as clearly not having commercial value, but many would appear to be equal runners, and something that happens down the track will determine that one industry partner will be interested and another will not. They may have a competing product so they do not want this one. It will not be based on any fundamental commercial merits. There is a real danger that there are not enough programs designed to support that.

Professor WAINWRIGHT: When people apply for discovery research type grants through the bodies, one aspect of the selection process is potential for commercialisation, but then those funding bodies will not support the commercialisation. It is a black hole, at the moment, knowing where we can do it. If we have an organisation like Unisearch which can generate cash flows through other areas, we are able to cover some patent costs, whereas we cannot spend money out of the university's recurrent budget through Commonwealth grants on those activities. It is a bit of a black hole at the moment to find funding for protection of IP.

The Hon. CHRISTINE ROBERTSON: What is worrying me about this emphasis is the eye research. The major potential for very lucrative commercialisation will attract further funding for more research, but health promotion will not. How do you make sure that you still have research for the public good—that will certainly not make dollars but probably lose dollars?

Ms TURNER: The social policy type related research, yes.

The Hon. CHRISTINE ROBERTSON: I do not object to commercialisation.

Professor WAINWRIGHT: No, but, once again, this is where universities and organisations such as ours will need to look at priority areas beyond those with a commercial outcome. The Centre for Social Policy Research at the University of New South Wales is a classic example of that. It is attracting large sums of money from different agencies for very good research in that area.

The Hon. Christine Robertson: Public agencies?

Professor WAINWRIGHT: Yes, to do that research, and also from the ARC. The Social Policy Research Centre at the University of New South Wales attracts good funding for discovery grants from the ARC and we are proud of that research and that particular Centre.

CHAIR: With respect to the fact that for some areas of research there will not be a commercial interest, does the university have an opinion that some areas of research, whether or not there is a commercial interest, ought not to be commercialised? I know that there has been a lot of discussion about DNA coding and whether or not it ought to be patentable. What is the university's perspective on that?

Professor WAINWRIGHT: We would need to look at that on a case-by-case basis. When the research is done, any research has to go through our ethics committees. Once again, that is a very big task in research organisations these days. But it would also be that we would want focus if we are going to go with research. I cannot really answer the specific.

The Hon. PATRICIA FORSYTHE: I want to come back to patenting costs and where you see a role for government. Are other States providing that level of support?

Ms TURNER: Good question. I do not know that I can comment in relation to particular State programs.

Mr BRADEY: I am not sure about the other States, but, obviously, the *BioFirst* program allows some small patenting costs to be reimbursed. There is \$75,000 that can be applied dollar for dollar, but that is very quickly used up because once you go to national-phase patenting it is several hundred thousand dollars or more and when you have multiple patents it very quickly gets into the millions of dollars. There is an early small sum available in New South Wales, but we are not sure about Queensland or Victoria.

The Hon. CHRISTINE ROBERTSON: Could the patent exist and work off some sort of loan program?

Ms TURNER: Theoretically, yes, I suppose it could.

The Hon. CHRISTINE ROBERTSON: You are patenting it because you think you are going to make a profit.

Ms TURNER: You are patenting it to protect your interest in it. You do not know for a while whether you are going to make a profit. To some degree that is the nub of it. Sometimes you are protecting it because you do not want somebody else to be able to take it. They are not always Australian patents, a lot of it is off shore.

Professor WAINWRIGHT: But it is something we should really look into because it is a major problem. Whether there was an investment fund or whatever for loans it would really assist in the process. It is something we need to get together with the Government to discuss.

CHAIR: To what extent does Unisearch interact with *BioFirst*?

Ms TURNER: Several start-up companies have had funds from *BioFirst*. I might ask Mr Bradey to comment because my voice is giving out.

Mr BRADEY: We have had two companies go through the program that have been eligible for *BioFirst* funding through the concept funding. Both those companies got \$100,000 through the concept funding and on top of that they accessed the *BioFirst* program, the bio business program, for \$75,000 and also the \$20,000 Australian Technology Showcase funding part of it. Each of those has not been fully drawn down, but they have certainly been eligible to access it. There is a limit that companies can be incorporated only in the last two years. For increasingly longer-term science projects that is going to be an issue. Realistically they would not be able to draw down from those funds because they would not need them until later because you need to do very early discovery science. We would encourage a longer term to be able to draw on those programs, which would be of value for the ones that we are supporting at the moment.

Ms TURNER: It is also only for spin-off companies. They are not available just for technology. A lot of the programs, Federal ones too, address only incorporated vehicles, and that is not really a cost you want to incur unless you really know it is going to go down that path, because it brings a whole lot of extra administration work, and costs, that are often wasted.

The Hon. PATRICIA FORSYTHE: In your submission you referred to legislative and regulatory impediments, in particular that Treasury can take up to six months to consider the incorporation of new start-up ventures. Do you have any examples of where New South Wales has lost out as a consequence?

Mr BRADEY: I guess the question is whether it has lost out, but it has certainly significantly delayed the process. We are going through one at the moment where we are looking to take a product through clinical trials. We have an industry partner who is prepared to work with us, and our view was that the best way forward was to incorporate and take that forward, but because of intellectual property issues where part of the research is done shoulder to shoulder with the area health service and the cancer group, we cannot get that intellectual property into an incorporated ether without referring to Treasury. We have been told that it would take over six months to do that. We have had to step back from incorporating, which has caused us delays. We have also looked to find another way of dealing with the project rather than through incorporation.

The Hon. CHRISTINE ROBERTSON: Do you understand why it has to go through Treasury? Is that because it has to put a money value on it? We will find out eventually.

Mr BRADEY: No. The Act is quite specific. If an incorporation is to occur then it has to have the approval of Treasury. In this instance we were not even asking the government to inject cash, it is just the Government's approach to the project to go forward.

The Hon. MELINDA PAVEY: Is that a personal issue within Treasury?

Mr BRADEY: I do not believe so. It is the way policy works in the process.

CHAIR: What or where are the future opportunities for science and innovation, and how do you see New South Wales playing a leading role in fostering those opportunities?

Professor WAINWRIGHT: The big opportunities are obviously in ICT in its broader sense and in biomedical research and biotechnology. The State Government partnership with NICTA has been a positive one. If we can get hospitals and other research bodies funded by the State Government to work more closely and overcome some of the issues that we have talked about in terms of IP—at the moment there is an initiative and we are looking more closely to do that at the University with a range of hospitals—that would really drive research in its broadest sense through biopharmaceuticals and biomedical engineering, which is particularly strong in the State. We have the only school of biomedical engineering in the country. Resmed takes a lot of our graduates. It is a big initiative for the State. Biomedical engineering has enormous potential for new devices, et cetera. That interaction

between medicine and science—life science and engineering—will really drive a lot of future research.

(The witnesses withdrew.)

(Short adjournment)

BERYL LILIAN HESKETH, Pro-Vice-Chancellor, College of Sciences and Technology, University of Sydney, affirmed and examined:

CHAIR: In what capacity are you appearing before the Committee, as a private individual or as a representative of an organisation or business?

Professor HESKETH: A representative of the University of Sydney.

CHAIR: If you should consider at any stage during your evidence that certain evidence or documents you may wish to present should be seen or heard in private by the Committee, the Committee will consider your request. However, the Committee or the Legislative Council may subsequently publish the evidence if it decides it is in the public interest to do so. Would you like to make a brief opening statement prior to questioning?

Professor HESKETH: First, if I can thank you for giving us the opportunity to present here, and also just to mention that Professor Les Field, who is the Pro-Vice-Chancellor of Research, was unable to come today. He is in Canberra with the Australian Research Council and has a very busy week there. I would normally have also brought Dr Clare Baxter, who heads up our Business Liaison Office, but she is unfortunately overseas. So, if there are any issues where you feel you may want more detailed information, it is possible that you might choose to invite one or other or both of those back at some stage.

I believe you have the submission from the university that was sent in on Friday. I will essentially work to that, but will also comment on some of the issues associated with it. We welcome the opportunity to be a participant in this debate regarding the future directions of research and commercialisation in New South Wales. We agree there is a need for a co-ordinated, whole-of-government response in relation to science and commercialisation. The University of Sydney is signalling that it wishes to engage actively in setting policies for commercialising the results of scientific research that support the New South Wales innovation system and increase the competitiveness, economic prosperity and social wellbeing of the State. We believe we have a lot to offer—other universities, us and the State—and look forward to working collaboratively with you in that.

In setting a bit of background, the University of Sydney is one of the leading universities in technology transfer. This arises in part because of a large number of top-class research groups, which are the engine that drives the innovation and technology in future years. So, we see the link between the fundamental research and research groups as an important precursor to the technology transfer. We think that that critical mass of powerful research teams has been behind what we see as the comparative success in commercialising within the university structure. We have been very proactive in trying to drive that technology transfer. Here I have to draw attention to what we think has been the right decision, which is the Business Liaison Office at Sydney that has a different model to some of the other universities. It is not a stand-alone unit, it is very much within the university and under the control of the university. We see that as having been, certainly at this stage in our development, one of the more important successes or reasons for the success for commercialising in so many areas. So, a big plus to our Business Liaison Office. We believe it has been a very powerful group that has helped many of the staff within the university to appreciate the importance of intellectual property [IP] and protocols associated with that and has assisted many staff in translating their research into IP and the whole commercialisation route.

We already collaborate with the State in several different enterprises. I think the ATPI can be seen as one of those. We have been involved in many other linkages that relate to commercialisation. Our submission documents quite fully the various achievements with respect to the Business Liaison Office, the support it provides and the success we have had in commercialising companies, and I do not believe I have to go through those specifically, they are in the submission. But I think it is an example of something that has worked well. Worldwide, the number of patents and the income from commercialisation is strongly correlated with research expenditure. So, that is a message we want to get across: The reason we are successful now is probably because of research that was done 10, 15 years ago. If people think it is a quick route to commercialisation, I do not believe that is the case. We have to invest in deep research infrastructure and fund basic research so that the sorts of ideas can

bubble up from that, and it places people in a position where they can capitalise on that. I am certainly not saying that the State has to fund all the fundamental research, but there is absolutely no doubt that the track record of the university over several decades of attaining competitive research funding and forming research centres and groups is behind what we see now as the comparative success in commercialisation. We would worry if there was ever a breaking of that nexus or an assumption that we had to go straight to commercialisation without feeding the engine room, which is research.

I guess, in improving the linkage between the Government and various research centres, we think there is still considerable scope for greater co-ordination, particularly amongst the research-intensive universities. We work well with the University of New South Wales in a number of areas. More can be done though and with other relevant overlapping universities—also with institutions within the New South Wales Government that are undertaking research, because there are quite a few of those. We think that linkage has not been explored sufficiently. We have one example in our submission and we draw attention to that.

Perhaps the most important point is the role of the New South Wales Government in helping the universities to leverage funding from the Commonwealth. We have examples of success there with NICTA and the major national research facility (MNRF) so there have been good examples where the State Government has assisted us. As we move now into the next version of backing Australia's ability, it will be crucial that we are all very quick-footed in taking whatever advantages might emerge out of the submissions currently being put forward to the five different reviews related to research being undertaken by the Commonwealth Government. That whole-of-State, team approach from New South Wales is something we would really welcome so that we can make sure that we leverage as much money as possible out of the Commonwealth Government for all sorts of components of research, from the basic infrastructure through to the funding of research. The way in which relationships between organisations such as the Australian Nuclear Science and Technology Organisation [ANSTO], the CSIRO and universities emerge will also be important for us to keep an eye on.

Perhaps the one example I would like to draw on is the value of thinking about infrastructure and the role of infrastructure as the absolute building block of research and then commercialisation. We would hope that potentially the State Government may see some potential role there, particularly as it relates to facilitating shared infrastructure amongst the research organisations funded by the State Government and the different universities. The example we have chosen to talk about is based at Cobbitty. The University of Sydney's Faculty of Veterinary Science has an excellent group of researchers in the genomic livestock animal area. There is the Plant Breeding Institute (PBI) out there, which also builds on some of the genomic areas, and we note that the Elizabeth Macarthur Agricultural Institute is not far. We think potentially they are areas where we might consider trying to build up a real source of expertise that will take us beyond just the medical biotechnology, to plant and animal biotechnology as well.

I believe New South Wales State has a distinct advantage here in that there is so much emphasis on medical research and we should not emphasise it, absolutely without question—but we also have very very strong research in the whole plant area, wheat breeding, development of new flora and then in animal health and veterinary bioscience where the genomics revolution is going to have quite a major impact down the track. We wonder whether this is some facility the State Government might want to consider. Already we have had some discussions with the University of New South Wales about the possibility of trying to set up a large animal research facility. The location of that is not quite clear yet—it could be Camden—we wanted it co-located with a veterinary school for obvious reasons and that sort of facility could provide basic support to the medical research foundations as well as some of the animal areas.

BioFirst has been very good, we just need more of it. There are several examples where there have been benefits that have arisen from BioFirst and we would like to see that develop and evolve.

CHAIR: Broadly speaking on the whole gamut of science and innovation research in New South Wales, is there a primary field where you believe research is going at a faster pace than in other areas?

Professor HESKETH: I think if you look at it currently, the photonics information communication technology [ICT], has to perhaps be seen as one where we appear to be doing well but there is an enormous debt for the medical, biological, veterinary, agricultural research that has not received quite the same prominence as those. But it is a sleeping giant, in my view, and one that if we get our act together in New South Wales we will really be able to capitalise on.

CHAIR: You would see the focus of biotechnology as being an appropriate one?

Professor HESKETH: It is a very broad one so it is useful, but I would like to see it as encompassing more than just medicine and very distinctly including the whole animal livestock, agriculture, and plant area in addition to medicine. There will be synergies by linking all of those that we perhaps do not see where there is an exclusive focus on the medical area.

CHAIR: Compared with our major international competitors, our level of private-sector research and development is considered quite poor. In your opinion what is the significance of this for publicly funded research in Australia and the drive towards commercialisation?

Professor HESKETH: I think it makes it difficult. I am surprised by how much success we have had despite that, but it is a big effort, an enormous effort on the part of the various researchers. Researchers are motivated by the sheer joy of discovery and the lengths that they will go to to continue to be able to do that is sometimes quite remarkable. I think we have been very fortunate that we have managed to carry that momentum despite what I think is comparatively poor support from the commercial sector.

CHAIR: So what role do you believe the government particularly—in this case the New South Wales Government—could play in improving the mechanisms that provide those links between the private sector, the university and the government research centres?

Professor HESKETH: One is to help us be very quick-footed in collaborating to make sure that we benefit from whatever money is available through the Commonwealth, and that often requires collaboration among the universities as well as the private sector. The other is to maybe cover when the private sector pulls out. We have had examples where I think it was in good faith that the private sector companies have participated in CRCs and then the funding situation has been tight for them so they have not been able to meet their obligations. That puts enormous pressure on the universities who are remaining members of the CRCs to find some way of continuing with the research programme. So a recognition that sometimes the private sector does not necessarily hang in there until the end and to cover for that would be quite useful.

We have examples of a couple of CRCs, which I probably do not need to mention, where it has clearly been the case that a downturn in the economy has meant that the partners have been unable to provide the support that they might have and that has put enormous pressure on those research teams and where they were heading.

CHAIR: In those instances—I know you do not wish to go to the very specifics—has the result been that the scientific research stops or slows down?

Professor HESKETH: Both, and it will be more so if we do not keep an eye on it, with considerable loss of potential IP and long-term commercialisation.

CHAIR: Organisations like FASTS, the Federation of Australian Scientific and Technological Societies, have talked about the need for greater coordination of scientific efforts and, in particular, the concept of whole-of-government approaches, interactive processes between the Commonwealth, the State and Territories. To what degree does infrastructure support or prevent coordination through there being bidding wars between the States and the institutions at other facilities and research centres?

Professor HESKETH: It is a difficult one. If I can answer that by saying if we had no competition at all and we had the whole of government—whoever that might be—making decisions about where it was going to put major research facilities, I am not sure that we would end up with the best results because sometimes there is a real motivation to try to grow areas where there is no

development whatsoever and to put massive infrastructure in areas where, with the best intention, they are not going to draw the top staff and they are not going to draw the top students, and you end up with white elephants. So there needs to be some combination of making sure that there is a bit of excellence in there that will result in the dollar being spent effectively, which requires competition and fair assessment with more coordination. We have not quite got it right yet, I agree.

CHAIR: You referred earlier to the issue of assistance towards getting Federal funding. What role does infrastructure play in acting as leverage for the additional Federal funding?

Professor HESKETH: It appears that increasingly any Federal dollar requires a vast amount of matching funding and the universities are actually not in a very good position to provide that matching funding right now. Often they do so at considerable difficulty because they know how important it is, it is absolutely crucial. But to have a little bit of help with that would make a difference because it does appear that the requirements for matching funding is an important component of the decision-making.

I see a slightly different role where if the infrastructure and facilities were provided in a coordinated way through partnerships, let us say, between institutions and the State Government, it would make it much easier for the institutions to collaborate. We have to do more of that. So there is a role for the Government to go in as a partner, not just as a facilitator; it has to show the colour of its money a little bit. But as a serious partner that will really help to bring the collaboration among various research institutes, and infrastructure is the way to do that.

CHAIR: How important is basic long-term research in driving innovation? There is some idea that commercialisation will often be more driven towards short-term research. I am just wondering what impact you have seen the focus on commercialisation has had on long-term research?

Professor HESKETH: If I answer from the University of Sydney perspective initially, I do not believe we will ever allow anything to divert us from a fairly strong emphasis on fundamental research and we have to encourage that for the sake of Australia. There are just too many examples of the sort of blue sky research that was done in the bowels of the School of Chemistry 15 years ago that no one thought would have any commercial application. That is what is driving the current innovation. One has to have a very long-term perspective to be able to see that link between fundamental research and commercialisation.

What is good, and I believe the university responded very positively to that, is that you cannot just allow the research to happen and assume that the commercialisation will follow, you also have to work hard at making sure that it does. That is what I believe we have done really well in the past three to five years. While not discouraging the blue sky research and researchers—and we have got a long way to go still—we are making the researchers very aware when there is potential intellectual property emerging from their research such that they then care for it a little bit better and work with the liaison office to ensure that then the commercialisation occurs to their benefit, the university's benefit and, far more importantly, to the benefit of the State. There is not that much money that comes back to the universities through commercialisation. But we do see it as an engine room that is driving innovation and industry development and things like that.

CHAIR: The creation of the Business Liaison Office [BLO]—was that something that the university had picked up and seen elsewhere?

Professor HESKETH: I might have to pass, on that. I actually do not know the history and I might say something that is wrong. But since I have been at Sydney, it has been there. It has always been very much within the university as distinct from some other universities that had a model of an external company to in a sense look after their commercialisation. The vice-chancellor is very committed to keeping it within the university and I think that has been the right decision for the current time, which is why we feel we have been so successful. It is a model that has evolved, but there may be some more to the history that I do not know.

CHAIR: Can I ask you about the circumstances of the individual scientists? Is there a process whereby they receive incentives? Should their research be commercialised? What is the thinking there?

Professor HESKETH: The university intellectual property rule does ensure that some of the money goes back to the researchers, and that is a motivator. I do not know that they have seen terribly much yet, but with the whole area of commercialisation you have to keep doing it because one or two will be wonderfully successful, and that is what drives it. There is a mechanism for ensuring that some of the money goes back to the researchers.

CHAIR: Is that done through equity, or through pay scales? Is that something that they receive on an ongoing basis while they remain in the employment of university? How is that actually structured?

Professor HESKETH: I might have to pass, on the exact detail. But it is tied into intellectual property and the returns that eventually come back get divided up, with them getting a proportion of it. If I can answer a slightly different question—how do we motivate the researchers—one of the wonderful things about a lot of science and scientists is that, for them, the major motivation is having access to funding to do their research. The problem is trying to stop them rather than trying to encourage them. But there are mechanisms for recognising the real high-fliers in the research area. The university makes use of those but certainly the intellectual property rule, which provides for some of the eventual returns to go back to the researcher, is also a motivator.

CHAIR: Would it be possible for you to come back to the Committee on that issue?

Professor HESKETH: Certainly.

CHAIR: For scientists and research managers within the universities, how familiar are they with the commercialisation process and the way that industry operates? Is it all done through the Business Liaison Office? How does that work?

Professor HESKETH: It has been an interactive process and they are much more aware now than they were five years ago. There are continual seminars and discussions and ways in which we involve the scientists in this, but it is a fine balance because you do not want them to get tied up in the nitty-gritty of having to do all the detailed work that is required for that, which is then run by the Business Liaison Office.

CHAIR: Does the role of the Business Liaison Office arise when research is nearing its conclusion and there is an issue of "How can this be commercialised?" or do they have a role in determining where the research will actually take place?

Professor HESKETH: No, only in so far as if the industry has particular areas of research that they would like to fund, the BLO is the first port of call. Through its knowledge of who has the expertise, it would approach them to carry out that research. There is a large amount of consulting and contract research that is done by the University of Sydney in all areas across medicine, engineering and science. Much of the research is currently funded through the Australian Research Council and the National Health and Medical Research Council, and the university's researchers have been extraordinarily successful in getting their funding there. Where the researchers are asked and encouraged—in fact, required—to identify the potential intellectual property of their discoveries and to notify the Business Liaison Office immediately, at that point there is a handholding process that occurs to make sure that the issues are dealt with appropriately.

CHAIR: To what extent do the scientists and technologists themselves have the skills and ability to move between universities and work in industry, and then come back from industry to work at the university? Are there sufficient opportunities for such transfers? Is that something that you see?

Professor HESKETH: I think it occurs in some areas more than in others. In some areas, that probably would not make all that much sense because the nature of the research would be such that you would not necessarily be wanting them to have that industry link, but where research is more toward the commercialisation end, then there are opportunities for them. There is always value in having more. In the linkage grants of the Australian Research Council that involve industry partners—we believe we have increased our success in those enormously—we see that as another opportunity

for further expanding the university-industry linkages. I think those sorts of opportunities are always good but one has to get the balance right.

I am not sure that you want all your researchers to just become totally focused on commercial output, but you need them aware of it so that they can then recognise opportunities and bring help in as is appropriate. But of course with a university the size of the University of Sydney, you would expect there to be some areas in which that is happening almost daily whereas in other areas it is more on the end of blue sky research.

CHAIR: Are universities becoming increasingly reliant on private sector funding?

Professor HESKETH: If, by that, you mean student fees—

CHAIR: No. I am not going to open the Committee up to that. I am just referring to simply private sector funding with respect to ascertaining to what extent there is intervention by business in funding research and its impact on overall university funding.

Professor HESKETH: It is certainly helpful. It is useful. We could do with a lot more of it. But I would not say at this stage that it is distorting. It is not distorting research in any way. Where it does occur, there are fairly careful protocols in place that ensure that the university maintains its integrity in terms of the way in which it goes about its research. We are very mindful of those sorts of issues. We are increasingly dependent on it, but we could happily handle more.

CHAIR: You referred earlier to businesses sometimes approaching the Business Liaison Office. I imagine part of that relationship is that the research is not being published because it becomes commercial-in-confidence. Is that right?

Professor HESKETH: Certainly there are times when the publication is delayed while we are sort of managing the patents and the intellectual property [IP] process. It varies. Sometimes industry is very happy to have the research published. It just depends on the nature of it. But there are examples—I know of examples in the animal veterinary area where there was some wonderful research that was done that probably would have been in top journals, but it was funded by particular companies. That is all right. There was an understanding right at the outset about that being the requirement for the research.

CHAIR: Has that had an impact? How do the academics involved feel about that, if their training has been along the lines of finding research, publishing it and academic growth from that?

Professor HESKETH: It has to be negotiated with each academic. If they do not want that, they would not be forced to. There is still academic freedom. But very often, the academics would recognise the value. They would get access to information for research that perhaps they might never have had a chance to do if they had not engaged in that type of relationship with the industry. The issue is one for negotiation upfront before a contract is signed.

The Hon. CHRISTINE ROBERTSON: So, recognising the commercial complexities, is there an issue about that piece of scientific information not being shared?

Professor HESKETH: I think it—

The Hon. CHRISTINE ROBERTSON: I know it is a debate.

Professor HESKETH: I am sure it is a debate.

The Hon. CHRISTINE ROBERTSON: I just want to hear your view.

Professor HESKETH: My view would be one where I actually have confidence in our top researchers. They would be mindful of the sorts of things that they would not want to have held exclusively with a single company. That seems like a hypothetical answer, but I believe we actually do have to have confidence in some of the processes and structures that we have got there, and we have to have the debate out in the open so that people are aware of it.

The Hon. CHRISTINE ROBERTSON: Because the risk is that you stop having evidence based on previous evidence based on previous evidence.

Professor HESKETH: I know, yes—sure. It presents an interesting challenge and one that there needs to be a debate around.

CHAIR: Do you ever find uncertainty as to who actually owns the intellectual property—the university or the customer—or have the lines that are drawn at the beginning of the contract always been sufficiently clear?

Professor HESKETH: I could not answer for every single contract that has been through the Business Liaison Office, but I would think that—or my sense is that the large majority of them pretty well have an understanding or an agreement. But these issues are really complex and there will always be some debate, discussion and negotiation around the edges. Certainly in the time that I have been there, I have not personally been involved in any major misunderstandings. There are mechanisms—the university has mechanisms, as most universities would have, that actually allow for discussions surrounding any debates about intellectual property.

The Hon. PATRICIA FORSYTHE: In your submission, you referred to the Federal Government funding policies and the need for a clear mechanism by the State Government in mounting bids for major research initiatives. Do you have a model that you are thinking of when you refer to that?

Professor HESKETH: I think if we can get our relationships right all along, then we will respond quickly when the opportunities come. A forum for fairly regular meetings between the key players in the State and the significant university research players would be one way where there is a better understanding of each other, a better understanding of strengths, issues and what they have to offer, so that when the Commonwealth comes out with a funding opportunity and there is a six-week delay, you do not spend half the time trying to establish the relationships to decide whether you can actually put in a partnered application. That is the sort of approach we need, I think. A lot of energy has been wasted over the past four years trying to get those sorts of relationships up. Maybe "wasted" is the wrong word, but we perhaps were not as quick footed as we could have been, and I hope we will be really quick footed for the next round.

The Hon. PATRICIA FORSYTHE: In your submission, you also referred to the fact that the State should be in a position to actively support initiatives such as CRCs, centres of excellence and major national research facilities. Is there a suggestion in your submission that the State is not doing all that it could do to actively support such initiatives?

Professor HESKETH: I believe we got there in the end, but certainly the areas where we were successful were because we had State support. The NANO MNRF is a classic example. I think there are some areas where we were not successful. I am not saying that we did not have State support, but it was less well organised and integrated. So, yes, I think we can do better. That is not a criticism of the State; it is a criticism of the university-State relationships.

The Hon. MELINDA PAVEY: Professor Wainwright mentioned earlier that his institution lost a lot of eminent scientists to Queensland through its infrastructure and enhanced facilities. Has the University Sydney lost any of its top people to Queensland through that State's aggressive attitude to improving its own facilities?

Professor HESKETH: I am not sure whether it was the Queensland State Government, but certainly there have been fairly aggressive policies from the University of Queensland. About three or four years ago they used to watch to see when we promoted someone to associate professor and promptly offer them a professorship, but I suppose that is just part of the whole natural argy-bargy that you do get in universities.

I have to say, though, that the bioscience initiative that occurred in Queensland has made it fairly difficult for us to compete. I think we can catch up and take over very easily, although we are not into competing specifically. I believe that we have more strength and depth of research and

opportunity across the agricultural sector. We have two really top-class research-intensive universities in one city, which is unusual. Some real strengths are emerging in other universities. We should be doing more than we are to capitalise on all that.

CHAIR: What role do you see BioFirst playing?

Professor HESKETH: I believe that BioFirst assisted, for example, with NANO. I think the BioFirst awards are useful. They might need to be a little more flexible and a little bigger to help us to attract people back. I will float an idea. This year we piloted an ex-patriot return fellowship, which was partly funded by the New South Wales Government through the Department of Education and Training, the Commonwealth Scientific and Industrial Research Organisation and the University of Sydney. Our plan was to bring back young Australians, not for a whole year because many of these people have jobs overseas and they do not want to come back permanently, but they do not want to lose contact with Australia. So we put up this program where we bring them back for two to three months over the northern summer period when they do not get paid anyway in a lot of institutions.

With minimal advertising we put that out before Christmas. I was absolutely inundated with wonderful applications in all sorts of areas, not just from people in research but also from some industry people. It made me realise that there is an incredible resource. Australian ex-patriots who are scattered throughout the rest of the world in top jobs actually quite like coming back to Australia. We have not got a mechanism for locking them in. Potentially, some BioFirst awards in that area could bring back these young Australians for two to three months. That would be terrific. We have two successful Australians. One who is in chemistry is working with Max Crossley's molecular electronics group. In 10 years time, watch that space, as that will be what is being commercialised. They do wonderful work. The other Australian is a person who will help SUSI, which is the Sydney University Stellar Interferometer at Narrabri.

We were a little worried because the person who started that is about to retire. This ex-patriot who has come back runs an equivalent facility in the United States and he will now help to ensure that we can keep maintaining that as a research facility through his links with the United States. That occurred as a result of a really minimalist pilot project that we put forward. I think there are enormous gains to be had from that. We tried to persuade the Commonwealth Government to take this up. I would not be surprised if there were room for some targeted areas, perhaps through BioFirst.

CHAIR: What opportunities does BioFirst provide in assisting with commercialisation of relevant research discoveries?

Professor HESKETH: I have to be a little careful about the specifics of this. I believe that it has provided assistance. Medsaic, which is an example of one of our companies that came out of Richard Christopherson's work in molecular and microbial biosciences and which is now located at the Australian Technology Park, received some assistance from BioFirst. But I would have to get the details on that. So there have been good examples of where BioFirst has provided assistance.

Mr IAN COHEN: We have heard much about the brain drain out of Australia. I was listening earlier to your optimistic views about eminent Australians wanting to come back to work in Australia. How can you hope to compete against the financial and commercial clout of big American universities that do so much in areas such as Silicon Valley? An immense number of talented young Australian scientists are working both in the private sector and also at universities, which are very much intertwined.

Professor HESKETH: I agree with you. Bringing back these young Australians, the federation fellowships, was an excellent initiative. Unfortunately, many of them do not want to come back full time. They would rather come back for two to three months and then go back to where there is more money, more opportunity and more access to research-type facilities. But even doing just that provides us with the link to those large international facilities, which will help our whole area of research. There is a good case in point in the micro-fabrication of the photonics field where we have Cudos, a centre in Sydney that has been funded by the Australian Research Council. It will need access to some facilities that I am not sure we will be able to provide. In some areas we will, but the cost of providing them will be enormous.

Singapore already has those facilities. Maybe we have to find some way of working collaboratively with a couple of the other countries for the really big-ticket items. To do that we have to have enough credibility ourselves. We have to maintain sufficient instrumentation and infrastructure here so that we do not just look like a Third World country and only go over to the international areas. I am optimistic because there is a degree of innovativeness that I think comes out of our approach. If we are clever with it we can get into some of the niche areas. But increasingly with some of the sciences and technology it is really the big-ticket items that will make the difference. So we will need to collaborate with some countries and with the other States.

CHAIR: Do you believe that the focus of BioFirst is an appropriate concentration of resources? Science covers a broad range but I refer to that specific focus on biotechnology.

Professor HESKETH: It all depends on how you define biotechnology. When a pot of money is associated with it, it is amazing how people manage to define what they are doing as biotechnology. That is okay. I have had the photonics people now recognise that they have to move into biotechnology, and they are right. There is scope for them to do that. As I think I have indicated, I believe we need to broaden the emphasis from just the medical so that we can also look at the animal, the plant and the agricultural applications.

CHAIR: Is that being done in other States?

Professor HESKETH: Queensland is probably starting to do some of that. I do not believe it has the depth of research that we have and the depth of expertise across a range of different areas. Also, one can find ways of making sure that it is not head-on competition. Scientists are quite good with that. They manage to work out how their niche is different and they shape things sufficiently differently so that the overall combined effect is good for Australia.

CHAIR: I refer to the CRCs. How successful has the CRC program been to date, particularly in the commercialisation of publicly funded research?

Professor HESKETH: I think there are some really good success stories. One of the advantages of the CRC program has been the bringing together of universities and industries, the learning that has occurred as a result of that and the environment that that has created for PhD students. There has been an opportunity to move between basic research and some of its more commercial applications. I get a little worried when I see the direction that some of them are going now where there are just so many players. They become so complex and the overheads for managing that many different players I think are unnecessary. To my way of thinking the slightly more focused CRCs with slightly fewer players have been more successful. You end up with too many different players all having slightly different IP rules. Everyone is trying to sign off on it and they are trying to satisfy themselves that they are going to get their piece, which they should if they are putting in resources—money or in kind. Big is not necessarily better when it comes to CRCs.

CHAIR: Is that principally a problem that creates difficulties when determining the direction of research, or is it also an accountability problem?

Professor HESKETH: I probably should emphasise that this is a personal view. There are very different views on CRCs. I think it is a combination. From what I have heard the plan is that the next round of CRCs will be very user driven. That may be good, but I have to admit to just a slight concern. If you have a group of users sitting on one side and your researchers are on the other, the users have these very tight deadlines. They have to produce something by a certain date, so creativity becomes a little difficult. So we may need to decide what type of research fits that model of doing it to a deadline, to a requirement and to a delivery date. But I hope that we never forgo research into that model because it is the serendipitous findings that are sometimes the ones that are really important for long-term commercialisation. Overall, I think they have been very good for Australia. We have not quite got the model right yet.

CHAIR: What could be done to ensure the long-term success of the CRC program?

Professor HESKETH: I go back to what I said earlier. Some of the difficulties for the CRCs are when industry partners have not been able to last the distance. Maybe there needs to be a safety net

arrangement. Maybe some support could be given in the interim while industry partners pull out so that you do not lose the whole momentum. Instead of having every CRC trying to invent its own structure, perhaps more guidance could be given on the structuring and the management of the CRCs. I think the association is working towards that, but it still seems to leave each CRC to go through what is an enormously long learning curve to come up with a set of arrangements that will work. So we have to be able to do that more efficiently and better.

CHAIR: Obviously there are some areas of research where there is no interest in commercialisation for the private sector. Is the university of the opinion that there are some areas of research that ought not to be commercialised?

Professor HESKETH: Some just will not be commercialised. There is no money in it.

CHAIR: As a matter of policy, I know that there has been some discussion about the patenting of DNA coding and things like that. I wondered whether the university had a position about whether some areas—whether or not there is private sector interest—should simply not be commercialised.

Professor HESKETH: I do not think the university as a whole has a specific policy on that. But the university is made up of researchers and professors. There is a strong research ethic and integrity in the researchers. I think that is where it lies at the moment. Whether there is a need for more than that to protect certain areas perhaps needs more discussion. I do worry if there is a logjam on any future development because some things are tied up in a particular company.

The Hon. CATHERINE ROBERTSON: Does it come up in ethics debates?

Professor HESKETH: Yes, with students and in discussions that are held. The issue of IP is one that gets thought about by researchers in their discussions with the Business Liaison Office.

The Hon. PATRICIA FORSYTHE: What sort of risk assessment process would the university undertake when it was deciding whether or not to commit to a CRC program?

Professor HESKETH: That is a good question. Increasingly, I think it is much more cautious about which CRCs it gets involved with. It is much more cautious about the extent of its support. Perhaps in some of the earlier CRCs there was less of an understanding of what the model was and where things were heading. But there is a lot more caution now about the extent to which support is given without the certainty of something coming back in return to the universities.

The Hon. PATRICIA FORSYTHE: Is a commercial return a key factor?

Professor HESKETH: I do not have all the facts to hand. However, I think it is a bit early to know whether the CRCs have resulted in massive commercial returns to anyone. I suspect it is a mixed bag. I do not know that that is the major driver for universities. They obviously want to invest in that, but it is more an opportunity for the researchers to participate with industry, to develop relationships. That is what certainly motivates the researchers who seek to get involved in the CRCs. Maybe that is something that should change. But mostly what is driving them is opportunities to do the research—of a commercial flavour, because that is what they become interested in.

CHAIR: What or where are the future opportunities for science and innovation, and how do you see New South Wales playing a leading role in fostering those opportunities?

Professor HESKETH: I believe you have some wonderful faculties in the universities, particularly the research-intensive universities where the engine room of the research is occurring in the basic sciences. Fortunately, they are still strong here in New South Wales. You cannot say the same about some of the basic science departments in other universities around the rest of Australia. It has been quite sad to see. Both New South Wales and Sydney still have very strong physics schools and chemistry schools, but that is not the case elsewhere. We are now seeing that those schools are really driving some of the basic research that is going to occur and have potential applications 10 to 15 years down the track. I think that is important for all of us to remember, because otherwise we will get locked into a short-term "Let's just drive all the research into commercialisation", and we will not

maintain that long-term basic intellectual infrastructure that is as important as the physical infrastructure.

CHAIR: On behalf of the Committee, I thank you for the important work you do, and particularly for your assistance today.

Professor HESKETH: If you want to pursue more specifically the issues with the Business Liaison Office, I am sure that Clare Baxter would be very happy to meet with you when she returns from overseas.

(The witness withdrew)

(Luncheon adjournment)

BRIEN HOLDEN, Chief Executive Officer, Co-operative Research Centre for Eye Research and Technology, and

DARRELL WILLIAMSON, Chief Executive Officer, Co-operative Research Centre for Smart Internet Technology, affirmed and examined:

COLIN GEORGE CHIPPERFIELD, Chief Executive Officer, Co-operative Research Centre for Welded Structures, sworn and examined:

CHAIR: If you should consider at any stage during your evidence that certain evidence or documents you may wish to present should be heard or seen in private by the Committee, the Committee will consider your request. However, the Committee or the Legislative Council itself may subsequently publish the evidence if they decide it is in the public interest to do so. I understand that you wish certain documents to be tabled.

Professor HOLDEN: Yes.

[Documents tabled]

CHAIR: Do you wish to make an opening statement question?

Professor HOLDEN: We have worked out between us that it would make sense for us not to overlap our discussion points, so we have briefly covered one each of the points raised in your terms of reference. My job is to briefly introduce the CRC program and tell you a little about its purpose and benefits. My colleague Colin Chipperfield will talk about opportunities for commercialisation, and Darrell Williamson will talk about the opportunities for interaction with the New South Wales public sector programs.

The Co-operative Research Centres Scheme was started by Ralph Slatyer and Bob Hawke back in 1989-90, and it was an attempt to try to harness the intellectual resources at our universities and the CSIRO into partnership with industry to create opportunities of social and economic benefit to Australia. The cement was to be money, and by putting a CRC grant on the table they hoped to bring together those three components and rescue all the knowledge and ideas that existed within universities and the CSIRO and attempt to bring them into commercial reality.

The industry research organisation and educational institution tripartite agreement was the core of the CRC program. I have tabled a brief summary of the comments I am making, and I am working my way through that. The Mercer-Stocker review decided that the CRC program was indeed of great benefit to Australia. It is interesting to note that America does not have such a program because the university researchers are much better funded through their agencies than in Australia.

The core of the financial arrangements was that the Government hoped that by putting some funds on the table it would be an effective multiplier in terms of resources. You will see that from the \$7 billion total that has been invested over the last 12 years about \$1.8 billion has been invested by the Commonwealth Government and the rest is invested by various organisations, including universities, the CSIRO and industry participants. In the case of my own CRC, our \$17.5 million of Commonwealth Government support ended up with \$165 million worth of resources being poured into our programs.

The aim of this exercise was to give both a multiplier effect and also to give some substance. In my own case, I ran a group at the University of New South Wales called the Cornea and Contact Lens Research Unit, and for 20 years we did research for a pittance for all sorts of organisations. We invented a contact lens that subsequently sold \$1 billion worth of product, and I think we received a grant of \$20,000 for it back in the 1970s. This gave us an opportunity to step up to big companies like Johnson & Johnson and CIBA Vision and say, "We have \$1 million worth of government funding; why don't you go into partnership with us?" In fact, that strength of having the dollar to invest in partnership with industry has made an enormous difference. Two of our products on the market at the present time, and the royalties from those two products flowing back to Australia, will be about \$500 million.

The enhancement of industry outcomes is also very much dependent upon the fact that industry gets involved at the start. It is not as though we are off doing something that is never going to see the light of day. Improvements in key benefits to the Government in terms of market-driven research and directed to national priorities and so forth are fairly obvious. New products and technology transfer are very important parts of the benefits of the CRC program.

It also changes the attitude and philosophy and in fact the jobs of many researchers who get involved. In the old days, nobody left the sinecure of a CSIRO job, or even a university job, because they were there for life and that was it. Many of my colleagues have now gone off into start-ups, they are involved in start-ups, and it has changed the way people think.

With regard to New South Wales, in my experience there has not been a co-ordinated effort from the New South Wales Government to understand the power and to have a strategic plan for CRCs. There is a one-sheet summary on the table which clearly shows that New South Wales is slipping behind quite substantially in competition with Victoria and Queensland, if one gets parochial about such matters—and I am sure that is one thing that we do in New South Wales from time to time.

If you look at the layout of these various sectors it is also clear that there is an opportunity for the State of New South Wales to try to plan for the types of activities it wants to encourage in the CRC program in this State. For example, in manufacturing technology there are seven CRCs in Victoria and only one in New South Wales, Colin Chipperfield's CRC. If you turn over the page you will see that in terms of the last round and the overall balance of CRCs, New South Wales has 24 per cent of the CRCs, versus one-third of Australia's population, and in the last round Queensland had \$140 million worth of grants in its new and continuing CRCs, compared to New South Wales \$98 million.

My colleagues will suggest to you some mechanisms for New South Wales to take a more co-ordinated approach, and perhaps a more strategic approach, to developing the CRC program which we think should be of great benefit. This is not to say that New South Wales individual departments have not been interested from time to time. My own CRC got a \$2.3 million grant from the State Government to start it off in 1990, so we appreciate those isolated efforts. However, as far as I know there is no strategic effort to harness this program. Colin Chipperfield will now talk about the opportunities for commercialisation.

Dr CHIPPERFIELD: As Brien said, I represent the one and only manufacturing sector CRC that is head-officed in New South Wales; in fact, we are head-officed in Wollongong. The important point I wish to make to re-emphasise Brien's point is that if one looks at the needs of New South Wales as a State and a community, would one actually choose that portfolio and spread of co-operative research centres.

I think quite clearly one would not. The question then is: How does the New South Wales Government, in association with research providers and industry, organise itself to match the vision of the portfolio of the State. That is what I would encourage as a key improvement for what we are collectively doing at the moment.

In terms of the second dot point in the terms of reference for the Committee, section 2 of this bound report brings together a few comments and reflections. I will relate primarily to section 2.1 where a key strength that has already been mentioned is that the CRC program attempts to bring together—and it is our role to bring together the best of academic and research capability with industry needs. Each of us operates in that nether region to force, cajole or encourage the meeting of those two partners.

Therefore, it is important firstly that that happens and, secondly, from the commercialisation point of view, it is important that it happens early in the research process. I have seen far too often in my early history developments that are very good developments, borne out of very good research, and then we went in search of a commercialisation partner. Inevitably, it does not work well that way and it is a lot harder to actually achieve. The secret is the early involvement of industry and on some occasions it will be an embryonic industry, but it is important that they have a role to play in helping the researchers understand all the practicalities of commercialisation.

In terms of involvement of SMEs, which is a key issue, and many of us are still attempting to improve the engagement of SMEs, in many cases SMEs, particularly those at the smaller end of the SME scale, believe that they have difficulty in staying afloat, let alone looking over the fence at what the business might be doing tomorrow. The challenge is to try to engage those organisations. In terms of my particular CRC, we have found a couple of strategies very useful. One is to involve industry associations and by way of my particular CRC, we have two associations, one to do with the welding industry and one to do with the pipeline industry, and together they have a membership of round about 800 companies, small, medium and large. Through their membership with the co-operative research centre we tap into the needs of those 800 companies. The CRC acts as a receptacle for their needs through these industry associations and after the research has happened, the public good outputs of those go back through the industry associations into the wider industry. We find that a very good template for involvement of SMEs in terms of their needs and in terms of dissemination of outputs.

The other key success factor that I attempt to summarise here is our success in engaging what I call medium to large companies in pre-competitive co-operative research, and I have mentioned three of our programs here. Our pipeline program involves sponsorship from 20 pipeline companies. These range in size from Duke Energy, Agility, right down to one or two main consultancy companies. We also now have the 11 power stations from a number of States collaborating. Also more recently we have seven companies from the alumina processing industry co-funding a program. What happens in these cases is that either the SMEs hear about the programs and join at a reduced fee or they are actually a supplier of services to one of the key companies, such as Epic Energy or Agility, that choose to join the program. In other words, they are attracted into the research and involved in that manner.

Mr IAN COHEN: It is a commercial relationship?

Dr CHIPPERFIELD: Yes. In terms of Brien's comment to me earlier this week, this has a parallel in terms of global supply chains. Likewise, I have provided examples of where one can bring these companies into a research collaboration process within Australia, such as the 11 power stations. Equally, it could be said that a global supply chain is equally appropriate to the engagement of local industry, medium and large, into a global supply situation. These are the points that I wanted to make on that second dot point about commercialising the results of scientific research. Over to you, Darrell.

Professor WILLIAMSON: I would like to reinforce the point that CRCs are uniquely Australian. Over the years in which I have been involved with CRCs—and I am from an academic background and I have been involved with co-operative research centres for five years—I am forever seeing people from Israel talking about the Israeli model and people from Ireland talking about the Ireland model and people from Cambridge talking about the Cambridge model and how Australia can adapt to all these models for commercialisation. The point is that we have invented our own model but we are not taking enough advantage of our own model, which is a co-operative research centre program. What we are missing is that we have to leverage in on what we have already developed. A lot of effort is required to get a co-operative research centre under way—in fact, much more than some of the overseas models. Once we have got to the stage of linking university researchers with commercial entities, the missing part is really taking the product to market and that is where CRCs really need assistance and help in getting that last final stage to market.

I strongly believe—and this is where the State Governments can leverage off the activities that are already going in the various States to maximise the benefits of the CRC because the infrastructure takes a lot of effort to get in place and that is the point from which governments can take advantage. Following earlier comments regarding the various sectors, it is strategic for the States to ascertain the areas they wish to emphasise across the various industry sectors. Different States will have priorities across various sectors but in the case of New South Wales, if there is high level linkage between policy objectives of government and the sectors that the CRCs cover, and in particular the CRCs in New South Wales that live within that sector, it provides an opportunity for everyone to win, especially in that commercialisation stage.

In the third section we made some comments that relate specifically to opportunities for New South Wales public sector programs. The Commonwealth Government leverages off universities and industry. In the same way the Government and government agencies can take it to the next stage and also work with CRCs to make it State specific, whereas in a sense the Commonwealth is making it

Australia specific. In areas of government agencies and within ICT, the area in which I come from, ICT permeates all of those agencies. Bringing together policy objectives in a strategic planning exercise involving agencies and the CRCs that exist within the State would be a very useful form for people to work out ways to co-operate. Certainly, the CRCs are moving to try to do that themselves.

It is important to have individual champions that support each CRC, and in my case I had a very strong champion in Warwick Watkins, who was head of the Office of Information Technology. Warwick was a very strong champion of my particular CRC but that was individual energy. It is unclear whether it came from a public policy program or it was his particular direction. Having an integrated approach would realise greater benefit.

Looking at domain focused form where we can co-operate actively together will, in some part, involve linkage grants and looking at the very last stages where CRCs get to the point where commercialisation is possible but often in needs a little bit of domain knowledge was support to get it to the pre-commercialisation phase. For example, in areas of public policy and health, in my CRC and other CRCs with intellectual property, having opportunities to work in a domain to demonstrate the next phase of commercialisation would be very valuable.

The other opportunities that the CRCs offer is that they are not coming to government as commercial entities trying to sell the next product, but they give a level of independence. Even though we have corporate sponsors, we have a level of independence in which we can provide sound advice to government. My particular CRC recently started a project with the Office of Best Practice and Information Management in the area of emergency services. As I said, my CRC is only a new one. Research has been going for only 18 months to two years. We now have a specific project working with government in emergency services. In that case we work with commercially in confidence material: we do not disclose State information, but we will try to extract generic issues that arise in that context that the State Government finds itself to commercialise generic solutions. That is an important opportunity that CRCs can have to help with their commercialisation.

The other area that was already mentioned was commercialisation through SMEs. Certainly, in the ICT sector that is a sector in which commercialisation will take place. Through various CRCs they help to keep research and development [R and D] activities in New South Wales. In my case the Motorola Australia Research Centre is a strong R and D laboratory in Australia; in fact, it is one of the only R and D laboratories left in Australia in the ICT space since Ericsson left Victoria. Having Motorola work closely with the CRC helps them and certainly helps us, but they will not commercialise. They will buy a product once it is produced. The two drivers in the economy will be SMEs, and we have some different programs to achieve that.

In section 3 there are various comments reported out, but I notice in the buy-out *BioFirst* program there is an opportunity, of which I will refer to, leveraging of State benefits to CRCs in which the *BioFirst* program will support particular researchers that come back to New South Wales, or they could be leveraged up with the participation of the co-operative research centre in New South Wales. You can open up that style to encourage strong research to come back and build up on what is already here. Likewise in the *BioFirst* program having early career rewards and also some for senior researchers would give a balance to the R and D strains within the State.

Earlier I mentioned linkage grants, and that is crucial to go to the next stage for commercialisation. Where possible, infrastructure grants that relate to agencies should not exclude ARC. It is strange, going to the Commonwealth arena in which, in some cases, people who apply for IRC grants cannot get support for co-operative research centres. The argument seems to be trying to stop double dipping, rather than trying to stop a solution being achieved. I know the Commonwealth is now working on that. Another example that is crazy when you think about it is pre-seed funding. The new funding was explicitly excluded from being used with co-operative research centres. Here is a program where the Government has invested millions of dollars into commercialisation then excluded from helping that commercialisation. There are lots of examples of government trying to be fair to the extent of being stupid, if I can say as much. The key message that I would see is to look at what you have in the State, work with it and try to leverage it forward.

CHAIR: Across the whole area of research in New South Wales is there a primary focus that you could point to in terms of direction of research generally in New South Wales? Is there a particular area that seems to be taking off more quickly than others?

Professor HOLDEN: It is far too fragmented to say that New South Wales has a scientific focus, which is not necessarily a bad thing. But critical mass is extremely important, and if you are looking at the whole area of biotechnology in Australia, we cannot afford 30 competing institutions, 20, 10 or even 3. There has to be some collection, some co-operation at the highest level, some decision making. I know there are talks in New South Wales about processes and so forth, but in the whole area of biosciences there has been a huge investment in the national ICT centre, which is based in New South Wales.

In my case I am a little bit out of left field because our aim is to make Australia the centre of the known civilised world in vision correction so that the 2 billion people in Asia who are short-sighted will think Sydney and the Co-operative Research Centre for Eye Research and Technology or, as its name will be changed next week, the Vision CRC. We are trying to create a position here in our new CRC, which was funded to the tune of \$32 million by the Government. About \$380 million will be invested. We have had absolutely no conversation with anyone in the State Government about anything to do with this.

As was suggested by Dr Chipperfield, we have got together with an industry association and said, okay, for 12 years we worked in the global marketplace; now we would like to bring that experience back to Australia and grow the Australian ophthalmic business. Every time we have interfaced with the State, except for our initial area, we have come across some strange attitudes about this double-dipping phenomenon. It is the refuge of the bureaucrat to cry double dipping. When you are trying to tackle an extremely broad area that requires tremendous resources, to talk about double dipping is a joke in Australia at the moment. My colleagues may be more familiar with general science.

Dr CHIPPERFIELD: This probably will not answer your question too well, but in recent times the Federal Government has at least tried to articulate the priority areas for research. These involve areas such as agriculture. I do not have them at my fingertips, but also in terms of materials, looking at nanotechnology, which are things at the very submicron level. These have been articulated by the Federal Government, and to some extent the Government funds, the IRC funds that feed through into universities and other organisations are beginning to address these priorities such that the IRC has devoted a fixed proportion of the fund—and I cannot recall the percentage—to those key areas.

Professor HOLDEN: It is 30 per cent.

Dr CHIPPERFIELD: All we have said in terms of analysing that one table to which Professor Holden referred was that the New South Wales Government would be, in our view, most appropriate in trying to articulate its own priorities, given its own business. I am not quite sure how it would come out, but I am absolutely sure that on a proportionate basis, say 1/16 of our business is in manufacturing and, therefore, there is some work to go there. Quite clearly, the State as a whole has some strengths, particularly in the medical field and some areas of the IT field, but whether that matches up exactly with where the State ought to be in terms of funding, which was suggested to you, there is not a very good way there. I am sorry, that does not exactly answer your question but strategically there is some way to go.

Mr IAN COHEN: Professor Holden commendably said that he wants to make Australia the centre of ophthalmic research and suchlike. Do you put that down to the structure in Australia, our geography as to where we are situated with such a huge demand? What is the secret?

Professor HOLDEN: The driving force is that Asia is on our doorstep, which means an incredible number of people who need vision correction for myopia. The other thing that has a lot of ramifications for priorities is that the population is ageing rapidly and everybody needs reading glasses. Our population is aging at an incredible rate such that in a place like Japan two-thirds of the population will be over the age of 65 by the year 2020, which means that the vision correction business will only grow. But that is not the reason companies come to Australia. We consider that at

the present time we are the world's biggest applied research activity. The reason they come to Australia is that they are fat cats in America. Universities get National Eye Institute funding and National Institute of Health funding. The best guy in the world in short-sightedness, myopia, which is an epidemic sweeping the world, has so much money from the National Eye Institute, that he does not need money. He is working for us, with us, because he can see the possibility of his ideas being translated into products that he can test on children to see if he can prevent this massive epidemic. Here it can be translated into a reality and manufactured and marketed.

Mr IAN COHEN: Is that not a complete turnaround on what we usually see as the brain drain to the United States and a greater amount of funding coming from commercial sectors to promote pioneering technology?

Professor HOLDEN: It is a tremendous opportunity for Australia because we are hungrier than our colleagues in universities in the United States. They have a lot of money to do fundamental research. We need the CRC program to generate funds to fill the gap that is caused by the decreased funding of educational research at higher education institutions. Everybody is saying to get more money in from industry. In our case this unique Australian solution is to put some money on the table, get the researchers together, commercialise your products then plough the money back into research education and public health. That is really what we are about. The Americans do not have one significant applied eye research institute in the whole country.

The Hon. PATRICIA FORSYTHE: Is that something that is unique to your field, or would you say that the example you used of the American researcher with all his money who finds it easier to be part of the partnership here is applicable in other areas beyond the ophthalmology area?

Professor HOLDEN: Yes. Photonics in New South Wales has done a fantastic job. The industry has taken a bit of a nosedive recently, but prior to the rationalisation of that industry it was going at 100 miles an hour because the inventiveness of the people in New South Wales—Mark and his group—was matched by the interest from overseas. None of my colleagues in the United States who are professors of optometry or ophthalmology are really interested at all in the industrial applications of their research, which is quite amazing. But in other industries the industry is so used to investment that they would try to capture early ideas. What we do not have in Australia is the \$US 250 million it took to get one of our products to market. How we overcome that incubator problem is a real issue.

Professor WILLIAMSON: Again in the ICT space, Motorola research laboratories are regarded as being the most efficient, cost effective of all the Motorola research laboratories in the world because of the high quality of skills, the higher R and D output and the low cost. If you take Nortel networks working off the campus of the University of Wollongong, it now delivers solutions worldwide, which is not just developed for South-East Asia. The skill sector is there, the quality is there and our cost structure is there, but it takes something to get these going. Motorola research laboratories worked closely with the University of Wollongong and now work closely with the CRC. Again, Nortel also worked closely with the university base. That is still the strength that the Australian scene has, to get good co-operation between industry and university researchers.

Dr CHIPPERFIELD: Perhaps I could add to that from the engineering perspective. Over the past year we have started a number of research collaborations in engineering. One notable one has just taken off in the past six months. It really picks up on Darrell's point about research credibility on an international scale, cost effectiveness and issues such as that. We are now involved in a project with a similar organisation in the United States of America plus Cranfield University in the United Kingdom, so we have a tri-continental co-operative research project across three continents plus five industry sponsors, including BP, a Korean steel company, a European pipemaking company and TransCanada in Canada. In other words, it has built up from the beginnings of a CRC to now we have true international collaboration and true international sponsorship. These things happen with the sort of attributes that Darrell has referred to.

Professor HOLDEN: I know it is on the record but a few years ago I got the Vice-President of Novartis Life Sciences, which is \$36 billion company, to come out to Australia because he was very impressed with the work that we and other people had done in Australia. He wanted to know what breaks there were for setting up industry in Australia. I took him to Canberra, and it was

embarrassing. The Minister fell asleep during the discussion about this science. The people from the department said we do not really need to have the incentive that they need in Ireland because we have Sydney Harbour and you can look out the window and it is a beautiful place to live. There was no co-ordinated, impressive package to encourage these people to come to Australia. This guy continues to invest. He just invested another \$70 million in research money with us, but there needs to be a plan. I think the Department of State Development has the most beautiful offices in the world. I was up there giving a talk recently, and it is fantastic, but where is the sales pitch that CRCs are now leveraging? We have 71 CRCs. They spun off hundreds of companies. We have connections with all the major industries around the world. We should be out there flogging off the potential for Australia as the regional headquarters for Asia. I am just working with the people from Ciba Vision to try to get Sydney to be the regional headquarters for the whole of Asian operations instead of Singapore, but there is nothing I can access from the State Government to help me in that task in terms of incentives.

The Hon. PATRICIA FORSYTHE: Does that incentive come down to money?

Professor HOLDEN: Not always. A lot of it has to do with philosophy, selling the benefits of Australia. We have pretty good infrastructure almost everywhere. We have a relatively stable government, and all those other good things that Australia has.

The Hon. PATRICIA FORSYTHE: Queensland?

Professor HOLDEN: It is that, and it is also the connections that you can feed into the New South Wales or the Australian Government and get them involved with those people in a way that will convince them to make sense.

The Hon. PATRICIA FORSYTHE: So you are saying now a better co-ordinated approach by State and Federal governments when these people come here?

Professor HOLDEN: There has never been a State meeting of CRCs. There are three chief executive officers [CEOs] of CRCs here. There are 71 of them. I have been to hundreds of meetings in my life. The best meeting of the year is when these 71 guys get into a room and start talking about how they can change the face of Australia, change the face of their industry. We do not have a forum. We are not making use of that brainpower.

Mr IAN COHEN: I suppose it is indicative of committees at parliamentary level. It goes to a process and ends up in a black hole. The first committee I was on, this committee in 1995—I am probably the oldest one on the committee, the rest have gone on to bigger and better things—was on the attractiveness of New South Wales as regional headquarters. That is on the record. It might be interesting to look at that. That was in 1995.

Professor HOLDEN: Someone should give me a package that I could give to this guy and say this is way you should be in Sydney. We had the woman in charge of the global program in this vision correction company here last week for a bunch of meetings. I do not have any stuff to say this is why it should be Sydney. We obviously have good red wine and can go to an aria and show her the Harbour and do all that good stuff but it needs to be more solid than that. We actually put in our contracts that before they manufacture products that we co-invent they have to give us a letter saying why they do not manufacture them in Australia. It is a thing they have to go through but we should also ask why they do not have their regional headquarters in Sydney, because along with that comes all the focus and attention.

CHAIR: Dr Chipperfield, if I can pick out on a point you made earlier when you were talking about trying to get the mix right between the quantum of resources and the quantum of output of research in particular areas. You have all spoken about promotion of innovation in a whole range of areas. The way things are currently set up the New South Wales Government is very much geared to biotechnology. I wonder whether you see that as an appropriate focus?

Dr CHIPPERFIELD: I think one has to take a portfolio approach in terms of emerging businesses and existing businesses. One has to safeguard the knitting, if you like, the key industrial base of New South Wales. One has to look after that in a portfolio approach, but one also has obviously to seek out emerging businesses such as nanotechnology and biotechnology. It is a bit of a

mixture. One cannot invest all one's money in blue *skies*. One has to ensure—and this is my plea—that we look after the knitting as well as the blue sky emerging industries. I do not mean this as a criticism in any way. I just share with you my vision that somehow one has to get to the position similar to the ARC where you say 30 per cent of money is going to go in this direction and 70 per cent in that. It is pretty arbitrary but at least people know that one is looking after the knitting as well as looking for the opportunities for new businesses.

How does one look after the existing portfolios? I think it is a matter of announcing the sort of portfolios the Government and all stakeholders, like the population, are looking for to look after the existing businesses and working with the appropriate people to identify opportunities, as opposed to the current system, which I feel is a bunch of researchers turning up to Government and saying this is a good idea, will you give us some money, and getting either a yes or no on that basis. We need to improve that ad hocery.

CHAIR: Before I ask about the knitting end and just looking at the blue sky end, the focus on biotechnology, is there potential for nanotechnology being adequately served at the moment, given that very much there is a push on biotechnology? Does that mean that nanotechnology is missing out on what it ought to be getting?

Dr CHIPPERFIELD: I personally think it is missing out a bit, but there is a connection between the two so we could argue semantics. But I feel a bit of a push on the nanotechnology would be more appropriate.

The Hon. PATRICIA FORSYTHE: This morning, in answering a question about accountability within CRCs, one witness suggested there is an issue to do with the size of the various boards and perhaps there is a need for more external boards—that some have up to 20 board members. Can you tell us a bit about your experience regarding the structure of CRCs?

Dr CHIPPERFIELD: For my part I have 15 core partners. They all have a representative on the board plus we have a couple of independents, including the chairman, so I think we are up to 17. We as the board have said collectively this is too many, however when we come to deciding whether or not this is a useful thing to decrease we tend to take the view, and have on a couple of occasions, to keep things as they are. It is a very cohesive bunch. We do not have any arguments, we do not even have any voting. It is by consensus. One of the key reasons we have stuck with the 15 or 17 is one example I will give you as a quote. We have on my board BHP, which makes steel. They have tried until recently unsuccessfully but recently successfully to work with Agility or AGL and the pipeline companies that are on my board to use a high strength, low alloy steel that could effectively reduce the cost of pipeline construction by about 8 per cent. This dialogue has been going across my board table. Suddenly the Department of Defence, which is sitting on the other side of my board table, says, "Can we use any of this steel in the design and manufacture of a defensive vessel? If it is high strength we can actually down gauge and the boats go faster." This started a discussion. Recently we have taken that steel and put it into a defence vessel for the first time. This steel is 55 per cent higher strength than is used conventionally in naval construction. That is a bit of a longwinded answer but this interchange across my board table is quite phenomenal on occasions and it brings about the innovation that one might think did not exist.

The Hon. MELINDA PAVEY: That is your experience, but would you suggest there could be other CRCs not as effective?

Dr CHIPPERFIELD: Yes. I think some CRCs have chosen not to have any core partners represented on the board. I think Brian is tending towards one at the moment.

Professor HOLDEN: We have had a very interesting history when it comes to boards. Our first CRC did not have one. We had an executive committee that consisted of all the core researchers. That was a fantastic experience, because they were the board of the centre for six years basically and they were involved in every aspect of planning and commercialisation. Out of that background grew some very effective people who are now CEOs of lots of different things and heads of division of the CSIRO and so forth. Then the CRC program said you have to have the board. If you do not have a board you are not going to get any more money. So, we had a board. With that board we brought in

some very serious independents—one is on the board of Woolworth's and so forth. That was just right for us at that time because we needed to get an external view of what we were doing.

In the next CRC, which is starting now, we have a board of nine individuals who are not representing anybody. Some are nominated by core partners. There are five independents and four other nominees, and that will be an incorporated company limited by guarantee that has very great independence. That is difficult for the universities and the CSIRO to deal with, especially the universities, because it means they do not have control and if they are a member of a company where they do not have control through the council of the university it creates governance problems for them, so they have dropped off as core partners to supporting partner level for that reason, which is fine.

My point here is that it needs to be flexible. There is a tremendous push for incredible strictness of governance, which, in many cases, is totally inappropriate for research organisations at all levels. There is also a tremendous push for commercialisation of everything—everybody should have a commercial arm, so you have to hire an IP lawyer and another lawyer. Why do that? Why have a CRC system that is specialist in commercialisation not collaborating with an ARC special research centre—not having a relationship with fundamental National Health and Medical Research Council research simply because everybody now has to fit into the same mould.

I think our biggest problems are related to the fact that if we are trying to compete on the world stage then we need to break down the barriers between health, social organisations, industry and other departments—aged care, for example. They all have their own rules and barriers to cooperation. When you take that from State to Federal how do you make sense out of getting the best out of Australia's resources? There has been a big push in New South Wales to biosciences. I think that is fine. If the biggest push for information communications technology was in Queensland, for Australia to be competitive in those big industries we need critical mass, we need flexibility. If you try to put the same rules on everybody—there are 71 CRCs that are so different—you would lose half the effectiveness of the system.

Professor WILLIAMSON: I think the direction in the past couple of years has been towards incorporated CRC boards. My CRC was set up two years ago. We have 10 university partners, six industry partners and two governments. So we have two people who represent the industry college, two who represent University college and one representing the Government, and he is an independent. So it is a representative board, representative of the sector rather than representative of individuals. We also have the opportunity to have observers from every partner, so it works both ways. I think it is to do with personalities whether boards work or not but in my case the board works very well; we do not have a vote but I think it is felt that this strong government structure at least can overcome difficulties that may arise.

Also, incorporated people, I guess, generally believe now that an incorporated structure gives you greater opportunity to commercialise, although there are some models like when photonics started off in which there was an unincorporated management system with an incorporated commercialisation arm. So at some point you have to create a commercialisation arm. If the CRC is originally incorporated you do not have to go to that next phase.

CHAIR: What sort of tensions and uncertainties do you face over an IP board when you are going through the whole process?

Professor HOLDEN: I think it is a very serious issue. The value of our CRC is across public health and education and research and development, but in the research and development area if IP law goes out the window you do not have an asset and then the competition becomes who has got the biggest dollar to get there quickest.

CHAIR: But do you find those tensions occurring within your CRC, for example between the universities and companies? How does that play out?

Professor HOLDEN: We have taken a different approach to most CRCs, we do not have the industry involved at all in the board because Bausch and Lomb and Johnson and Johnson and CIBA Vision would not say a word in the presence of each other because they are intense competitors. So

we compartmentalise industry to projects. We sit down at the start and say okay, here is the negotiated arrangement for ownership of intellectual property in this project. That usually ends up being 50 per cent industry and 50 per cent the research partners. Those research partners will all have equity, depending on their investment. So it is all transparent, it is all automatic, and once you get over the initial contract agreement in relation to a particular project then it should be plain sailing.

If from time to time you get changes in personnel, particularly at universities, and they suddenly realise that it is not the way they thought it was, then you can get into problems, but the fact is the system operates very well as set up by the CRC program.

Professor WILLIAMSON: In fact I would say one of the key reasons why our CRC was set up as an incorporated entity was to manage industrial property. The commercial people are the ones behind the centre management to a large extent. Telstra and Motorola, Adacel—Hewlett and Packard was in the CRC at the time but it did pull out—Nortel was a core partner. But we signed up just at the point where everybody was going down. But there was a very strong emphasis on management of intellectual property. In fact the value that the commercial partners get is that everyone gets access to IP for non-commercial use free of charge. Telstra, for example, regard that as invaluable because their benchmarks are information communication and technology and research and development; they are not interested in taking that IP and commercialising it, they just want to access it and use it to see what the state of the art is.

But in turn we have a well-established process about who gets rights to commercialise on an exclusive or non-exclusive basis, and how much funding needs to go into it. So there is a full process and that is property management and CRC. However, the difficult part with the universities is that universities are like a leaky sieve; to try to manage how IP is driven in universities and making students and staff aware of what is commercialised and what is not is a difficult exercise. So we do go around—my commercialisation director goes around and gives talks. Emails do not work, you have to go around and talk to the researchers, then they understand that really it is an idea that can be patented; it is not the algorithm, it is the idea. If you give the idea away then the algorithm behind it means nothing. So it is an education process and CRCs are more difficult compared to a company because a company has all the rules and everything like that; CRCs are a little bit more difficult to manage in that way.

The Hon. MELINDA PAVEY: In respect to your comments earlier about the Department of State and Regional Development, what fundamental changes could be introduced to see a better commercialisation of products in New South Wales or to see Sydney and New South Wales as a centre for the Asia Pacific region for ophthalmology that you are looking at? How can we better do what we are supposed to be doing?

Professor HOLDEN: I think it would be unfair of me to give you a comment about the Department of State and Regional Development because I have really not had a lot to do with it other than they invited me to give a talk at one stage about how we deal with IP at our centre, and it was very enjoyable. I think the communication of what the department has and even this report here on factors influencing the relocation of regional headquarters of Australian and Overseas Corporation New South Wales, I would have no idea that this thing existed prior to coming here today. I think that is where there needs to be a CRC forum with State departments. Some person with some level of authority and influence from each department should sit down with the CRCs—there are 16 in New South Wales. The 16 chief executive officers [CEOs] need to sit down with the Department of State and Regional Development and the other departments and say, "Okay, here is what we are about, here are our issues, what can you guys help us with, or how can we help you guys do your jobs?"

There is a tremendous wealth of research education and infrastructure knowledge in these CRCs; they have been funded primarily by industry, the participants and by the Commonwealth Government. There is a terrific opportunity, but at some level the communication has to be raised; so we bring up our issues and work out how those guys can help us.

The Hon. PATRICIA FORSYTHE: Is there such a model in one of the other States because certainly Queensland and Victoria would seem to be accessing CRCs to a greater extent than New South Wales would be? Do you see that sort of coordination in either of those States?

Professor HOLDEN: They have been far more proactive in Queensland. They know more about what Queensland has been up to than Victoria. But they have been very active. I am not sure if the investment level has been any higher but it is the activity level in terms of "How can we help you get this across-the-board?" There has been some consultation on how you put these CRCs together and make the headquarters in Queensland and those sorts of activities. Very much more conversation.

Dr CHIPPERFIELD: Of course, for every dollar that the State puts in, whether it is Victoria or New South Wales, there is usually at least a dollar from the Federal Government that comes with it.

The Hon. CHRISTINE ROBERTSON: May I just ask, while recognising it is a very competitive field, as commercially oriented research people, do you perceive that research dollars should relate to commercial possibility?

Professor HOLDEN: My view is that we need a balance. If I am trying to solve a problem as to curing myopia for kids I need to know that I can access someone in this country or overseas who understands how the retina of the eye works or what effect reading for eight hours a day is going to have on the growth of the eye. So I need fundamental researchers who I can access. The CRC program is potentially brilliant in that you have got an outcome: we want to cure myopia. Now backtrack from there to what information do we need in order to achieve that objective? A lot of that is basic science, fundamental science knowledge that we need to access, but you do not want the CRC program paying for 90 per cent of its dollars into fundamental science because the outcome is important.

That is where it is very important to take down the barriers between the fundamental scientists who are out there in the stratosphere somewhere, and the outcome which is some child whose eyes are going to grow without myopia. All of those components are very important. In Australia we are so worried about double-dipping and overlapping and all that sort of stuff that we do not get the synergies that we could possibly get.

The Hon. CHRISTINE ROBERTSON: So the fundamental scientists can actually prove a link to the commercial application, I am just supposing, the epidemiologist that works this out?

Professor HOLDEN: Absolutely. All of those components are absolutely critical. They are all critical to a successful outcome, at least in my field. We have tied up with the best epidemiologists in New South Wales, such as Paul Mitchell out at Westmead hospital. Those guys can give us the understanding of what is happening in society.

The Hon. CHRISTINE ROBERTSON: But some epidemiologists will be asking questions that definitely are of a non-commercial nature, the opposite if anything?

Professor HOLDEN: Well, yes. We are not interested in their understanding of commercial issues, we are interested in their understanding of epidemiology. It is up to me and my colleagues to pick the bits out of their information and their brains that will solve our problems.

The Hon. CHRISTINE ROBERTSON: So is there a risk that the emphasis on commercialisation will decrease the numbers of people capable of doing that?

Professor HOLDEN: My own view is that we have not got the balance right in Australia yet. I think the amount of money that goes into National Health and Medical Research Council [NHMRC] and Australian Research Council [ARC] and other fundamental programs is not balanced by our ability to commercialise our outcomes well enough yet. But I think this CRC program when added to the portfolio of expenditure on the balance between fundamental and outcomes has made a big difference. At the universities in the old days if you wanted to get promoted you did not mention anything practical like a spectacle or a contact lens, you probably would get fired for mentioning something sensible or pragmatic like that. But these days there is a greater appreciation that commercialisation is important for the country. We cannot afford to become Philistines focusing only on commercial outcomes because we will never have the answer to fundamental questions that we need.

Dr CHIPPERFIELD: That is one of the advantages in the sort of programs that I indicated earlier, namely involving 20 sponsoring companies from the pipeline industry in research. In making the connection there are research students involved in that program and, believe me, as a result of that sort of work and that involvement, those researchers are not only doing more industrial focused research but they are very cluey about commercialisation because they have got an industry person looking over their shoulder and trying to educate them in the commercialisation or the usefulness of what is going on. So I think it is an educational thing too that I am seeing greatly benefits the research students working in our field.

CHAIR: I cannot begin to tell you how helpful that has been. You may well find that we want to make contact again during the course of the inquiry. Thank you very much for your assistance today. On behalf of the committee thank you for what you have done this afternoon and also for the work that you do every day.

JAMES AUSTIN PIPER, Deputy Vice-Chancellor (Research), Macquarie University, 6/22 Karrabee Avenue, Gladesville, and

IAIN GUY ROTHWELL, Director, Office of Business Development, Managing Director, Macquarie Research Ltd, 90 Railway Avenue, Stanmore, affirmed and examined:

CHAIR: In what official capacity are you appearing before the Committee—as a private individual, or as a representative of an organisation or business?

Professor PIPER: As a representative of Macquarie University.

Mr ROTHWELL: As a representative of Macquarie University.

CHAIR: If you consider at any stage during the evidence that certain evidence or documents you may wish to present should be heard or seen in private by the Committee, the Committee will consider your request. However the Committee or the Legislative Council itself may subsequently publish the evidence, if they decide that it is in the public interest to do so. I offer either of you the opportunity, if you wish, to make an opening statement.

Professor PIPER: We have a document which is a briefing paper or overview, as you might like to call it, on a general approach to collaborative research, intellectual property, commercialisation and so on. If you refer to the document, I will take you briefly through it. It is effectively a briefing on the approach by the Macquarie University to issues of how we are seeking to build the outcomes of our research in terms of benefit to the community—local, State and national—and our approaches towards collaboration, contractual arrangements, our approaches to intellectual property and our approaches to commercialisation.

CHAIR: Do you wish to count this as a submission?

Professor PIPER: Yes, I think so. Effectively, it is a briefing paper.

CHAIR: It is so received.

Professor PIPER: I took it that, as part of items one and two of your terms of reference, you would appropriately cover those issues. The first page is a brief introduction focusing on issues of science and commercialisation. I should say at the start that Macquarie University's profile is primarily towards basic research because we do not have a large engineering faculty, we do not have medicine, we do not have agriculture, pharmacy and a variety of those areas. Macquarie's basic research is very strong and in terms of the normal indicators of national grants, Macquarie does extremely well. In fact, of all of the Australian universities, we have the highest fraction of our income from national competitive grants. That is both a plus and minus: It shows that we are actually extremely competitive in the arena on the one hand, and on the other hand that we would like to be able to expand our base of research more in applied research and experimental development.

As a consequence of our profile in basic research we are more towards strategic, fundamental, basic research and less towards applied research. In terms of funding for research at Macquarie, around about 90 per cent of the funding goes to science and technology and the remaining 10 per cent goes to business and humanities but we do not have the very large funding generators in engineering, medicine and professional technical faculties. On the other hand, part of our guiding concepts and our active foundation is that we are strongly committed to seeing that our research outcomes are used to the benefit of the community. We have a strong commitment to seeing our research outcomes out there, to have strong intellectual policy structures, and to build on those commercialisation processes. Mr Rothwell recently was appointed as the Director of the Office of Business Development, which is a new office entirely within the university.

The topics I will address are collaboration and so on and our structure in that, and I will address a little bit our commercialisation approaches which have been radically revised. Iain can speak in some detail on that, if you like. As a preface for that I should say that Macquarie has probably the most famous commercialisation in the country, that is, the commercialisation of the

wireless radio chip technology and Radiata Communications. That was a joint project with the CSIRO that was started in the early 1990s. I guess the simple most effective illustration about was that the company was established in May 1998 with capital of \$70,000. It was sold to Cisco Systems in November 2000 for \$564 million. That is a very interesting example and it has been used as one of the prototypes for major spin-offs. The situation in that case was that we had a joint project with the CSIRO. We ceded the carriage of the intellectual property to the CSIRO and ultimately the intellectual property of both the CSIRO and the Macquarie University was licensed to the start-up company which involved a couple of our professors.

We are in receipt of royalties from that, as is the CSIRO, and are following the US model—where universities do not necessarily seek to get the maximum return for intellectual property immediately but later on down the track when strong industries have been founded you get wealthy philanthropists funding universities under the US system. We were very fortunate that Professor Skellern gave us a cheque for \$500,000 for research and for the university in general. That is just an example. We have two or three major spin-offs like that, but they all have their individual characteristics and so on. We have been working very much towards having a highly standardised approach towards commercialisation, and that is embodied in this document.

Industry collaboration and partnerships are two issues that are mentioned in the document. One relates to our approach to increasing collaboration between university researchers and the local Australian community through levered grants, both external national grants and internal national grants. Our activity in that area has approximately doubled over the past two years. We have some extremely good schemes. If an academic staff member has received an expression of interest from a local company that is prepared to put some dollars into a project, we will match those dollars up to \$50,000 with a turnaround of about three weeks. That is a rapidly growing scheme. We also participate in national schemes. However, those schemes have some problems because they have long turnaround times on decisions and they require long-term commitments.

Some companies cannot wait up to a year for a decision and they will not commit for three years, and with a year's notice. We found that our quick turnaround programs are very effective. Macquarie University Research Park, which you would be familiar with, a highly successful park, has been focusing essentially on the corporate headquarters of technology intensive companies. Recently we negotiated to bring all of Nortel's Sydney operations on campus. At the moment there is a large hole in the ground about 150 metres from where the railway station will be. That is where Nortel will be locating all its activities. It will be on campus late next year. Included with that are Goodman Fielders and Siemens northern headquarters and a variety of smaller companies including Cisco Systems, which undertakes its research and development based on Radiata technology. So our strategy is to build up relationships with those companies, to develop collaborative programs and to move forward. We have had some considerable success with that.

We look forward to Nortel, a major multinational telecommunications company, coming onto campus. At the same time we actually introduced our first engineering degree at Macquarie, which will be a bachelor of engineering in telecommunications. That is our first formal engineering program. That coincides with Nortel coming on campus. So a variety of strategies are associated with our interaction with local companies, but we are also building on our park activities. In relation to IP and commercialisation, we have our own research company—Macquarie Research Ltd. Iain, as well as being Director of the Office of Business Development, is Managing Director of Macquarie Research Ltd, a company that is some 13 years old now. It turns over approximately \$12.5 million a year. Its turnover involves contract research, provision of services, including expert services and consultancy, and commercialisation. The requirement of the university is that staff members consult through Macquarie Research Ltd or have specific written permission to do that in any other form.

When Iain arrived at Macquarie and undertook a major review of the commercialisation process we felt that a variety of aspects of our commercialisation model had to be reviewed. As a result of that there has been a substantial review. The briefing paper summarises the process by which we are undertaking commercialisation now. There is an active group. In fact, Iain and I more or less came from a meeting of that group. For the first few months this year we have generated a large folder of activities, which includes intellectual property disclosures. In fact, we now have a pre-disclosure form. If people have a good idea they can disclose it. When people have a really good idea we have a formal disclosure process and a whole set of processes which are enumerated about how we take it,

make decisions about whether to go to provisional patents, and so on. At each stage there is an evaluation, a development of business plans and so on, through to quite heavy investment of full patenting and the spin-offs arranged for that.

Last year we had four spin-off companies directly out of the university. That was in an interim phase when we had taken that responsibility out of Macquarie Research Ltd and we were doing it in an interim phase through the university. Now, after Iain's review, we have an integrated approach with the university owning the IP but a lot of the commercialisation process being handled by Macquarie Research Ltd. Iain can respond to questions on that issue, which is referred to in our document. In fact we have just come from a meeting of a new spin-off that we hope will be launched before the end of the year. We received one offer from a venture capital company to inject funding into that and we are looking forward to receiving a second offer later in the week. That summarises that issue. As I said earlier, Iain can cover those areas.

Our IP policy is on the web. We have a well-established IP policy for staff, which involves them effectively assigning their IP rights to the university as part of their employment but deriving benefits from it. Equally, for students we request higher degree post-graduates to sign over their intellectual property to the university in exchange for rights. If they are uncomfortable with that they have a range of options to seek better advice, including ultimately arm's length external advice. If they so choose they may exercise the option of not signing their IP to the university, but in that case we have to have a project for them that is unlikely to generate IP for the university's needs. In the end we have to be able to control our intellectual property.

If you have worked with students you would know that who owns what becomes inseparable from all other activities. Finally, in relation to our contractual arrangements, we have two structures in the university. One is Macquarie Research Ltd. You can do contract research directly through that organisation or through the research office itself. Quite a lot of our funding for industry related research is by way of levered Federal Government money through a variety of schemes. In that situation it is a three-way arrangement between a company, the university and the Federal Government. We have requirements to meet in relation to conditions for those things. So most of those contracts are arranged through the research office. Invariably that is our standard approach for levered government research where the client is not paying full cost recovery.

We have a de facto or a start-off point in the negotiations in that the university must retain ownership of all IP. But we assign certain rights to pursue IP under commercial terms. So that is our status quo position running right through to full cost recovery, in which case the client owns the IP. Full cost recovery is typically 2.3 to 2.7 times base salary cost. That activity is expanding quite rapidly at Macquarie University as we build our interactions with local companies. We also have quite strong interaction with international companies. Recently we signed some quite substantial grant agreements with international companies. That is as good an overview as I can give you. We are more than happy to answer any questions about that.

Mr ROTHWELL: It is timely that this Committee looks at commercialisation of science in public sector organisations. I am not too sure in which order and how many universities you may have previously interviewed, so perhaps I am repeating a message that other universities have said. We are now at a point where your Federal colleagues are demanding that universities better emphasise and be much more professional in our efforts to commercialise science.

That is an interesting position for the university to find itself in because, in effect, it is funded for teaching and research but it is not actually funded to commercialise. Commercialisation is a high-risk activity; it involves a skill set that ordinarily universities do not have. The university itself is being asked for innovation to be part of its mission beyond the standard teaching and research community-type missions. There is a long lag time between the cost of engaging in this activity and actually getting a financial return. In fact, due to the high risks involved there is a likelihood that you will not ever recover the money that is invested.

There is a public good at stake here, which is the transfer of technology to the community and industry. The university, in meeting this public good, has to take upon itself an investment. As I said, this has to come, in effect, out of its teaching and research budgets; in effect, that is what it has to do. There are very few universities that generate sufficient money on an ongoing basis in this area to

fund this activity. Certainly those institutions that do so struggle to do it effectively, because you need to have the infrastructure, the funding and the systems in place irrespective of the cash flows and the royalties that you might be receiving.

At Macquarie the first thing I have attempted to do in arriving is to develop a much more proactive approach. Like most universities, Macquarie's systems were established to deliver a licensing approach to the commercialisation of science technology. The consequences of that are that a lot of the benefits of commercialisation actually bypass the institution. Again, this is one of the quandaries that the university finds itself in: to retain the benefits, you have to invest up front. That is a difficult thing; you need to have the skill base to make those decisions and judgments and there is a developmental cost.

The Federal Government has recently tried to fill some of that gap through the creation of the pre-seed funds, which I imagine the Committee would be aware of. But that source of funding only fills part of the gap; there is still an ongoing gap. Even to get an idea to a point where you put it in front of a pre-seed fund manager, you have to still invest in that. There are things like basic patent costs, often feasibility studies have to be done, and research has to be done, which is often targeted towards product development or service development and is not necessarily research that would fit within the university's ordinary portfolio of research.

To establish a really proactive approach to be able to actively manage intellectual property down a commercialisation pathway you have to have an infrastructure, you have to have access to funding, and you have to have access to a skill base. As I said, for most universities that is a challenge, given that there is no underlying funding for that sort of model. They are the key issues.

I guess Macquarie is unique. Given its relative size, it has either directly or indirectly been involved in a number of spin-off ventures, and they themselves pose an issue because once you have spun out a company you have to know what to do with it. We sit in what is often referred to as a silicon gully or the technology valley of the Sydney region in the north. The consequences of the market forces there are that it is not really a place for innovation companies to locate because primarily the market is targeted to large multinationals, large technology-based companies. So there is a real gap in the market.

One of the things that we feel is urgently necessary to assist our own spin-off companies to even commercialisation within that region is the establishment of an enterprise incubator facility that could better link the research capacity of the university with those that are the engine of innovation, which are largely small technology companies. That is where those ideas often enter the marketplace, and later on they can be acquired as Radiata was acquired. At the moment we are incubating on the university's own campus, at some considerable subsidy, three start-up companies, but it is not really a sustainable model. One of the innovations that we would like to bring to the campus is establishing our own enterprise and incubator centre.

I note that the Committee's terms of reference talks about *BioFirst* and how it relates to commercialisation. It is certainly a valuable component of the start-up company model, but essentially the benefits of it mostly come at a point at which someone else has already funded. So for us to access *BioFirst* money, generally we have to be successful through some other means, and then it is really only a relatively small portion of the total cost.

Most technology commercialisation, particularly in Macquarie's areas, relates to laser technology, medical application-type technology and biotechnology. To get viable companies in that area into the marketplace costs many millions of dollars just to get to a starting point. That is a lot of investment for someone to make. Some of it obviously comes through the university through its research and development program, but ultimately it has to come through the private sector and, as I indicated earlier, there is that pre-seed funding gap that at various times is not filled. That is all I wish to add, and I would be happy to respond to any questions.

CHAIR: With regard to *BioFirst*, you referred to one of the problems in gaining funding being the point at which the *BioFirst* money becomes available. To what extent has it been a limitation on the efforts of Macquarie that that money is only available for biotechnology?

Mr ROTHWELL: Given that the ventures for which we have sought the funding have been biotech, that in itself has not been an obstacle. It is fair to say that some of Macquarie's spin-offs in the current pipeline are biotech anyway, so in a sense that discipline focus is not necessarily seen to be a disadvantage. The key disadvantage is that you must have succeeded with an application, and sometimes you have gone a bit further than the funding allows. When you are talking about early-stage innovation and discovery, and you have an idea, taking it down an early part of the pathway, that is when the funding is actually required. Unfortunately, most of the *BioFirst* funding is not available for early-stage development.

CHAIR: At that early stage does any liaison occur between your office, or the university generally, and *BioFirst*?

Mr ROTHWELL: Absolutely, yes.

CHAIR: Even at the early stage, before the money—?

Mr ROTHWELL: We have an ongoing relationship with the Department of State and Regional Development. We know the key people there; they come out and visit us and we put forward projects as they are coming forward. I think it is fair to say that there is a fairly early-stage exchange happening.

CHAIR: With regard to the intellectual property issues, what tensions might arise between the university and industry in addressing those intellectual property concerns?

Mr ROTHWELL: Most of the industry interaction happens at the point of research collaboration, and generally that is clearly specified. I do not think we have had too many issues. The university's position generally is that it seeks to own and control the intellectual property. At times that will be in exchange for exclusivity in licensing to the industry partner. So those are pretty well worn paths that are fairly well established.

Professor PIPER: We have had one or two things fall over, particularly with some of the Government grants with small IT companies for whom the IP is their only bricks and mortar and they are very keen to have total control of the IP, which is difficult for us to reconcile. There have been one or two where we have had to say finally that we cannot concede that we will give all of our IP; there have been a few that we have had to walk away from.

Generally speaking, it has not been a huge problem, and this includes some major projects with international companies as well. We seem to have got to a point where they are reasonably happy with essentially exclusive rights for a period, and we try not to argue about terms too soon, and most companies have been quite happy about that. I thought you may ask about the tensions that arise between IP and commercialisation and the normal role of academic staff. Indeed, we have been chatting about that this morning in a particular case. That is difficult. We are very much taking the approach—and I am obviously talking about publication, because overwhelmingly most of our research funding comes from government grants, which are incredibly competitive, and of course people have to have favourable track records so there is a tension. We are trying to approach it by saying you can have both, but it is a matter of having an appropriate plan for publication and protection and they have to be done with the right timing. So it is really more a matter of planning and having an appropriate structure to get IP protection so you can publish.

We certainly have examples where we have lost things because people have published too early and so on. A good example of our level of interest and level of activity in this area is that we have usually run a six-monthly IP seminar in the university. We had one just last week. It is not a huge university; we have 750 staff. We had a little over 100 people at that IP seminar, which was a half-day seminar covering whole aspects of commercialisation, publishing strategy, and so on. So there is a high level of interest, including a growing level of interest amongst graduate students as well.

So there are natural tensions there between the sort of yardsticks on which staff are measured in order to get competitive grants on the one hand and the need to have a properly managed IP portfolio on the other. We are really approaching it by being quite up front about it and saying there is a need to plan both of those things.

CHAIR: Does Macquarie offer any incentive to the scientists involved in research, such as financial reward or the option of equity in commercial outcomes?

Mr ROTHWELL: Yes. I think it is fair to say that the use of the spin-off model as a way to capture value through the commercialisation pathway is a fairly recent event for Macquarie, as it is for a lot of universities. It is fair to say that our intellectual property policy is geared more towards a licensing arrangement, so it is quite a generous policy which says that the inventors are entitled to 50 per cent. Obviously, that does not necessarily translate logically to a spin-out venture where a lot more variables and risks are involved and obviously commitment of resources is often involved. The University's approach has been to negotiate those on an individual basis. We are trying to streamline that, to set some benchmarks as to the parameters in which we should negotiate, particularly taking into account the key variables of risk and resource requirements.

Professor PIPER: We take account of things like patents and commercialisation as part of our promotion criteria as well.

CHAIR: I imagine there is an argument that commercialisation is easier to fund when there are more short-term outcomes. To what extent does this have an impact on the university involving itself in long-term research?

Professor PIPER: I guess that has not been a major factor yet at the university, except for one thing, which is also part of the model that exercises Iain and I a lot. The sorts of models we have at the moment are spin-outs and commercialisation where the key technical players leave, which was the case with the Radiata spin-off. We had two professors of electronics leave and they took everyone who knew anything about that area. This was all on the up and up, but that was the consequence. We did some other ones last year of a similar model.

The consequence is that if you have a spin-out that takes out the key players, the danger you run, particularly with a small or middle sized university like ours is that you strip out of your academic structure your key people. These are always your top people. One of the downsides of the Radiata success was that we lost everybody who knew anything about wireless technology. That was a small department with only eight staff members and we lost one-quarter of them, plus a number of technical people and a bunch of graduate students. We had to put a lot of resources into rebuilding that department, which is now again very successful and Radiata, or Cisco as it is now called, is interested in supporting that. That is one of the consequences and a similar thing happened with a biotech one, where a couple of leading people who were the linchpins of our other major projects were no longer there for us. That is an issue.

We have been following literature from the United States that addresses this point too, particularly since often with spin-outs the key technical people are needed in the short term but not necessarily in the long term. As the business starts growing, you need production managers and so on and the technical people adopt a different role. We have taken up with the Commonwealth whether there are ways of recognising that those key technical people are not going to be required forever in the company but maybe only for two years. You do not want to lose them entirely so we have suggested structures whereby such people are essentially seconded out of the university but they then return, with all the valuable experience that they have had, so that your very success does not destroy you.

In terms of that impact, to me that is one of the most important issues. It is also recognised in the United States that you do not want to destroy your technical team. I think the models that we have been using over the past decade have tended to do that a bit and we need to restructure them somewhat.

The Hon. PATRICIA FORSYTHE: In that example, what was the outcome for the university's intellectual property?

Professor PIPER: That was complex in the case of Radiata because the IP was always jointly owned between Macquarie and CSIRO, and CSIRO had right of carriage of the IP, so we were never going to have equity in that arrangement but we had a royalty flow. With some of the other

models, as part of the spin-off in the recent ones we have licensed that IP exclusively to the spin-off company.

Mr ROTHWELL: A preferred approach is to retain ownership of the IP and licence, which essentially is the United States model. You talked about tension between IP ownership and industry. One of the key areas of tension is actually between venture capitalists funding in the marketplace and ownership of IP because they often require, as part of putting in the money, that the IP actually be transferred across in that exchange. If that is required we are increasingly trying to put performance criteria into the agreement so that if they are not met, the IP reverts back to the University.

The Hon. CHRISTINE ROBERTSON: Is the potential for commercialisation actually having an influence on the direction that the research questions are taking within the university?

Professor PIPER: That is an interesting question. I think the awareness of the potential commercialisation is growing rapidly for research. As I indicated in the IP seminar, we had more than one-eighth of our staff turn up on the day to do that. There is a mixture of both. There is longer term and shorter term, and there is a very high awareness. We had a growing number of IP disclosures over the last year. We have something like 50 pieces of intellectual property in our portfolio at the moment, and that is growing at the rate of about 20 a year, so there is a much higher awareness.

We are trying to promote that amongst graduate students too, so that our commencement programs for graduate students involve intellectual property and commercialisation issues, so that they are increasingly aware. We would actually like to get that into some of the undergraduate programs to enhance that awareness. Is it broadly changing the balance? Probably not. I think in my own area of lasers, we have a big centre with some fundamental, long-term research but we also have some shorter term research. What drives students, interestingly enough, is that they are usually pretty much curiosity-motivated in the first place. That is what drives them to do high-degree studies. I think they become progressively aware of the potential outcomes.

I gave a talk at the seminar about Radiata that it was my common experience—interestingly echoed by the venture capitalists present—that mostly scientists are driven to commercialise not because of the money but because they really want to see what they have done become useful. We all write these things in our grants: "If only we could understand this we could make it work better. If we were given a better laser we could treat these illnesses." Certainly, in the case of Radiata the two professors involved were never driven by the thought that they would make \$100 million each. It was their real desire to make this technology work, and I think that is still very much true. I think it is more an awareness increasingly that the research is largely publicly funded; there is a responsibility to try to ensure that the outcome is used by the community and that somehow you might make 100 million bucks comes a bit down the track—no-one knocks it back, of course—but mostly people are driven by the desire to have it useful.

The Hon. MELINDA PAVEY: Many of our students come from Asia. Is there any follow-up or do they return to their universities in Asia and come back with research ideas or they work with another company in Asia but realise they could do some research in Australia at their old university because of its facilities and capabilities. Are you getting an investment from Asian countries through former Asian students?

Professor PIPER: It is probably a little early to say because the huge expansion of international students at post-graduate level has worked but now one-sixth of our high-degree research students are international. Macquarie is investing a large amount in international scholarships, more than most other universities. We have a very good scholarships scheme for internationals, but that only started about three years ago so we are just starting to get the outputs of that. Our goal is to have our high-degree internationals up towards about one-third of our total.

I would say that at the moment, particularly because we have strong access of students from mainland China, Hong Kong and Singapore of course, but mainland China is a big theatre for us. Most of those students really want to stay and become post-doctoral fellows and continue to work in Australia or perhaps the United States. At this stage in terms of commercial opportunities, I guess we have not tracked that very much. We do get very strong benefits from international co-operation once students go back, and that is part of the whole mix about developing staff, so that is certainly

demonstrated. We plan to track student destinations a bit more carefully as the numbers start to grow and see if we can identify such trends.

CHAIR: Which State government departments would form the more important relationships in terms of science and commercialisation?

Mr ROTHWELL: The Office of State and Regional Development and I would say that is the major one.

CHAIR: In terms of the employment of your scientists, as a result of the drive towards commercialisation has there been a growth in the number of casual positions or people on short-term contracts as opposed to permanent employment at Macquarie University?

Professor PIPER: No, it is fairly stable. I can answer your question fairly exactly because we have just reviewed our areas of research strengths and so on. We have round about 750 staff—that is teaching research and research-only staff. There are about 120 research-only staff out of that 750, those post-doctoral fellows and so on. They are overwhelmingly in science and technology, with something like 90 per cent in science and technology. In terms of the profile, probably not a lot has changed in the recent past. The numbers have increased and for many of the research departments it is not unusual that the research-only post-doctoral people, the non-tenured people, might make up two-thirds of the staff numbers, which is quite interesting. I think that trend will continue.

You are speaking to someone who has been in applied science and of my 30 PhD students, only about three or four are in academic positions and the rest are in industry. It takes a particular type of person to set out to have an academic career these days because it is an extremely tough and competitive row to hoe. I sometimes grind my teeth a little when some of our industry partners puff about putting themselves on the line all the time. No-one puts themselves more on the line than your research academic these days.

National success rates are 20 per cent, which means every year we are taking in 150 applications, of which 30 will get up. These people have to put them in again and again. It is an extremely tough and unforgiving business at the moment to build up research. Not surprisingly many of the graduate students do not really see an academic life as one that is extremely attractive at the moment. Of course, there are those who are driven to teach and they are outstanding people, but I would say at the moment that the majority of our students are really looking to wider involvement in the community as researchers, commercialisers, working for large companies and so on.

The Hon. CHRISTINE ROBERTSON: Do you think the change to the competitive nature is because there is less resource or because there is a new world? It is very easy to lose your head, I know that.

Professor PIPER: Yes, there is less resource and it is a new world. There has been a huge change in universities over the past decade. It is acutely competitive in research. For lots of good reasons I think the money is now much more targeted to large groups and concentration, and that is not an unreasonable approach. However, it means that the old-fashioned idea of an academic who does research to inform and teach well is seriously under threat. The foreshadowed changes in the Federal Government policy suggest that inevitably it would become more and more polarised: researchers will do research and teachers are scholars who somehow do not do research. After the Nelson reforms were announced I was very interested to attend briefings and hear Commonwealth people talk overtly about researchers as people who are different from teachers and scholars using the words.

If you want a prediction, I would say that in five years, assuming that trend continues, we will have researchers who might make up only 10 per cent of academics who recover quite a lot of costs from their research projects to meet their salary components. Someone else will do the teaching and we will have this class of teacher-scholar people who do not really do research as we call it, new knowledge, but who keep up with other people's new knowledge. I do not believe that is a good thing, but because of the constriction of funding and the need to concentrate, which is a good thing, and the need to network better, which is an extremely good thing, because Australians have tended to do it our way whereas often you have a better collaborative tie with the Oxford University or something like

that rather than down the road at the University of New South Wales or whatever. We need to consolidate. We are seeing an increasing polarisation between researchers and non-researchers.

The Hon. CHRISTINE ROBERTSON: Who do you think will end up doing the particularly unpopular research?

Professor PIPER: That is an interesting question. It will be increasingly hard for your average academic to pursue research in that really active way, and that is worrying. Apart from anything else, the mythology that great researchers are lousy teachers is not true in my experience. However, the exception illustrates the rule. In general the things that make people good researchers—they are good leaders, good motivators, good organisers because they have to be, they know how to make a pitch and all those sorts of things—are the very things that make them also good teachers. That concerns me as well. It is a slippery slope. It has been tried before—splitting these things then realising it is a disaster and putting them back together again. The question about what type of research is done is a very good one. Who does the long-term, maybe politically unpopular, research? Motherhood in ancient Rome springs to mind.

The Hon. MELINDA PAVEY: I am interested in understanding your relationship with Nortel. It sounds like an extremely exciting development. Was there any active role participation by the Department of State and Regional Development in bringing this partnership to fruition? Five years ago the share price of Nortel was \$80 dollars and it is now down to \$8 or \$9. Did their economics force them into a situation where they needed to think outside the square to do some R and D, and they came to you because they could not afford it themselves?

Professor PIPER: This was done over a time when telecoms had been really hurting. Was State and Regional Development involved in those negotiations? The answer is no. It is an arrangement that involves four parties: Nortel as the tenant who will be in the building under a six-year deal with some ongoing replacement; a funding agreement; the developer, Balderstone Hornibrook; and the university as the owner of the land. When you get companies on campus collocation is not enough, you have to be much more involved than that. It is a purpose-made building. I was involved in negotiations for two years up until now, and we have teams of people who are matched within the university and Nortel to try to establish connections, and potentially teaching and/or research collaboration right from now, including the relocation of all Nortel's training facilities on to the university not only for the country but, potentially, aspects of South-East Asia as well. It will be an exciting challenge.

CHAIR: What do you see as the future opportunities for science and innovation, and how can New South Wales play a leading role in fostering these opportunities?

Professor PIPER: Let me talk about our university. We are very strong in the basic sciences. We have done very well in aspects of biotechnology, communications, optics, lasers and these types of things. We see opportunities in those areas. We have a variety of opportunities presenting. Interestingly enough, many of the opportunities for physical things end up being the biomedical. For example, all of you would probably remember that great cryptosporidium scare of a couple of years ago. That was generated by us. It is a wonderful example of scientific triumph and management disaster. It was the result of the development of a new test, which was a combination of optoelectronics and biotech immunology. It started from a long-term collaboration of more than five years between my group, which is lasers and optics, and the molecular biology people. We had been funded by the AWT, the commercial arm of the Water Board, to develop this test.

We finally cracked it and it turned a three-day test into a two-hour test. That was the scientific triumph. The management disaster is that AWT, which had been funding it, had never figured out what would happen if it worked and it did not have any management strategy. We all know what happened to that. The corollary, of course, is that while at the time there were great accusations of dead foxes and all this sort of stuff, the reality was that it had been as dry as a chip for three months, it commenced to rain in good time for the public holidays at Easter, it did not stop raining for about 12 weeks and Warragamba Dam filled up. We have a lot of ongoing research now. We just got a major project with the Water Board relating to kangaroos in the catchment area. Where there is lots of rain the kangaroos move up into the tops and when it is as dry as a chip they move

down to the dam. As the water recedes there is a foot of kangaroo crap around it. Then it rained, and it all came up.

Kangaroos are very susceptible to cryptosporidium. It is actually a rather beautiful story—I am getting to a point—that involves really hard-edged technology, optoelectronics, lasers, optics, the most modern stuff, molecular biology, immunology and so on. It is really good old ecology-type stuff, not to mention the management aspects, which just fell over, but we were not in control of it. It is a good example of where research is undoubtedly going, and that is these major problems are multifaceted and require people with a whole bunch of complementary skills. That is as good and as topical an example as I can use because it involves really high-tech stuff, really leading molecular biology, ecology management, the whole thing to make something work. Instead of being a disaster it could have been a triumph. As it turned out it was not a public health disaster. Some people who swam in the EG Whitlam pool got sick.

Now down the track we have really top-class tests. We have one spin-off that came out of our laboratory, BTF, Biotechnology Frontiers, which was the New South Wales small business of the year one year after it started, that has licensed technology from us and we continue to do those developments, including some really radical developments now that would make those tests almost completely automatable and a lot cheaper. Some of the examples of what can happen are that in the three weeks of absolute panic all of the tests were done at Macquarie University at that time before the great price had been negotiated. I think it was \$1,000 a test and \$2,000 out of time. In three weeks we turned over \$950,000 worth of tests, and this is just little Sydney so the opportunities are enormous. Everybody knows that there is a huge problem around the world and it is only going to get worse. They are really big issues and the big gains will be those multidisciplinary projects that tackle really major important issues but require people from all walks of science.

Before I handover my soapbox over to Mr Rothwell, one of the key issues, which is one of the threats at the moment, is maintaining the basic disciplines in universities, things like chemistry, physics and biology. You can use the accountant's bean counter approach and say that not enough students are doing physics or chemistry, but those things are absolutely fundamental to modern technology. It is crucial that we maintain the strength of those basic disciplines in universities. Otherwise we will not get these. When I was on the ARC, the Chair would always say what a great triumph of biology the human genome project was and I would say that it was not true, that it was a triumph of optoelectronics. It was a triumph of the technology that could do all that really quickly and, subsequently, a triumph for biology and so on. Those are the opportunities that we have to capitalise on.

Mr IAN COHEN: We hear about private industry driving a lot of the research projects, and there is that debate. Here we have an example of what you are talking about. Immediately I think: why is Sydney Water not fully utilising the technology that you have described and go from research back to industry. What is holding it back?

Professor PIPER: Sydney Water is using the test.

Mr IAN COHEN: It is using the test?

Professor PIPER: Absolutely. We have one spin-off that is doing quite well that is using the technology and selling it internationally.

The Hon. MELINDA PAVEY: Sydney Water is?

Professor PIPER: Sydney Water is using the test. I am a bit rusty on its commercialisation, but we have a couple of spin-offs that we have licensed our technology to.

The Hon. CHRISTINE ROBERTSON: I think one of the laboratories has it.

Professor PIPER: Yes. But this company, BTF, is international supplier of the kits for the test, and those tests have been taken up around the world.

Mr IAN COHEN: So Australia is in quite a special position because we have so many obvious environmental constraints. Working on environmental projects like that we really are in a position to export that sort of technology, particularly to Asia.

Professor PIPER: Absolutely.

Mr ROTHWELL: The limiting factor with a lot of those environmental tests is that the marketplace is a regulatory authority. If you do not change the regulation the test may well be best practice but if a regulatory authority—for example, that test that is licensed to BTF to pick up gardia—in the United States there is a regulation on how that test is applied, and, not surprisingly, it is geared towards a US provider of that test. For us to get our test into the US market requires regulatory change in the US.

The Hon. CHRISTINE ROBERTSON: There are other issues too, like the means to comply, like the management issue. I think gradually the small towns and regional centres are introducing testing but if we had all rushed off after Sydney Water and started testing those small towns, no-one would have had any water. There are issues about management as well.

Professor PIPER: Management of technology is very important.

The Hon. CHRISTINE ROBERTSON: With the swimming pool issue I know they are doing that but it is sometimes quite bizarre.

Mr IAN COHEN: Given that the Minister for Science and Technology recommended this inquiry and he is the Minister responsible for Sydney Water makes it very interesting.

The Hon. CHRISTINE ROBERTSON: But Sydney Water is a small component of this issue, and Sydney Water is using it.

Professor PIPER: Generally, the whole issue of certification of foodstuffs, beverages and so on, is going to have a very big impact. I am talking a little bit from my own perspective here but fast on-line testing associated with foods and beverages, and so on, is going to be really important in the marketplace in the next 20 years, because we are going to end up with everything having to be certified. Your milk is going to have to be certified, and the food you eat, and pies and everything for the bacteria level and all these sorts of things.

Mr IAN COHEN: Speaking as a conservationist, it is a huge problem for the public to get access to testing like this to monitor what governments often do not want to talk about, in terms of our river systems, our water supplies. There was a lot of information about water in the papers recently. Where do we find a driver to keep technology of interest across the board and also to allow some sort of public access to it?

Professor PIPER: I think the cryptosporidium story is a great one because it has so many aspects, and there are political aspects to it as well. It was a very interesting example.

The Hon. CHRISTINE ROBERTSON: And equity aspects.

Professor PIPER: Yes.

CHAIR: Iain, you were midway through what you were saying?

Mr ROTHWELL: No. I was just emphasising the reality that you can get very good ideas that have good applications but for whatever reason, particularly in a regulated marketplace, it is difficult to get that idea out there. For example, there was a technology that some academics from university developed for a different type of water testing, to test ground water seepage. Most water testing is actually fixed station testing. This could test at any point on a map what is happening in the system, but again that will take regulatory changes in all the various catchment and water areas for it to ever apply. The system in place almost across the world is a fixed-station testing regime.

(The witnesses were excused)

(The Committee adjourned at 4.04 p.m.)