COMMONWEALTH OF AUSTRALIA

Proof Committee Hansard

HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION

Reference: Research training and workforce issues in Australian universities

WEDNESDAY, 3 SEPTEMBER 2008

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HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION

Wednesday, 3 September 2008

Members: Ms Vamvakinou *(Chair)*, Fran Bailey *(Deputy Chair)*, Mr Bidgood, Mr Champion, Mr Cheeseman, Dr Jensen, Mr Johnson, Mr Ramsey, Ms Rishworth, Mr Symon

Members in attendance: Mr Bidgood, Mr Champion, Mr Cheeseman, Dr Jensen, Mr Ramsay, Ms Rishworth, Mr Symon, Ms Vamvakinou

Terms of reference for the inquiry:

To inquire into and report on:

1. The contribution that Australian universities make to research in Australia, including:
    - The contribution of research training programs to Australia's competitiveness in the areas of science, research and innovation;
    - The effectiveness of current Commonwealth research training schemes; and
    - The adequacy of current research training schemes to support Australia's anticipated future requirements for tertiary-qualified professionals in a wide range of disciplines.

2. The challenges Australian universities face in training, recruiting and retaining high quality research graduates and staff, including, but not limited to:
    - Adequacy of training and support (including income support) available to research graduates in Australia;
    - Factors for graduates that determine pursuit of a career in research;
    - Opportunities for career advancement for research graduates and staff;
    - Factors determining pursuit of research opportunities overseas;
    - Australia's ability to compete internationally for high quality researchers; and
    - Whether Australia's academic workforce is ageing, and the impact this may have on Australia's research capacity.

WITNESSES

Committee met at 10.07 am

CHAIR (Ms Vamvakinou)—I declare open this public hearing of the inquiry into research training in Australia being conducted by the House of Representatives Standing Committee on Industry, Science and Innovation. The inquiry arises from a request to this committee by Senator the Hon. Kim Carr, the federal Minister for Innovation, Industry, Science and Research. Written submissions were called for and 105 have been received to date. The committee is now conducting a program of public hearings and inspections. This hearing is the tenth for the inquiry.

[10.08 am]

PEACOCK, Dr William James (Jim), Fellow, Commonwealth Scientific and Industrial Research Organisation

ROBERTSON, Dr Alastair, Deputy Chief Executive, Science Strategy and Investment, Commonwealth Scientific and Industrial Research Organisation

CHAIR—Do you have any comments to make on the capacity in which you appear?

Dr Peacock—I have responsibilities, among other things, for CSIRO education and science training.

CHAIR—Although the committee does not require you to give evidence under oath, I advise you that these hearings are formal proceedings of the parliament. Consequently, they want the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and now welcome you to make a brief opening statement.

Dr Robertson—CSIRO has two roles to play in this inquiry, in that (1) we are a user of scientists and researchers that come from the university and higher education sector and (2) under the Science and Industry Research Act 1949 we have a responsibility in the training of researchers and research technology. We have an interface with university in four different areas. One, obviously, is that we are dependent upon the higher education system to provide us with graduates and postgraduates. We also share some of the training responsibility in the higher education sector around postgrad, postdoc and PhD studentships.

We provide an experience for researchers that would not be easily accessible within the university sector. In other words we are an output focused organisation, and we provide that opportunity for those researchers to engage with the other sectors on the outcome and delivery sides of science. We provide opportunities to be involved in research scale and we carry out very large research programs where researchers are participants as opposed to autonomous individuals doing science projects. That often involves cross-organisational links with other scientists and, obviously, science of a multidisciplinary type nature.

As a recipient, we are looking for scientists who have a greater capacity than just academic, curiosity driven research. We are looking for scientists who are able to cross boundaries and exhibit flexibility and research leadership as they go through their careers, in terms of being able to project-manage very large delivery of science where more than one discipline might be necessary in terms of achieving that. At that stage, I will leave it to the committee to ask us more questions. Clearly, we have documented our views in our submission to this committee.

CHAIR—Thank you. Dr Peacock, do you want to add anything?

Dr Peacock—Maybe just one point, which is that we do not give PhD degrees in our own right. When PhD students work with CSIRO it is always in a partnership with a university, so the PhD student is supervised by both university lecturers and personnel and CSIRO people, even if all of the actual laboratory work is done within the CSIRO laboratory. So there is good contact maintained, and I think it serves as one of the more useful connections between universities and CSIRO.

CHAIR—I want to look at the issue you just mentioned of cross-border training for people who are involved in higher degree research. It seems that once upon a time there were very clear definitions of what research was, but obviously times have changed and research students and indeed scientists need to have other skills. We have heard that extensively from virtually everybody. I am trying to understand that a little bit better because it appears to be a significant issue. If you are going to address it, even from a government point of view, you need to actually acknowledge, I think—and I might be wrong—the fact that today research students, scientists and PhD students are in a totally different ball game altogether. Is that a fair assessment, or is it just a passing phase or cycle and we might go back to the labs and to the curiosity factors only? Can you give us an appraisal of that and how that challenge can be met? It appears to be having an impact even on the availability of people who actually choose to do research.

Dr Robertson—Going back to my own research career and looking at how I was trained, I was fortunate enough to be able do what was called in the UK a cooperative science award scheme, which was a shared research project with Shell research at the time. I had the opportunity to work six to eight months at the university and four to eight months in the research facility of Shell. I think that stands you in good stead when you are moving into an arena where science is expected to deliver increasingly into society. So it depends whether you are into knowledge generation; we obviously do get into knowledge generation within CSIRO, but it has a line of sight to the strategic function and delivery that CSIRO is engaged in in terms of its research.

Is it a passing fad? No. I think probably it is quite the opposite of that. It is obviously growing, in the sense that the tractability of the problems we have to deal with in science now is highly unlikely to be delivered by a single discipline anymore. It is quite likely now that we require cross-discipline engagement between quite disparate disciplines that even a few years ago you would not have thought of putting together. I think the advantage we have at CSIRO, as a national research organisation, is that we can draw on capability that exists as far apart as radioastronomy and the biological sciences because, say, you are into noise reduction or sensing.

There is a need for scientists to have a greater understanding of each other's areas. In fact, the dialogue between scientists is often quite vertical. We want social scientists to talk to biophysical scientists. There is often quite a difficulty in terms of the dialogue that is used and the philosophy of thinking. So we are looking for two things: the bridging of that type of gap as people go through the formal education system and also a different kind of animal that goes into science. I think that is an animal that is more gregarious and wants to investigate across boundaries into other people's areas. The wish to not work in a very linear way but to work across those boundaries is very, very important. So if you are dealing with climate and energy—the issues that we are facing globally as well as in Australia—those are the areas where we really need to have that engagement now in many, many disciplines and scientists that are able to cross over and identify quite disparate areas and research them.

CHAIR—One of the other major issues that have come up is the ongoing problem of shortage of mathematicians and scientists. Ultimately, that has been identified at a school level, where kids and young people are not interested in pursuing science and maths. All this is happening at a time when, paradoxically, the whole nature of the scientists and the research has to change. You have just outlined some of those changes, and they make me think that that kind of change is happening because of the knowledge economy and the crossover there. But at the same time there is an argument that schools need to return to a more classical, constrained and defined way of teaching, which seems to be incongruous and inconsistent with what is now expected at the other end at university and as a scientist. How do you deal with what appear to be contradictory issues—although they may not be—in terms of being able to develop a domestic capacity for higher degree research? You may wish to answer the next question I want to ask you in this answer. That is, universities are relying more and more on international students and there is an argument about us needing to be out there in the global knowledge economy; are you having the same problem at CSIRO? How is that going to be dealt with at the same time as encouraging our own kids—from a very low base of just not being interested in science and maths—to be all the things that scientists are supposed to be now?

Dr Robertson—You have asked quite a mixture of questions.

CHAIR—I know—it has become such a mixed issue.

Dr Robertson—Jim and I will share—

CHAIR—Jim and I have already had a chance to talk about this.

Dr Robertson—Well, obviously we will share this session. You have asked quite a number of questions. One is: how do you get the reputation of science more formally into schools so that children actually see it as an appropriate career to go into and one which is satisfying?

CHAIR—And see that it is not just a lab coat. That is what we are trying to do, isn't it?

Dr Robertson—That is right. So there is the whole reputation issue around science and scientists. Then there is the other issue about how you teach those formal skills, the basic first principles, and then how you move from that process into a wider cultural and philosophical thinking about how you use that skill base. I might ask Jim to say something about the early career, because we are into that now.

Dr Peacock—Until the end of last week, I was Chief Scientist in Australia. In that position, I was able to put quite a lot of focus on science in schools, in school education. One of the programs that we have running now—and it is actually run by CSIRO with the Deputy Prime Minister's department—is called Scientists in Schools. It is wonderfully successful. At the moment, we have about 800 pairings of a working scientist with a working teacher, right across Australia. The aim is to have all 10,000 schools in Australia linked with one or more of these pairs. I think it is adding a great deal by exciting children about science and showing them how they can learn by their own hands. All sorts of scientists are involved, from industry, from universities, from CSIRO, from medical research institutes and so on.

The children are obviously very motivated by interaction with a real, live scientist. They see that they are not peculiar nerds all the time. The teacher gains enormously because the scientists can bring knowledge of recent discoveries and freshen science, and it is a good way for teachers to have continuing professional development. We have found that the scientists want to go on with these partnerships. They form in many different ways. They are obviously excited by the reactions of the children, but they also then help the teacher meet certain curriculum requirements and so on. I think it is going to be one of the most important adjuncts to the more professional.

You might also remember, Chair, that the Academy of Science run Primary Connections, where we now have a science course taught through the literacy program. It is something I initiated when I was president of the academy, and that has now been adopted by all states and territories and is growing all the time. That, too, is exciting children about how to ask questions and learn to make decisions on the basis of evidence and exciting them about science, its many different forms and their role in the community, so it is the sort of thing you were emphasising.

We in CSIRO take our role in education not only at the research training level but in school science very seriously. We have a substantial program.

CHAIR—I would actually like to see CSIRO take an even higher profile in its involvement in the teaching of science at school level and a more upfront one in terms of parent communities and their awareness of the role—and perhaps even your input into the determinations of curriculum rather than just being an accessory to the curriculum. There is obvious evidence that we need to look, if not at some fundamental changes, certainly at some fundamental redirections of the science curriculum, and it should be done in a more uniform way. Do you see a role for CSIRO to be at the forefront of that? I will stop there because I know my colleagues wish to ask questions too.

Dr Peacock—It should have a definite role, because you cannot think about a science curriculum divorced from our lives and our community and how science impinges on and helps us. CSIRO scientists, as Alastair mentioned, apart from doing great science, emphasise the relevance of the science we are doing. That is actually something that I have always felt to be a privilege, working in CSIRO.

Dr JENSEN—On the issue of outreach and education with schools, I really commend the CSIRO for going into schools and into society and telling students and the society in general about science. I have a question. I had a parliamentary intern from ANU, and I asked him to examine issues relating to science and maths education, what was putting people off and so on. I think one of the profound things that he said was that, in looking at the literature now—he was a social scientist, and he was looking at literature relating to science education in schools—the literature is apparently almost completely about teaching children about science rather than teaching them science. While I commend what CSIRO is doing and I do think it is extremely important, is there a danger that we are teaching so much about it that they do not actually learn the process, and we have teachers that become fearful of teaching the difficult subject matter, and sometimes they are struggling themselves?

Dr Peacock—I would just make one comment. I have had primary school teachers write about the Primary Connections program and admit that they had been teaching, say, for 12 to 15

years and did everything they could never to teach science. Of course, they were scared. They had not been trained. They came to the academy for a professional development program, which is really only four days and then the teachers build on that remarkably and we provide materials. They said, 'But you should see us now.' It is one of the thrills I have had to see just what you are saying. So we have emphasised the learning by doing, and it means a great deal to children.

Dr JENSEN—Absolutely—natural scientists.

Dr Peacock—They write up their experiments every day, very truthfully and honestly, and they have discussions. One of the other great things, which touches a bit on what you have said, is that the teachers have told me that, apart from this renewed excitement and interest in a whole range of science and science in the community, the social aspects of working as a team together on these things have done enormous good, especially in schools where disadvantaged children are working. That has been very pleasing.

Dr Robertson—I think that, if you talk to any scientist, there will have been a point in their education when they say, 'Something triggered why I went to science.' Generally, obviously, it is an understanding of what science can do, which I think was your first point, but the second thing is actually getting your hands on the things you need to do, those experimental things. To work at the bench initially, you need to have some understanding of what you are doing, but the dexterity of what you are doing around a bench is very important too. That has to come by experience. You can teach some of that.

Obviously there are significant impediments, from the time that I was doing science in schools. There is a health and safety aspect to being able to do that. We have to be able to make sure that we can teach science safely in an environment but at the same time give the hands-on experience that is necessary at an experimental level and at the mental level of working through in a systematic way—doing an experiment, interpreting the results and writing down those results in a very systematic way. That is part of doing science. The formal aspects of doing science are very important.

Ms RISHWORTH—I will just follow on from that, because I just got to open a science block. I did not cut a ribbon; I lit a magnesium string which exploded, and then we could all walk in, so that was very exciting. But it did strike me when I was there that that school particularly had spent a lot of money on the equipment to be able to teach and so they could do the experiments. But it is all very expensive.

Dr Robertson—Absolutely.

Ms RISHWORTH—I was wondering what experience the scientists you have worked with, going out into the schools, have had—whether there was feedback that some schools have really great equipment so they feel that they can really teach, whereas in other schools they cannot, and whether or not that had been raised as a problem.

Dr Robertson—Jim has probably had more hands-on experience in Australia with that and he could give you the answer.

Dr Peacock—I think you were treated to a rare circumstance. Mostly, the infrastructure we have associated with our science laboratories is in high schools and I presume that was a high school.

Ms RISHWORTH—Yes, it was an R to 11 school.

Dr Peacock—I have been associating with the curriculum people and pointing out to them that no matter what sort of wonderful job they do with the curriculum, if it is not associated with professional development and infrastructure support it is not worth too much. There is one story which will horrify you. I cannot tell you that it is backed up by great figures, but I think it is essentially correct. Five or six years ago the amount of investment we were putting into primary schools per student per year was 50c. It is embarrassing even to think about it. So one of the difficulties we have had with our going into schools program and so on is that we have to face up to the fact that unless we take equipment there, the schools often do not have it. We are looking forward to the use of broadband and so on to help that, but it is a major problem.

Ms RISHWORTH—Thank you.

Mr CHEESEMAN—I went to a public high school that had trade wings that quite frankly had technology laboratories that were pretty run down. A lot of the curriculum was not able to be taught in that school because it was not safe to do it et cetera. What sort of capital investment do you think might be required to address that? It may not be every school but bringing clusters of schools together. I think that is a critical issue. If we are going to have properly trained people in the future, we have to be able to give them access really early on to good technology, good laboratories to be able to engender an enthusiasm for science.

Dr Robertson—I cannot answer that question. My experience of the primary and secondary school education system is not sufficiently well advanced to be able to give you that answer. I am sure the secondary system will tell you that.

Dr Peacock—I think the schools section in Minister Gillard's department would be the best place to go to for that figure.

Dr JENSEN—Another important point that you brought up was the issue of joint PhDs between CSIRO and universities. I have first-hand experience with that. I did my PhD jointly between Monash and CSIRO. There are considerable benefits not only in the fact that you have a lot of researchers in a lot of areas that you can speak to—and my PhD was fairly broadly based so a lot of areas were brought in—but also that you have access to things like equipment and so on that you do not have at universities. It facilitates doing a PhD in a three to 3½ year period. What is happening to the percentage of PhD students doing PhDs jointly between CSIRO and university? Is that percentage increasing?

I have another question which does not quite relate to this, but it is an issue of research. I remember when the requirement for getting a certain percentage of outside funding came in. I recall that an awful lot more effort was spent going about getting that outside funding and conducting the 'research' sometimes for that outside funding, and it actually reduced the effective productivity of the CSIRO. Is this something that CSIRO has managed to work its way

through effectively? Is industry now starting to pay the real dollars that they should be paying for research or is that still an issue? Sorry, they are two completely different questions.

Dr Robertson—They are two different questions, so we will take the first one first. In fact, the second one we can comment on because we made comment on that in our submission to the NIS review. The numbers I have in front of me here are for 31 May 2007. We are supervising in the region of 674 PhD students. We are not funding or co-funding all of those. We are involved with universities in that co-supervision. At the end of 31 May, we were sponsoring, either fully or partially, 256 of those PhDs. Sixty-five were full sponsorship from us, and that comes from the office of the OCE, which Jim has been responsible for.

Dr Peacock—Most of those are APAs though.

Dr Robertson—The 211 we have got here which are partial are the APAs. When we say 'partial', we tend to top up the stipend of the APA. Obviously, when they are working within CSIRO we fully fund that working environment in terms of chemicals and materials. Is that growing? It is about static at the moment, and it has been static probably for about two or three years. The question is: will it grow? I think that will depend on, obviously, the nature of the demographics—or, should I say, the ratios—of our students. We are looking very carefully at our capability at the moment to see where a PhD plays a part in the role and the activities of CSIRO, where a postdoc does and so on, and through, if you like, the talent chain through early-career, midcareer and late-career scientists. As we are working our way through that, we will certainly define where that funding goes. But, in general, if I look at the stats, our young scientists, our graduates—and this is under-25s, so this would be primarily through the PhD and postdoc system—have increased from about 1999, when they were about 12½ per cent of our total research scientist cohort, to 21 per cent now, so we are actually on the increase and continue to increase the young players in the CSIRO team.

Dr JENSEN—That is very promising.

Mr RAMSEY—I will just follow up on that. We have been asked by a number of universities, particularly the junior universities, to examine the possibility of joint enrolments. That cuts across this area where you are sharing the student or sharing the supervision of the student with the universities. Where in this situation are the RTS funding and the infrastructure block grants going to?

Dr Peacock—They go entirely to the university. It is something that needs to be looked at sometime.

CHAIR—Can you elaborate on that, now that you have mentioned it?

Dr Peacock—It varies a little bit, but mostly, if a student is working in our labs, as Alastair said, we meet all costs of the research and so on, and that is fair because there is a very positive gain for us by having PhD students and so on around. If we ask the university to help with, say, sending the student to a conference or something, then usually some funds are made available, but we do not receive any portion of the completion fund or anything like that. It is something that needs to be looked at. CSIRO is not going broke because of that, but it is something—I think anything to encourage the true partnership would be positive.

Mr RAMSEY—So it is a really good deal for the universities when their PhD students are with you.

Dr Peacock—I do not know whether we should comment on that!

Dr Robertson—You could say it is good for us and for the students—he said diplomatically!

CHAIR—But it is obviously an issue.

Mr RAMSEY—So there is not really a template here for how we handle two universities together.

Dr Robertson—Yes.

Mr RAMSEY—That is what I wanted to know.

Dr Robertson—The second point is: do we get full funding for our research? The answer would be no to that, and there are various reasons for that. It is generally about how the dollar cascades from central government down onto the bench. There are lots of costs that get associated with that and a lot of expectations of co-investment between our appropriation, if you like, and the other part of the funding. So very often that co-investment ultimately ends up not paying for the full cost of our research. That is an issue not just for us but also for the universities, which will make the same point.

Dr Peacock—Could I make a comment about your point. I was the chief of a division in that 30 per cent era. In my division it was not a problem of the type that you mention because we were very closely connected with our stakeholder industries, so we had lot of co-investment and we never had to chase that money. We found that, by doing first-class science of relevance with good communication, that money was easily recognised and came into the division. But CSIRO in part mismanaged that situation—that is true—and I think it was a definite improvement when that requirement was removed as a requirement. We still depended a lot on external funds added to the appropriation.

Mr BIDGOOD—Thank you very much for your presentation. I am basically totally in favour of your request for PhDs linking straight from schools to CSIRO and having a career path and that future job security. I think that is very important. Part of what this new government is keen about is keeping the smartest and brightest engaged and not losing them overseas. Obviously, that does require funding, and we know that, but I suppose the good thing is that there is a political will to make it happen. Where I come from, in Mackay, in Queensland, there is a very clear link of the mining resource sector with state schools—particularly, I know, Pioneer State High School, in Mackay, which I have visited. There is a very strong engagement with industry and the school. How many schools does CSIRO link directly with across the nation?

Dr Peacock—Each year we make direct contact with something like 400,000 children. I am sorry; I just cannot recall the exact number of schools, but it is about 1,000.

Mr BIDGOOD—That is fine; I will give you the question on notice, if you would like to send us the information.

Dr Peacock—We have that information, yes.

Mr BIDGOOD—That would be good. I am very keen on that, because I see the model working where I am, and I am very keen that CSIRO is engaged at that level. I would like to see a government help and facilitate that engagement, so I am on your side, basically. I want to see you do what you are looking for, basically. I think you have put a very good paper together.

Mr SYMON—I would like to go back to a couple of questions ago when we were talking about science in schools and the program you run getting scientists into schools to help teachers out and to demonstrate to students what you are talking about. Does that extend across to the people in those schools in the careers guidance section? From experience, if those people do not have laid out in front of them what the requirements are to go into that field and what the career paths and rewards are, a lot of students miss out because they are not getting that option laid out in front of them at the time. Do you have any comments on that?

Dr Peacock—We have not addressed the connection between those scientists—we have been operating for a year now—and the careers advisers, but it is beginning to happen by osmosis, if you like, and the fact that the children become aware of science not only from CSIRO and universities but from industries and so on is helping this awareness. But it is an area where we are going to develop a specific program to enhance that. What you have talked about is very important. One of the problems, I think, is that, despite best endeavours of the government and education departments, frequently the careers advisers themselves are not fully aware of the hugely increased set of opportunities in careers associated with science.

Dr Robertson—I absolutely agree with your comment. I think this is an absolutely vital link in the chain of engaging with children but also in building the reputation of science. I think we are seeing some optimism here—not just the fact that we are sitting here having this dialogue with you. There is some optimism right the way through. Firstly, the issues that we are dealing with now around society and science are becoming much more visible. Science went through probably two to three decades of a very strong economic push where people were questioning the value of science because there was a tenuous link. With issues such as climate and food security and so on it is clear that there is a very strong association between science solutions and the impact those can have in resolving some of those issues. So there is a natural interest now starting to build once again in science, and that is going through the schools but it is also going through society in general. I think we are pushing now at a much more open door than we were 10 years ago and certainly through the in-between years. Post war, science was very high in people's visibility. That was the day when CSIRO had a part of the curriculum within the Australian school system. Now we are coming back again to where science is very visible to a large part of society, whether it is medicine or climate adaptation issues.

There is the concept that scientists are introverted anoraks—even industry has a view that scientists perhaps do not form the best senior managers in industry, for instance. In Germany that would not be the case. Science and technology are very strongly linked to successful industries. In the UK, for instance, they are not. In Australia they are not strongly linked into industry success, which tends to be driven by the financial, marketing and commercial aspects of businesses as opposed to where scientists can fit in. We have a job to do to increase people's perception that science can form a very good career, a career that is well paid relative to other professions and other areas. It is not at the moment. The jobs that Jim and I are very lucky to

have are few and far between in any innovation system. So the majority of scientists are not well paid relative to their equivalents in other professions.

Mr SYMON—Moving further up that education chain, I noticed in your submission that you have called for reduced uni fees and increased access to scholarships in areas where there are skills shortages. Obviously, if there is not a big enough pool there of candidates to put through, you are going to be constrained in that. I note that seems to be throughout your paper. What are your specific ideas on increased net pool gain? What type of fee help at university or what could be done with scholarships to make that pool bigger? Getting back to pay levels is one of those reasons.

Dr Robertson—We can take this at different levels, I guess. If you are thinking about kids going from secondary school into tertiary education, there is obviously one opportunity there. The thing about those core skills that we are short of right now is that they are based on the basic disciplines of maths, physics, chemistry and biology. Those are disciplines which are difficult, they are hard to do and you require obviously the brightest and the best to go into them. Out of that come some of the skilled people like hydrologists, molecular biologists and so on. We are short of those because they are based on those basic disciplines.

Mr SYMON—Decreasing pool.

Dr Robertson—Absolutely. The other thing about science training of course is that it tends to be relatively long compared with other types of skill based education. If you want to get to the PhD level you are talking of a minimum of six years and probably more. So the question is: how can you help people get through that process and make it less expensive for them? Scholarships and grants may make it easier for people going into science studies, as would have some kind of subsidisation for their education. That would be a way that might just promote science to those people who are thinking about alternatives.

Dr Peacock—I would like to add one story related to your question on careers. One of the Scientists in Schools program schools is in Esperance, Western Australia. The teacher there, in the primary school, and her students have been quite remarkable. They have paired up with climate change scientists here in Canberra and that distant pairing works wonderfully. I will not go through all the things that they have done but one is that they started a program called Science in Our Community. I went over to launch it a few months ago and 150 professionals from the 15,000 population of Esperance signed up with the schools indicating they were willing to come to talk to students about the way they use science and technology in their jobs. A tremendous range of people were able to go to talk to the 22 schools of that district. And they invited the students back to their workplaces. I would like to think we are going to see much more of that in Australia.

Mr CHAMPION—My question is related to careers advice. I have this view that most careers advice in schools is pretty poor because the people giving it do not have much knowledge or experience in the private sector. Do you think we would be better off funding organisations like the CSIRO or industry even to give careers advice rather than getting those careers advisers? I am not being critical of those people; I think they are trying their hardest. I think people get interested in things and get jobs through who they know as much as through what they know and they are more likely to learn more off those people who have industry

networks. Would we be better off, given that you are seeing 400,000 students a year anyway, having a specific program to give careers advice?

Dr Robertson—At the highest level, generically, the careers advisers are not just advising around science and technology subjects. They have a much more diverse role to play within the education system. When it comes to specific advice around the value and quality of science and where that can lead, that is something that CSIRO can advise on, but as part of our engagement probably with the whole school system.

Dr Peacock—We do in fact do that within that engagement. It is not the whole answer but there is nothing like face-to-face contact and every program and support that we can provide to schools of letting children see what it is really all about is of huge importance. All of us can think back to particular incidents.

Dr Robertson—I have a point about the skills that we will need and do need. At CSIRO we are doing two roles. We are obviously answering questions of today based on the capability we have built over the last 20 to 30 years. We are working now very heavily in the climate and environmental areas and on water issues, which are very important, because over the last two to three decades we have built a capability base, a critical mass, for Australia in order to be able to answer those questions. One of our roles therefore is not just to deal with today's issues but to anticipate tomorrow's issues, and to anticipate the skills and capability that tomorrow's issues are going to need. One of the interfaces that we probably need to build with universities and the higher education sector is to think about what is necessary for tomorrow. Some of those courses will be built around undergraduate courses in the knowledge that they flow through into the PhDs and post docs of the next few decades.

But what is important is that maybe at this stage those courses do not look terribly attractive to get up and running. So if we are going to build a capacity in the preparedness of Australia with universities, then universities need to think about how to fund courses that may not, at this stage, be the most attractive to students. At the moment, universities like us are always thinking about how they can sustain their activities going forward. That is often based around attracting people into the current courses because they are fashionable and so on.

CHAIR—I thank you both for being here. I think most of the discussion that we have had today is similar to many other discussions. I think Rowan's question about the shared training between university and CSIRO and who gets the money is an interesting one. I am not going to ask you to answer that, but it is certainly something that will exercise our minds as an issue that is coming up—ever so quietly, but it is coming up. I appreciate the fact that you may not wish to comment further on it, but I thank Rowan for it because it has given us another dimension to look at in relation to the funding of research generally. Thank you very much.

[10.58 am]

COWLED, Dr Brendan David, Member, Cooperative Research Centres Association

DAGLEY, Dr Ian, Member, Cooperative Research Centres Association

HARTMANN, Mr Michael, Chief Executive Officer, Cooperative Research Centres Association

GLANZNIG, Mr Andreas, Chief Operating Officer, Invasive Animals Cooperative Research Centre

CHAIR—Welcome. Is there anything any of you would like to add to the capacity in which you appear before the committee today?

Dr Cowled—I appear as a representative of the association, but also as a former PhD student of the Invasive Animals Cooperative Research Centre.

CHAIR—Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and I now welcome you to make a brief opening statement before proceeding to questions.

Mr Hartmann—Thank you, I will be pleased to kick off. The CRC Association is very pleased (1) to see this inquiry come forth, (2) to make its submission and (3) to be here today. For the information of members present, next year the CRC program celebrates 18 years in existence. I am led to believe that that makes it the longest-running government program, certainly in the science portfolio. We have been successful through successive governments and have a strong track record, particularly in the area of research endeavours. But of course what we are here to talk about today is on the side of education.

The education component of CRCs has been somewhat undersold in the past. It has been an area in which we have certainly been making a strong effort to increase understanding, not just throughout this place but also throughout the general community. Every CRC—and there have been 168 CRCs over the life of the program; 49 in existence at the moment—has to have a PhD program as a core principle. The education component of CRCs, however, goes further than just PhDs. The postdoctoral side is extremely strong; some would even say that the post docs are the grunt of the CRC. It goes even further: many, if not all, CRCs have gone beyond their brief and are doing their part to work on the skills shortage issue in the science fields by going into schools not just at the tertiary level but back down to primary school, infants and preschool levels and educating them about science, educating their teachers about science and doing vocational education programs and science education for the general community. So the major point that we are here to make sure the committee is aware of is that the CRC program is an active, long-running program with a track record—not only in research, but also in contributing,

in its own small way, towards the production of PhD students who are recognised as being industry ready as well as going further beyond that into educating the wider community and the wider audience about science in general and breeding the future innovators for Australia.

With me today we have Brendan, who is an example of a PhD who has come through the CRC program and who is now working in the industry. We have Andreas, who is a representative of a local CRC, and Ian Dagley, who is the CEO of a CRC based in Melbourne. I will ask Ian to make a few comments from his perspective of his involvement with the education side of CRCs.

Dr Dagley—My experience with the program spans some 13 years. The CRC program is a proven program; it really does add a very important extra dimension to the training that we give our researchers who go through the university system. That occurs at many different levels. It broadens the offering and attractiveness to people to pursue careers in research. We do influence undergraduates to do PhDs who may not normally undertake PhDs. The people who come to us to do PhDs have high expectations of what they will get. They expect that they will get broader skills than a traditional PhD, and we work very hard to do that. There are a number of initiatives across the program to make sure that our PhD students come better equipped to make a successful transition from their PhD experience to the next phase in their profession—be that in academia, in government research or in industry. The other thing that Michael picked up on is really important too: we do employ a very large cohort of postdoctoral fellows. Our CRC, for example, has more postdoctoral fellows than PhD students. These are people who have come to us with a PhD, and we are teaching them how to work in multidisciplinary teams and work with industry. We are giving them broad skills in project management, intellectual property management, commercialisation and all the sorts of things that will help them regardless of what career path they go down.

CHAIR—I will just take you up on your opening comments about the 18-year duration since your establishment. Our inquiry has been looking at research generally, and it would be fair to say that we are actually looking at the state of play of our researchers, our capabilities, where we have difficulties, what areas we need to address and how we strengthen our position to meet future challenges. Would any of you like to comment from your CRC perspective on the health of our current research capability and therefore on our innovation capability—where you think there are difficulties, how we can improve and how you see your institution fitting in with the broad process of training, innovation, pathways and funding? I am just going to throw it all at you. I want an assessment from you about where you think things are and what you think are the most pressing issues in terms of problems that may require government assistance—what changes, what funding, what structural changes and how you can play a role in secondary schooling. You were here during the conversation we had with the CSIRO, and that is a big issue.

Mr Hartmann—There are a myriad of answers in that question. What I would like to do first is to incorporate some of the background about why the CRC program was established in the first place 18 years ago, because that leads into some of those answers. I would then like Ian to give some specifics on his feelings over his 30 years in the program as to what has changed and what might need to be a way forward, bearing in mind that he will be speaking from the perspective of a particular CRC.

The CRC program itself was established under the Hawke government. The feeling at the time was that there was a wonderful example of silo mentality in the science field where different sectors were doing their own thing but not talking to each other and where there was a lot of replicating the wheel. Industry, in particular, was not really involved in research. The scientists were in their areas working away diligently. Their work was finding its way into journals but that was about it. Science was not getting up into application. The feeling was that something needed to happen to science in Australia to get it back on its feet and moving forward, and the CRC program was developed to get those different sectors talking to each other—the CSIRO talking with industry, with universities and with general researchers.

Evidence shows that over 18 years that has been successful and broken an awful lot of paradigms in the science and innovation field. We now have established an area where scientists and industry are prepared to work together. The strength that the CRC program now has is that whole end-user focus. Today we see CRCs established because industry say, 'We need some work done in this area. Let's build a consortium, get some people together and try to solve the issue.' That is the fundamental change that has happened over that period of time. Ian can tell you about some of the differences he has noticed.

Dr Dagley—I want to make sure I address the questions you raised—and there were several. The first one was the big picture and how things are going. I think there is cause for a lot of optimism. I think that certainly the CRC program, the science community and universities have a big role to play in helping solve a lot of the problems that the country faces. That point was made by the previous people you spoke to. There are bright young people who want to address those challenges, and I think the science and engineering community provides an opportunity to really make a difference. I think that the CRC program is tracking very well and is attracting people who want to solve these problems and apply their skills, and I think there is a great opportunity to build on that going forward because of the renewed interest in really making a difference to the country and the economy. One of your other questions was about what can be done to improve training, I think?

CHAIR—Yes. I ask it because there seems to be an issue out there about young people in Australia taking up these sorts of careers. We get the feeling that there is a problem with our current—future—generation in terms of areas of science, engineering and mathematics and, clearly, those are all part of powering a knowledge economy and innovation. So that is the context in which this inquiry is taking place. We are looking for identification of problem areas; we have seen a number of them and they are consistent. But we are also looking at perhaps suggestions for creative ways of doing things outside the square to address these issues, because clearly you have to operate outside the square—we all do; even schools have to now, perhaps. I wanted your ideas on that. I appreciate that you are doing a great job; I am not asking for an assessment of what you are doing. But you are involved; you must have a picture of how we could perhaps do things differently—better.

Dr Dagley—The point was made earlier that we do not do a very good job of communicating what wonderful careers people can have in science and engineering. Somehow we need to get that message out to people and interact with them, particularly at the decision-making stages—when they are coming towards the end of high school, when they are coming towards the end of their undergraduate experience, and so on, when they are really looking at their various options—and trying to get the message out, not only to them but also to their parents, that these

are good careers. Not everyone wants their child to become a doctor; they may want them to become a scientist because they see that as an exciting option for them. And I think the careers are very good.

In terms of what we can do on the training front, I think there is an opportunity here to look at what is being done broadly. And CRCs are great experimental testbeds, as you would have seen from the submission; lots of CRCs are trying a whole lot of different initiatives. Working with Michael and the CRC community we have put together a graduate certificate in research commercialisation. The idea behind that is to try and distil best practice in all of the skills that you need, from taking an idea through to a commercial outcome and managing that whole process, and trying to have that taught formally to people, and giving them the opportunity not just to get a PhD or not just to do post-doc time with a CRC but also to get an additional qualification where they have some broad training in benchmark best practice. So that would be one example of an initiative that could help broaden people's skills and make them more useful as researchers and add value to their careers.

Ms RISHWORTH—Brendan, obviously you had an experience where you got the industry add-on value. Obviously, not every PhD candidate can go through that. So is that type of generic skill training something that you or anyone else would see as a benefit in the more traditional university PhD? What extra components could perhaps help that translation within the PhD at a traditional university?

Dr Cowled—Maybe I could list the things that I found useful in the CRC. I have only limited experience in the university—only in research. But I found that the collaborative networks that were developed in the CRC were very useful to me, both during my PhD, to complete it, and then afterwards, to come out with a ready-made network and knowledge of the industry. I think that that would be very useful for all PhD students to have. I am not sure if that is offered in universities particularly, because they are very focused on their own interest areas.

The partners that were involved in the CRC were a real advantage. As Ian said, the extra training was useful. So the commercialisation was very useful. I was able to participate in research which we patented recently, and that was a very useful experience to go through outside of pure research. So I do not know that universities particularly focus on that. They do have IP officers, sectors within universities that approach that. But often it is just handing off your research to those guys and letting them sort it out, whereas I was actively involved as a CRC participant.

I think flexibility is also very good in the CRC. I had five or six years industry experience as a vet before I came into the PhD, and I only had second-class honours so I was not able to gain an APA scholarship. But the CRC took an educated risk on me, and I rewarded that with, I think, a good PhD, publications, patents and focused research. I think that maybe to have some more flexibility in the students that you take into universities would be useful, rather than just having it based on their undergraduate honours, for example—so take advantage of industry experience. Does that answer your question?

Ms RISHWORTH—Yes, that is really useful. What is the criterion for the CRCs to take on a student for a PhD? It sounds as though it is quite flexible.

Dr Dagley—We do have the option of providing full scholarships. There are people who would not ordinarily go on to do a PhD who have the opportunity because the program receives the funding it does from government. The way different CRCs approach this varies. We try to have a balance. So about half of our PhD students will be offered full scholarships and the other half will have top-up scholarships, so they will have already got an APA or equivalent. We simply look for the best people we can find, and we look beyond just their academic results. There are plenty of examples of students who start to blossom towards the end of their degree. The professors who get to know them and who might have them doing projects with them towards the end of their studies see that they are maturing to a stage where they do have great potential. Those people might be people who ordinarily would not get a scholarship. If we think that they have the range of skills they need to be a good researcher, we can provide them with opportunities. But we do also attract some of the very top-performing students who just find it more exciting to be in the environment we can provide, which is different and gives them a broader range of skills.

CHAIR—Do you make a conscious decision to be more flexible? We are interested in this because what has come up on a number of occasions is that the selection criteria for those who get scholarships is a numerical thing—99.9 versus 99.3—and here we are in a situation where universities are saying that there is a crisis because domestic students do not want to do PhDs yet there seems to be no inclination from the universities to be a bit more flexible in the way they make those selections. I do not want to speak for them, but you seem to be doing this. Is it because of experience? Personally, I think you are on the right track.

Dr Dagley—We do a very thorough job of interviewing students, and there are plenty who would like to get scholarships whom we decide not to fund. We do look for signs that these people have the skills they need to really be a great asset. We also do try to encourage people to do research at the undergraduate level. For example, we are offering scholarships for really bright undergraduates to do part-time work with us, basically one day a week, working on a real research project targeted at publishing in a journal. This is an experience that people do not ordinarily get. We have found that that has attracted some of the very brightest students to go on and do PhDs with us. That is another example of flexibility—you can do something that ordinarily is not done and it can give that person a greater appreciation of what research is all about, what a science career is all about and where the opportunities lie. I think the system really has not changed a lot from when I went through as a PhD student, and I do think there is plenty of scope for experimenting, for doing things to encourage people to consider seriously the option of a career in science.

Mr RAMSEY—One of the great problems presenting most PhD students is the inadequacy of the stipend and the length of time to complete—all that kind of thing. It has been pushed to us that you would lose fewer students through starvation if you paid them better, that anyone doing a PhD in a CRC is better rewarded than someone doing one in a university. What would someone doing a PhD at a CRC be earning and how is that funded?

Dr Dagley—I can only talk from my CRC's perspective, which is probably pretty typical. A normal APA would be of the order of $20,000, from memory. We are typically paying between $26,000 and $28,000. That is the funding to the student. On top of that we are paying around $8,000 to the university to support that student. Of course the problem we face, and it is a serious problem, is that people who are graduating now can go out and get $50,000 or $60,000 a

year without too much trouble. So we are asking them to forgo several years of earning significantly more money. We need to think very seriously about making it a more attractive option and perhaps also making sure they see that people who have done postdoctoral fellows are happy and have a good career path.

Mr RAMSEY—Typically the university industry is asking for around 30 per cent in the APA. Given that is about where you are, do you consider that adequate or is it still an underfunded position to compete out there?

Dr Dagley—I think it is going to help. It would be nice if there was even more flexibility there because there are some areas, and maybe finance is an example, where if you want to encourage someone to do a PhD maybe up around $30,000 is still not enough.

CHAIR—Considering what they would be earning in the world of finance.

Dr Dagley—Yes, that is right. So it would be nice if there was more flexibility in the system. From our perspective, if we could offer up round the $40,000 mark there would be some really brilliant people who would look seriously at doing a PhD in Australia rather than heading off overseas. Finding some way to better reward and to be more flexible in how you do it would improve the system.

CHAIR—Brendan, did you want to add to this?

Dr Cowled—I have a couple of quick comments about the economic advantages of being with the CRC. Whilst I was at the CRC I was able to complete industry consultancies with partners with the CRC, which worked directly towards increasing my skills, worked directly towards my PhD and enhanced my income. So that was a win-win situation for everyone.

Mr RAMSEY—Did you finish your PhD on time?

Dr Cowled—Early, actually. In addition to that, the other advantage is that, with the weight of the CRC and their partners behind you, you can often apply for tenders for research, which you can use to enhance your operating costs. So your bench fee of $8,000 is quite generous for a PhD student, but you can then add on top of that $30,000, $40,000 or $50,000 for field studies if you are doing a field study, as I was, through government funding and through other industry tenders. So they are a couple of advantages.

Mr Glanznig—I want to build on that by adding two points. The first is the opportunity of the CRC to increase flexibility, and Brendan is a very good example of that—we were able to identify somebody who really had the hunger to stay in industry and contribute to it. That enabled us to support Brendan, and we have done that with a number of other PhDs who are really passionate about our industry and what we do. That increases the probability that they are going to stay in that industry, which is a value-add that the CRC provides.

The other key example that we can provide is that, in our top-up scholarship, we also provide access to a balanced scientists program. In addition to enhancing technical skills, including project management, commercialisation management and so on, we also offer leadership training, which you would normally get if you joined, say, the public service or a corporate. On

top of that, they also get media training and exposure to how to effectively operate not only in the technical sphere but also in communicating their message out to the broader community. A lot of the students have found that highly valuable.

CHAIR—Brendan, would you have pursued a scholarship at a university?

Dr Cowled—I did pursue one.

CHAIR—Where was your experience better placed to achieve what you wanted?

Dr Cowled—Obviously I was enrolled at university, but for day-to-day activities I was at the CRC and I found that very useful.

CHAIR—And if the CRC were not around?

Dr Cowled—I probably would not have been able to.

CHAIR—That is what I was getting at.

Dr Cowled—With second class honours, whilst it is good—it was a veterinary degree, so it was a high degree—I would not have qualified for an APA scholarship. In fact I did not, so I would not have been able to pursue it.

CHAIR—So if it was not for the CRC you probably would not be here.

Dr Cowled—No. I would be working as a veterinarian.

Mr Glanznig—The key point here is that Brendan's research is now leading to a new product that we are going to commercialise.

CHAIR—So the system would have lost Brendan.

Mr Glanznig—The system would have lost Brendan if it were not for the CRC.

Mr RAMSEY—What is it? I want one.

Mr Glanznig—What is the next generation of pig control toxins?

CHAIR—That is a good example. Thank you for that. I note it; it is in *Hansard*.

Mr BIDGOOD—Thank you very much for the paper you have presented and for your public statements. I am really pleased to see that you have taken into account industry prerequisite experience as well as second-class honours, and I think that says a lot. The statements you have just made about the fact that you would have missed out on a key bit of research and a key bit of innovation unless you had done that speak volumes. That is a great example, so thank you for bringing that to us. That is a good story; well done.

In a former life, before I became a politician, I was chief financial officer running two medical centres in Mackay, Queensland. We had a terrible problem getting doctors, GPs and nurses to our rural area. As chief financial officer, it was my job to give incentives to people to come. The key incentives I found for attracting doctors were offering accommodation for the first six months, offering a car, paying their airfares—things like that. I do not know what incentives you offer. Do you offer any accommodation or car incentives? Do you need to do that to get people to relocate? That is one part of the question. The next thing, which follows on from that question, is: do you have much mobility in your actual staff from CRCs to academia? So I want to know about the incentives for the people who work in CRC: accommodation, a car and things like that. Do you offer those sorts of things? Do you offer those to your potential PhD students? Do you help them with accommodation? Do you have much mobility of staff out of CRC to academia?

Dr Dagley—Typically we would try to see what the norm was for assisting people to relocate. It applies not just to PhD students, in our case, but also to postdoctoral fellows. We have a number of people we have brought from overseas, for example, to fill positions, and we would fund the sort of support that a university would typically give them. The big, attractive benefit we can provide them with is the training, the opportunity to do the courses that are being mentioned here; the graduate certificate course would cost us about $10,000. We would send them to conferences and provide a whole lot of additional benefits. That is really how we attract them—by offering those additional benefits, which add value to them. It is the training benefit they gain that is attractive to them, not the personal financial benefit that they get.

Mr BIDGOOD—That is the point that I am looking for. It is not necessarily the dollars in the pocket; it is saving people dollars in expenditure later, whether it is on accommodation, on a car or on conference fees and certain projects they might have to go and visit. That is the sort of thing I am looking for: how much you do that—an added benefit that makes your situation more attractive than them going somewhere else.

Dr Dagley—Occasionally we fund people to go overseas and do research—when the facilities are there and not in Australia. That is another benefit, for example, where the CRC can provide additional financial support.

Mr Glanznig—It is not only financial; it is also about motivational incentives. As Brendan flagged, the big one is access to the relevant industry players, government players and so on so at the end of your PhD you are not just coming out cloistered within a research provider; you actually know the landscape, and that facilitates the pool by industry pulling that PhD into a career path. I think those motivational incentives are also very important.

Dr Dagley—You did ask about career paths and where people go. We have had people spend time with us and then go into lecturing positions in universities, take up jobs in CSIRO or jobs with companies which are associated with the CRC. We find that the CRC represents an excellent stepping stone for people where, as was pointed out by Andreas, they establish a network and they become known within that network. It gives them an opportunity to size up all of the options that are out there and decide which one is best for them.

Mr BIDGOOD—After people move on do you find that, because there has obviously been a good association with you, that in itself feeds back to you? Obviously, I know the power of networking.

Dr Dagley—I think that is really true across the community. For example, one of the professors who are now working with us was a PhD student in another CRC. We have a person now working for a multinational company in Switzerland who was a post-PhD student with us. They became known to that company through a CRC project and were recruited into that company. So there are plenty of examples of the networks working and working well.

Dr Cowled—As a small personal example, I am no longer with the Invasive Animals CRC where I completed my PhD, but I am very happy to be providing my time, assisting them and advocating because I am appreciative of the efforts they put into me and the opportunities they gave me. It is a small personal example.

Mr BIDGOOD—That is excellent. I like your story. That is a great example, and I am really glad you are here today.

Mr Hartmann—I draw your attention to the article that is in appendix B of our submission, which is the centrespread from the *Financial Review*. There are examples in there. We surveyed our CRCs last year to get this data. You can see examples of a PhD student from a CRC who then becomes adviser to the science minister here in this House. It is amazing where they end up.

Mr BIDGOOD—I think you are doing a good job.

CHAIR—The fact that you, Brendan, could have slipped through the net—and I suspect there are a lot more like you—is really one thing that we have picked up.

Mr BIDGOOD—Yes, I like that approach.

CHAIR—If you are going to address issues you have to look at the Brendans of the world against some very static sorts of attitudes.

Mr BIDGOOD—We would have lost great potential.

Mr SYMON—I intend to switch subjects slightly by going back to your submission where you mentioned running programs at both primary and secondary school levels. From reading what is there, it looks as though individual CRCs do particular programs in just a few schools. What can we as a government do to expand upon that, because I do not think an individual CRC can roll out their program countrywide? They do not have the resources. How do we take that knowledge to schools across the country, to raise interest in students of a path in science, in research? What can we do at this level that you cannot do at a CRC level?

Dr Dagley—Here is a thought: if you provide funding for schools to run science awareness programs where they could draw on material from CSIRO, CRCs, universities and if you encourage them to have a science week or a science awareness component of their teaching—particularly absent in primary schools is science awareness—I think you would encourage offerings from CRCs to be taken up more broadly. There are plenty of good things that are happening out there, but they are not being adopted very widely. My suggestion would be to encourage schools to look at the opportunities, to pick up existing things and to introduce them more broadly into the school community.

Mr SYMON—As I said, if the school is not currently near the CRC, physically or with an intellectual connection somewhere along the way, then it is probably not on that radar.

Mr Glanznig—Just by way of example, the schools project that our CRC is funding, which is called Feral Focus and which will be rolled out later this year, is internet based, so it has the potential to be national and even international in scope. It will be promoted through various teacher associations—science teachers association, geography teachers association—and then combined with teacher training. So the opportunity is there but, again, it is a resourcing question. You have to then obviously align that with the relevant curricula. You do have these structural impediments to getting your particular program picked up by teachers. I think there is a lot of interest, but the question is: how do you make it easier, how do you enable teachers to teach your scientific area?

Mr SYMON—Realistically, you are trying to get them to use your product versus whatever they are doing at the moment, so you need someone out there to do that sales job. There is a resource issue.

Mr Glanznig—It is competitive. I will give you an example in relation to Science Week. One of the key messages we are trying to give kids is that pets can become pests, particularly aquarium fish. We have examples of goldfish but also carp and a whole array of the new and emerging invasive aquarium fish, such as platies, which recently escaped and naturalised in New South Wales. It is about trying to get those messages out but of course you need infrastructure, you need a person and resources to roll that out. Again, that is where CRCs are constrained because we do not have the funds. To build on what Ian was saying, if that was all rolled up into a national type of science program where we could all feed in our different perspectives—and each school has different interests; it depends a lot, particularly at the primary level, on the interest of the teacher—then they can cherry pick the issues that they would like to use to communicate science and technology to their students.

Mr Hartmann—From my perspective, the interesting thing about human beings is that we are naturally curious and science has an affinity with everybody, whether or not they believe it. People say that school children are not interested in science but, when you look at the most popular shows on TV, such as *CSI* and *Mythbusters*, they all have that curiosity factor to them. There are programs around like Science for Schools, at CSIRO, which we have just been speaking about, or the Amazing World of Science that we have just had here in Canberra, with 30,000 school kids being exposed to science endeavours and the like, which are doing fantastic things and getting that exposure to school kids. But what is missing is at the school teacher level. You would recognise, coming from a school-teaching background, that often a child's career is shaped by a teacher who excited them, and they say, 'That's what I want to be when I grow up.'

One of the things we refer to here in our brochure is that some of the CRCs involved in mining over in the west actually got school teachers to go to a mine. They said, 'This is a mine; this is how it works.' They did some stuff in the lab, they did some electrolysis, they got some spatulas and put some gold on it and did things like that and had a great time. But, after they visited the mine, they came back and said: 'Do you know what? The people at the mine are actually really nice people.' They had entered into the mine with the philosophy that miners were 1850s gold diggers or something and it totally broke their whole idea of what it was. So they could then go back to their school kids, and say, 'There are some really cool careers in mining

and it's something you might want to follow up.' So it is about getting it to that level—the people who inspire the youth, it is not just about getting the education to them themselves.

Dr Dagley—I would like to pick up on that because I think it is a really important point. If you do get through to the teachers, they have this enduring impact year after year on students. When I was a postgraduate in a chemistry school there were a disproportionately high number of people from Bendigo who were doing postgraduate studies. When you asked them why, they said that there was this great teacher who inspired them. Somehow, finding a way to better connect scientists with teachers who are in the classroom day after day imparting their enthusiasm to the students is an important link that could probably be strengthened.

Dr JENSEN—You were talking about the issue of CRCs bringing in students when otherwise they may be thinking of doing something like law. The single word that I can think of here is 'aspiration'. The message that teachers put out there among students is that the student should be aspiring to do medicine or law. How do we turn this around? How do we market science so that science becomes an aspirational career rather than something that they 'may' think of doing?

Dr Dagley—I think it really is somehow, at a whole range of different levels, getting people to experience and interact with the science community—perhaps through work experience or by giving people opportunities at the end of high school to move into a research environment. That might make the difference between their doing medicine and science. We did mention teachers as well. I think it is at a whole lot of different levels. As I said, you can go through those courses at the undergraduate level and not really have a good appreciation of what research is and what an exciting career you can have as a researcher. People are not putting that as a serious career option because they simply are not aware of how great the career is.

Dr JENSEN—In a way, we almost seem to have lost something that we had. One of the things that switched me on with science—apart from a great teacher that I happened to have—was the space program. The sixties, in particular, were a very exciting time for science. I think there was an aspirational aspect to science and a science career at that time. I think somewhere or other along the line we have missed the boat on that and we have actually moved backwards. In that context, can you think of why we have moved backwards and how we can address that so that we can move forwards?

Dr Dagley—We have not put a high enough price on innovation because it has not been an essential component of being successful and maybe because we are in a lucky country. But I think that that is changing because of the points that were made to your committee by the previous speakers, and that is because we are in a period of paradigm shift where we do need new technologies and where we have major problems like climate change and the need for alternative energy sources and changed agricultural practices—and the list goes on and on. Underpinning all of this is the opportunity to develop new technology and that new technology being very important for the economic growth of the country, for the community et cetera. I think there is an excellent opportunity to reignite that passion, because the problems are out there to be solved and they are there to be solved by scientists and engineers. There is a generation of people coming through whom I think will respond very favourably to being part of that challenge.

Mr Glanznig—I think what fuelled the imagination in the sixties was the national political agenda which was linked to Cold War politics. You had presidents and PMs really pushing the science agenda. That was at a political level and we have retreated from that. We have not had PMs saying, 'By the end of the decade will have a cure for disease A, B or C.' We have not had that aspirational rhetoric for a long time.

Dr JENSEN—We have not had a sputnik either!

Mr Glanznig—Touche! But there is an opportunity at a political level to really elevate the role of science and technology in solving some of these critical global issues, whether they be climate change or a range of diseases. You hear the comparison drawn often, but the recent Olympics captured the imagination so how do you elevate the role of our scientists?

CHAIR—How do you promote the scientist who designed the swimsuit above and beyond the swimmer who actually swam in it?

Mr Glanznig—Exactly.

CHAIR—I think that is a really good example. I have come to the view that the current generation of kids in possibly late primary and secondary school might be a lost generation to us in terms of some of the issues we are trying to address, because the school system works in years. Australia has traded very much on its good reputation—I will not go into that now: we have done well, we have punched above our weight in so many areas—and it is possible we have taken it for granted that it is always going to be like that. And suddenly we have realised that we are obviously slipping behind; our standards, our schooling, everything seems to be falling behind. At least it is better to be aware of it now and try to address it, but I worry a bit about my kids' generation and where they are at in terms of this transitional period. But that is probably not as bad as I think it is. Maybe it is because I am a teacher and I know what the teachers get bogged down with as well. And ultimately it does boil down to the teacher; it boils down to the person in that classroom and how they are treated and perceived by society. At the moment the teaching profession is not doing well at all, thank you very much, and it should be doing a lot better. You cannot get scientists? Why should anyone teach for the treatment and the money that they get as well? So there is a real fundamental reaction. We are not going to solve it today, but the discussion here has been very valuable to us and we, as a committee, are hoping to be able to come up with some small contribution of ideas of how we can fix things—hopefully, at a systemic level because it is a systemic issue too.

Mr Glanznig—I want to make one concluding comment which relates to your term of reference that is essentially talking about the ageing academic workforce. I will put that into sharp relief with our industry. A lot of the researchers are going to be retiring in the next five or 10 years, and without the CRC, which provided that critical mass, we would not have trained a whole suite of new PHD students to be able to replace those retiring researchers. We have come in at just the right time, and I will give you a good example in relation to rabbit biocontrol research. The scientists who worked on the calicivirus are now at the tail end of their careers in CSIRO. We have pulled one of the researchers directly from CSIRO into our CRC just to make sure that we do not lose that corporate knowledge. We are already investing to top up the CSIRO budget in this area to make sure we are training a couple of really bright scientists to enable that succession. So without the CRC you would not be enabled to make those strategic interventions.

CHAIR—I am glad you are making strategic interventions in resolving this issue, because we ask universities what their strategies are and I do not think anyone has given us a strategy yet. Everyone identifies it as a problem, but when you say, 'What are you doing about it,' they really are not doing anything about it. Thank you for that dimension because we will certainly single it out as part of whatever recommendations we can make to address the issue. Everyone is ageing, the academic workforce is having similar problems, but to date we have yet to be given anything constructive to address it. I certainly was not aware of your deliberate contribution. So if you had not been around, their problem would have been even greater. Is that correct?

Mr Glanznig—I think there would be a chance that that new research would not have been funded, it would have been moved off rabbit biocontrol and all of that scientific knowledge that was built up when calici was tested and then rolled out in Australia would be lost. That is a specific example within our CRC. There must be a multitude in other CRCs.

CHAIR—Thank you very much.

Resolved (on motion by **Mr Symon**, seconded by **Dr Jensen**):

That this committee authorises publication of the transcript of the evidence given before it at public hearing this day.

Committee adjourned at 11.48 am