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SENATE

COMMUNITY AFFAIRS LEGISLATION COMMITTEE

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WITNESSES

SENATE

COMMUNITY AFFAIRS LEGISLATION COMMITTEE

Thursday, 19 September 2002

Members: Senator Knowles *(Chair)*, Senator Stott Despoja *(Deputy Chair)*, Senators Barnett, Denman, Heffernan and Hutchins

Substitute members: Senator McLucas for Senator Denman and Senator Eggleston for Senator Heffernan

Participating members: Senators Abetz, Bishop, Boswell, Buckland, Brown, Carr, Chapman, Collins, Coonan, Crossin, Eggleston, Evans, Faulkner, Ferguson, Ferris, Forshaw, Harradine, Harris, Hogg, Lees, Lightfoot, McGauran, McLucas, Moore, Murphy, Nettle, Payne, Tierney, Watson and Webber

Senators in attendance: Senator Knowles *(Chair)*, Senators Barnett, Eggleston,, Bishop, Boswell, Collins, Denman, Harradine, Hogg, Hutchins, McLucas, Stott Despoja and Webber

Terms of reference for the inquiry:

On 21 August 2002 the Senate, on the recommendation of the Selection of Bills Committee, referred the Research Involving Embryos and Prohibition of Human Cloning Bill 2002 to the committee for inquiry and report by 24 October 2002.

Committee met at 3.32 p.m.

BARTLETT, Professor Perry Francis (Private capacity)

GOOD, Professor Michael (Private capacity)

ROWE, Professor Peter Brock, Director, Children's Medical Research Institute, Westmead, Sydney

SIMMONS, Associate Professor Paul J. (Private capacity)

CHAIR—I welcome the witnesses before us at the table. The Senate Community Affairs Legislation Committee is continuing its inquiry into the Research Involving Embryos and Prohibition of Human Cloning Bill 2002. As I stated in the previous hearing, the committee has been asked to inquire into the bill and to inform the Senate on its deliberations on the bill. I ask my colleagues that their questioning remain focused on issues relevant to the bill. Witnesses are reminded that the giving of evidence to the committee is protected by parliamentary privilege; however, the giving of false or misleading evidence may constitute a contempt of the Senate. Do you have any comments to make on the capacity in which you appear?

Prof. Bartlett—At the present stage I, like a stem cell, am transforming—from Melbourne to Queensland. I am Foundation Professor of Molecular Neuroscience at the University of Queensland and I am also currently Head of the Development and Neurobiology Group at the Walter and Eliza Hall Institute of Medical Research in Melbourne.

CHAIR—Thank you. The committee approaches these hearings in panel style sessions. We have before us your submissions. I invite each of you to make additional comments, if you wish, and, at the conclusion of that, I will invite honourable senators to ask you questions. We will start with you, Professor Rowe.

Prof. Rowe—I defer to Professor Good; he has made a formal submission, which I have read. Some of my views would be subordinate to his.

Prof. Good—I am the director of the Queensland Institute of Medical Research. I was formerly the director of a cooperative research centre for vaccine technology, developing vaccines and heading towards clinical trial. My research background is in immunology. I undertook a PhD at the Walter and Eliza Hall Institute of Medical Research in Melbourne after a medical degree and, subsequently, a Doctor of Science qualification. I undertook postdoctoral work in Washington at the National Institutes of Health. My research does not involve stem cells; I am an immunologist, and my PhD was in graft rejection and the development of immunological tolerance. So I believe I come to the debate uncompromised in any way. This particular bill will not directly affect my research in a positive or negative sense. I come to the debate with a great deal of interest in the topic and, I believe, some wisdom in the field.

I became interested in the debate for two main reasons. First of all, this is an incredibly important topic. It is a topic that has galvanised the community and it draws anybody with even a peripheral interest straight into the debate. Having quickly got interested in the debate, I became astounded by the scientific level of the debate—the lack of scientific depth in the debate. In particular, I was astounded by the lack of discussion of the problems of immunological rejection that will occur if foreign tissue is used in transplantation and derived from embryonic cells.

To me, this is the major scientific obstacle in this whole debate. I know that the public have not been properly informed about this. That is something that, because of my background in immunology and tolerance, captured my interest immediately. The question I quickly came to pose was this: what is the magnitude of the problem? To put this into perspective, let me say this: if we are to receive a foreign graft—a foreign liver or kidney or foreign bone marrow—we have to make sure that the organ we are receiving is tissue typed and is a similar tissue type to our own, otherwise, it will be rejected. That is why it is not always possible to find a kidney if you need one and it is not always possible to find bone marrow. If you need bone marrow, what are your chances of finding it? If you have leukemia, need bone marrow and are fortunate to have a sibling of the same tissue type, that is okay. That is the ideal. Otherwise, you have to search the community to see who out there has bone marrow of your tissue type.

The Australian Bone Marrow Donor Registry tells me that approximately seven million people around the world have put their hand up and said, 'I'm willing to give my bone marrow to a patient if it is required because of the matching tissue type.' There are seven million people on the registry, but the chance of finding bone marrow that matches you amongst those seven million people is 53 per cent. That is data from the Australian Bone Marrow Donor Registry and data that have been confirmed to me by consultant haematologists and colleagues in Brisbane. That is if you are Caucasian. If you are Asian your chance, currently, is far lower. Your chance of finding a match amongst those seven million donors is only 10 per cent. Exactly the same principle will occur with tissue derived from embryonic stem cells. The tissue is, effectively, foreign tissue: it is derived from a different human being. For a graft not to be rejected it will have to be matched at all those tissue typing molecules—of which, as I said, there are millions of different permutations and combinations.

People who work in stem cells realise this very well and acknowledge it in scientific literature, and I have referred to that in my submission. What they do not acknowledge is the size of the bank of cells which is required. I have heard Professor Trounson say, for example, that maybe as few as half-a-dozen embryonic stem cell lines will be required. I have seen him

put in writing that a few dozen embryonic stem cells will be required, and I understand that the Bresagen company has said that maybe 600 to 1,000 stem cells will be required.

Those figures are wrong. I believe that to get a bank suitably large enough to guarantee you a reasonable chance of finding a correct tissue typing match, you would need a bank of approximately 10 million, of that order, for each of the major human races: Caucasian, Asian, African and Hispanic. That has never been discussed in public, and I am really angry that this has not come into the debate. This is a major issue. That is my major concern.

The second concern, however, is that I am astounded by the lack of pre-clinical data. I work currently in the vaccine development field. Before we put new potential vaccine molecule candidates into people, we test them extensively in preclinical situations—initially in mice or rabbits, and then perhaps in monkeys. If safety and efficacy have been demonstrated, then we proceed with great caution to a phase 1 clinical trial, and the first stage of that clinical trial is really looking at safety. There seems to be an inordinate haste to rush into working with human embryonic stem cell lines when the proof of concept, or proof of principle, has not been established in animal systems. The proponents of this legislation point to a number of models, including Parkinson's disease and demyelinating diseases such as diabetes, where they point to some efficacy using embryonic stem cell line derived tissue.

I will say two things about that. Firstly, the animals have either been immunosuppressed to overcome the problem of rejection or, where they have not been, tissues have been rejected or the efficacy of a transplanted tissue has stopped working after days or weeks. Secondly, the animal models are very contrived. Let me give an example of what I mean by that. There is a paper which I referred to by Soria, and there is another paper which I can show you a copy of by Lew which looks at a demyelating model. In both these situations, either the myelin secreting cells were destroyed chemically or the islet cells in the pancreas were destroyed chemically, creating, effectively, a vacuum in which the embryonic stem cell derived tissue was transplanted.

With immunosuppression, in some situations, they saw an effect. Unfortunately, the human diseases of multiple sclerosis and diabetes myelitis are not caused by a chemical. The pathogenesis of these diseases is under intense investigation and it appears, at this point in time, to be an autoimmune type of phenomenon where the body's own tissues and immune system are, in fact, destroying the cells responsible for making insulin, which leads to diabetes or the myelin sheaths, which leads to multiple sclerosis. If you were to model that in a proper model system, you would not be putting cells into a mouse where those cells had been destroyed by a chemical without regard to the nature of a disease process. In other words, there has been no consideration of the pathogenesis of disease. That is my second main concern.

In concert with that, as I have been drawn into this debate and as I have read more and more into it, I have been astounded really by the utility and the efficacy of the alternative therapies, which are these adult stem cell derived tissues both in the mouse situation and in the human situation. I have heard Professor Trounsen, and other proponents, argue that these cells will not have enough plasticity. In other words, they cannot differentiate into enough tissues to be useful or they cannot get sufficient numbers of cells to be useful.

I would like to address those two issues. The embryonic stem cells are all called totipotent. They have enormous proliferative potential and they can differentiate into every single cell of 200-odd tissues of the body. That is not an advantage; it is a disadvantage. Why would you want to put cells into a person which have the potential to change into other cell types that are not required? Those particular cells, due to their totipotential, can give rise to teratomas; that

is, tumours formed by cells which can give rise to multiple tissues. The greater plasticity of embryonic cells is a disadvantage, not an advantage. The other argument that they use is that you cannot get enough cells from the adult stem cell derived tissue. There are many papers, which I have brought along here and which I have referred to in my submission, demonstrating that adult stem cells can, in fact, divide in tissue culture for many doublings—30, 50 or 100 doublings—sufficient to give rise to all the cells that you will require. The ideal cell that you want in a transplantation situation is one that does not have great pluripotency, that cannot differentiate into multiple unwanted tissues, that has a limited tissue differentiating profile and that you have enough of. Those cells are provided by adult stem cells. Furthermore, if they are taken from the patient, you will not have this problem of graft rejection, which to me is the major problem of embryonic stem cell derived tissue.

So we have to ask ourselves: why is it that the proponents want to experiment with human embryonic cell tissue? People I speak to who are not opposed to the ethics of working with embryonic stem cell tissue—I am talking about scientists now—agree with me that cell therapies will not be developed from embryonic stem cell derived tissue. This, I believe, is what has been sold to the Australian community. On news reports and in newspaper articles you have people who are in wheelchairs or blind from diabetes saying, 'If scientists aren't allowed to work on embryonic stem cells, I will never walk or I will never see again.' I feel very sorry for them, but they have been led down the garden path. They have been used in this debate, and I feel very upset about that. I work in an institute where we are trying right now, for example, to develop cancer vaccines. The thing that gets me most annoyed is our staff or scientists overselling what they are doing, because the people who are disadvantaged by this are the very patients that ultimately you want to help. It is incredibly bad, and it makes me very annoyed that these people have been brought into this debate. They do not have the scientific knowledge and they have been brought out as reasons why we should be developing embryonic stem cells. The best hope for those patients is, in fact, adult stem cell research. That provides them with their best hope. Even then, you would have to say that their individual chances would be slim. But there is a chance with adult stem cells.

The other thing about embryonic stem cell research, I am finding as a scientist, is that the world—overseas, at least—has passed on. I support stem cell science. I think it is a wonderful new initiative, it is a new technology, and I strongly support it. The real excitement to me in stem cell science is getting endogenous stem cells in the various tissues of the body to turn on with certain drugs or chemicals. For example, there is a recent paper published in the *New England Journal of Medicine* by Körbling et al where they took human, not mouse, bone marrow cells and put these into patients. These were male human bone marrow cells that they put into female patients who were treated for leukaemia and lymphomas. The importance of male into female is because the XY chromosome in the male means you can follow those cells in the various tissues of the body. Körbling et al were able to show that those human bone marrow stem cells could be found subsequently in liver, gut and skin. That is a human experiment, and it is very powerful. That demonstrates to us that these adult stem cells have the potential to differentiate into different pathways if given the right stimuli. The really exciting science, where Australia would have a competitive advantage, I strongly believe, is in finding out which molecular stimuli and molecular pathways trigger those intrinsic stem cells to go down that pathway.

Embryonic stem cell science as a science is very passe. To me it is incredibly boring. It is unbelievably overhyped. I can only think that the reason that people might be even remotely interested in it is from a commercial perspective. I would be interested to know what the commercial perspective is. I do not know what it is: following commercial strategies is not

one of my areas of expertise. But I can think of no other reason. They do not need them for therapy. As I said, even my colleagues who are not morally opposed to it say, 'There's no way that embryonic stem cells will ever be used as cell therapies.' They do not need them for research because there are existing ES cell lines which will not be affected by this act which are already in existence. They can be used for research if they need to use those cells for research. There must be a commercial motive. I would like to know what it is.

CHAIR—Thank you. Dr Simmons.

Dr Simmons—As I said, I am currently head of the stem cell program at the Peter MacCallum Cancer Institute. I have been actively involved in adult stem cell research for some 21 years. I did my training at the Paterson Institute at the University of Manchester under Professor Mike Dexter, currently a director of the Wellcome Institute now in London. I did postdoctoral studies in Vancouver at a cancer centre there, and I spent five years at the Fred Hutchinson Cancer Research Centre in Seattle, during which time the head of that unit gained the Nobel Prize for his contributions to bone marrow transplantation. I then moved to Adelaide to establish my own group, and three years ago I was recruited to Melbourne to head up the stem cell program there, to essentially initiate the stem cell program at Peter MacCallum.

I come here today to make a number of points. I am a passionate, fervent believer in the use of adult stem cells. I note for this committee's benefit that of course the use of adult stem cells is in no way viewed as contentious. They are indeed the basis of many clinical therapies that are efficacious in various settings in human beings. But there are, I think, some points in this debate that have not been to my mind adequately covered. One of the points I would like to make today is really to look for a balance in terms of research in embryonic and adult stem cells. One of the major arguments that proponents of the moratorium on embryonic stem cell research use is that adult stem cells, being truly a very potent population of cells—and I will be more specific about that point in a moment—can in fact do everything, so why do we need to work on embryonic stem cells? For example, adult stem cells in the bone marrow—haematopoietic stem cells, as we would call them—are indeed the basis of many therapies. Stem cells in the skin would essentially be the basis of skin transplantation for burns victims, for ulcer treatments and so forth. There are some major diseases, however, that adult stem cells have really not demonstrated any efficacy in. One could probably cite heart disease, kidney disease, diabetes and lung disease.

What I would like to raise with the committee is a fact which I do not think sufficient attention has been paid to. There are in fact some limitations to adult cells. Again I should remind the committee I actively work on adult stem cells so I am, I think, a person well able to see the shortfalls of the tissue and cells I work with. Adult stem cells are generally very rare cells in all those tissues in which we have discovered them. Adult stem cells have only in fact been identified in a certain number of adult tissues. For example, they are well demonstrated and well documented in bone marrow, in skin and in gut. There are major advances in identifying liver stem cells, for example. But for tissues such as lung and kidney there is no formal identification of stem cells in those organs. So they are rare cells. That would mean that the absolute number of cells one could isolate for a therapy is going to be limited. Therefore there is the need potentially to generate a therapeutically effective dose of stem cells—the need to propagate those cells in culture to expand in absolute numbers those cells.

Therein lies the second major problem: can we in fact grow all adult stem cell populations? There are some which most certainly we can grow and expand in numbers to a very large

extent. I would cite for example a population called mesenchymal stem cells, which I am very familiar with. They can indeed be grown—as Professor Good has just said—to very large numbers, potentially providing a very large number of cells that could be used for therapy. However, in contrast, let us take the example of haematopoietic stem cells, perhaps the best characterised stem cell population in adult invertebrate physiology. Haematopoietic stem cells cannot be grown in culture, at the present time, to expand their numbers in net terms. When one attempts to grow haematopoietic stem cells in culture, they actually lose their stem cell properties—they differentiate. Try as we might, we have not—and I have been actively engaged in this form of research for at least 10 years—found ways to retain their stem cell properties. They differentiate. Even in a situation where we think we can grow them, we lose the stem cell properties. There are limited numbers, and we cannot grow all the adult stem cell populations we would like. These I think are two important limitations of adult stem cells which, in fairness, the committee needs to take on board if it is to engage in a rational debate on the relative merits of embryonic and adult.

The other argument that has been raised in favour of the use of adult stem cells is this term 'plasticity'. Adult stem cells appear to have a developmental potential beyond the tissue from which they were derived. This is indeed an incredibly striking observation that has been made in many laboratories. In fact, this whole field of research really challenged a lot of people's notions in adult stem cell biology. It was a very counterintuitive series of observations that only started in 1998-99. In my submission, I have given a summary of some of the major observations in so-called stem cell plasticity. What is interesting is that a number of the observations purporting to demonstrate plasticity have not been reproduced in very reputable labs around the world.

For example, the neural to haematopoietic stem cell transition has not been reproduced by a consortium of scientists working in Canada. There has been a very recent report from the Weissman laboratories demonstrating that bone marrow cells in their model do not contribute to multiple epithelial tissues—although I take Professor Good's point that there is some evidence that bone marrow cells in a human transplant context can indeed contribute to epithelial tissues. There has been no reproduction of the observation that skeletal muscle can give rise to blood. That study found that the investigators were dealing with two completely different adult stem cell populations, not one stem cell population that apparently could give rise to both muscle and blood. So that publication fell down based on the lack of rigour of the experimenters doing that work. My point is that, since a sizeable proportion of the studies on so-called stem cell plasticity have not been reproduced so far—and it is still early days—it is to my mind not appropriate to use stem cell plasticity as an argument to not study embryonic stem cells. It is looking very much like adult stem cells are not as plastic in their developmental properties as was initially suggested by publications.

My final point is to address a single publication, and that is the work—which is indeed an amazing observation—by Professor Catherine Verfaillie of the University of Minnesota. This is a publication that appeared in July this year in *Nature*. It demonstrated the presence in adult human bone marrow of what appeared to be a population of adult pluripotent stem cells. They are cells that ostensibly have characteristics very similar in many respects to embryonic stem cells. That is, they could give rise to cells of all three germ lands—endoderm, mesoderm and ectoderm. They had the apparent advantage over embryonic stem cells in that they did not form tumours in the animal models these investigators were using.

This is indeed, as I have said, a very amazing observation. Under the general umbrella of plasticity studies, if I might, I would caution the committee that this is one paper from one laboratory. It has yet to be reproduced independently by other scientific laboratories working

in stem cell biology, and I would like to see a reproduction of those data. Any scientific observation by definition needs to be reproducible. We would like to see a reproduction of those data. Secondly, the mechanism whereby these so-called pluripotent cells arise has not been defined. Do cells with these potentials exist in the native state in adult human bone marrow or, in fact, are they created as a result of the culture conditions that Catherine Verfaillie's group use?

If one looks at the publication, these cells are forced to undergo an enormous number of population doublings. They are capable of some 125 population doublings. That is a simply enormous number of cells; it would create something in the order of a cubic kilometre of cells. The idea that genetic alterations occur during that prolonged propagation cannot be excluded. Indeed, one of the major findings by the group in Canada was that, during prolonged propagation of neural stem cells, that was occurring: they underwent genetic changes during prolonged expansion in culture. I urge the committee to consider a very balanced view when we are talking about the comparison between adult stem cells and embryonic stem cells.

A final couple of points come from some very recent publications that were published on 12 September in *Science Online*. These are analyses performed by two reputable stem cell laboratories in the United States—one from Harvard, one from Princeton—in which they have done what is called micro-array analysis to molecularly profile stem cells. They have compared two adult stem cell populations with embryonic stem cells. What is interesting about that comparison, as one would suspect, is that there are genes that are uniquely expressed in each stem cell population and there are genes that are expressed in all three populations—a commonality of gene expression—implying that there may well be some fundamental aspects in terms of stem cell biology that we could approach only through studying all three types of stem cell. At the heart of the matter, as Professor Good said, is to understand and define pathways with differentiation that are responsible for derivation of the matured cell types that stem cells give rise to. It is by studying a cell population that is totipotent—that can give rise to any type of cell; it is an amazing tool from a scientific point of view to have at one's disposal. And the comparison of those cells with adult stem cells will inevitably yield secrets as to how adult stem cells work. My view is to ask for balance in this debate.

CHAIR—Professor, do you wish to make a contribution?

Prof. Bartlett—Thank you for the opportunity to appear. I appear hopefully to give some information in the debate about the neurological aspect of stem cells and stem cell therapy. My background is that I am presently head of a large group of neurobiology and developmental people at the Walter and Eliza Hall Institute, but I have just accepted a position to set up a new institute at the University of Queensland where I will be Foundation Professor of Molecular Neuroscience. I did my PhD in Melbourne and then did postdoctoral studies, first at John Hopkins University and then at University College, London.

I have been at the Hall Institute for 25 years where my group has made several fundamental discoveries in the area of neural stem cell biology. Some 10 years ago, members of my group discovered that in fact there were neural stem cells in the adult brain. More recently, we have shown that we have been able to purify these stem cells—and that appeared on the front cover of *Nature* last year. I have an extensive background in understanding the function and characteristics of the stem cells in the brain that are able to make new nerve cells and do so in all of us on a daily basis—something that 10 years ago we did not realise.

Point No. 1 is that, like all other tissue—although we have not discovered stem cells in skeletal muscle—certainly the brain, although it was thought to be different, has the capacity

to regenerate and renew and does so on a daily basis in certain areas. Even areas in which you and I create short-term memory are turning over and replacing neurons and can be influenced by environmental stimuli. I do not know what a Senate committee hearing does, but I suspect it suppresses that stimulation. It is an exciting field in terms of therapy, because there are now papers to show that that endogenous, innate capacity to make nerve cells can be harnessed to make cells that replace damaged cells. For example, last month in *Cell*, which is a very prestigious journal, it was shown that you could generate cells in the hippocampus—the area of the brain that is related to memory—after a stroke using growth factors. These animals not only replaced nerve cells but in fact showed improved performance in a memory type maze.

So we are at the cusp, the cutting edge, of a new generation of discoveries not only about repair but about the way you and I function in response to environmental stimuli. Regulation of stem cells is going to have far greater impact on our lives than just thinking about stem cell therapy. I think we are going to have to understand how you and I respond to environment and how we create memory and learn things. So understanding stem cells is a very broad and a very interesting intellectual enterprise. But, as Michael made the point, the easiest possible way to address repair with therapy is by stimulating those populations that exist in you and me at the present stage.

The reason that we went on to purify and find these cells was not to be able to transplant them but to be able to finally discover what molecules regulate these stem cells in you and me to make nerve cells, because the $64 million question—and the $64 billion therapy—is to have a drug that is able to stimulate those cells that reside in our own brains and that can make nerve cells to replace those cells lost in stroke, Alzheimer's disease, et cetera. That is where I see the most exciting area of therapy. I think that is the easiest way forward, whether it is going to fulfil that promise or not. In many ways, it is comparable to the bone marrow research of 40 years ago—remember, this country actually discovered the molecules that stimulate haemopoietic cells to make new cells—so the concept of using a drug to make more of one cell type by stimulating stem cells is a very old concept. Bone marrow cells have been doing this successfully for 20 or 30 years. That molecule was discovered at the Walter and Eliza Hall Institute by Don Metcalf and is now a $4 billion industry. Make no mistake, we can do these things in Australia—and we are going to do these things in Australia; that is, discovering ways of stimulating those cells that reside, in this case, in the brain. I see this as a 'degree of difficulty' enterprise.

I have a chart here which I have drawn as a slope of difficulty of therapy. As I have said, I think the easiest therapy is to find the drug that stimulates the cell that replaces brain cells. We know it replaces blood and we know that you and I replace skin cells every day, so there is no problem there. Conceptually, the easiest way to think about stem cell therapy is to make use of the endogenous capacity of all of us. On that slope, you can see that there are a number of hurdles that start coming in which build up to quite a climax in embryonic stem cells. Blood stem cells, as you have heard, can be easily obtainable. In fact, this morning, I was chairing a session on stem cells where it is now very clear that both cord blood and haemopoietic cells are very easily obtainable and used in therapy. I agree with Dr Simmons that the science on whether blood cells can make other tissues is still anecdotal and not irrevocable, but you have probably realised by now that science in this area is at an early stage and many of the things are unsubstantiated.

Nevertheless, blood cells are the most easily obtainable cells without any problem of rejection or anything else and if they can be used in the next stage of therapy—that is, when one does have to replace a cell—if endogenous activation does not work and you need to make up the numbers, as Dr Simmons has said, then perhaps the next easiest source would be

to take one's own blood cells and be able to stimulate then to make other tissues. As you move up the tree, up the slope, you then start running into problems of immune rejection and tumour potential. That is perhaps something that has not been raised but I think it reflects very much on this if we are thinking about replacement therapy using embryonic stem cells. As you know, embryonic stem cells were originally discovered because they formed tumours in animals. In fact, 100 per cent of these cells, when transplanted in mice, give rise to tumours.

So the only way around this at the moment is to differentiate these cells—change the cells—into non-dividing populations of cells. So in my case, if we just stick with the nervous system, what you need to do is to change all these stem cells into nerve cells so that they are longer dividing; they are nice juicy nerve cells. Then you put them back in the body. That could well be possible but I have to tell you that, as we sit here today, transplanting mature nerve cells back into an adult animal simply does not work. They simply do not survive. They simply do not integrate.

The way you and I make new nerve cells, as we are doing every day, is that these cells are generated from a stem cell. They migrate into position as an undifferentiated cell. They then undergo all these interconnections. Every nerve cell has something like 1,000 connections with other nerve cells. This process of integrating into the network is not an easy process. You cannot just hardwire in a component as you can in an electrical system. I see really great difficulties in overcoming the tumour potential by differentiating ES cells into nerve cells.

There are parts of the nervous system where you may be able to do this, and the proponents and the people developing ES cell therapy have used Parkinson's disease, where you have an area of the brain that is deficient or that has lost cells which make a certain chemical. This chemical is dopamine. It is a bit like diabetes. You are lacking a hormone. In this case, it is dopamine; in diabetes, it is insulin. Getting cells to produce dopamine may well be an interesting approach and it has been shown in animal models to work to overcome some of the parkinsonian aspects. But this is a model of just a factory of cells producing chemicals, not of integrated networks of higher function which really, in Alzheimer's disease and stroke and things like that, we are wanting to achieve. I can see exogenous cells being engineered to make certain chemicals and to act as factories of cells but they will not at this stage of development—of what we know now—be capable of being integrated into the network. So I see overcoming tumourogenesis and being able to use ES cells in the central nervous system as being a very major stumbling block. Whether it will be overcome or not, I am not sure.

When we get to the embryonic stem cell stage, there clearly are a number of clearly defined difficulties we need to overcome and the questions are: (a) can they be overcome and (b) is the potential of these embryonic stem cells so dominant that they will show a proof of principle that makes it worthwhile? I do not know the answer to those. I think it is worthwhile at least keeping the door open to see if proof of principle can occur. That is, I think the research should go on with the embryonic stem cells to find out whether the potential that has been talked about is a real potential. As everyone has said here today, the proof of principle in this debate is just not established. There is not enough data for any of us to sit here today and say embryonic stem cells can be a therapy for x or y. It is simply not there. It is unequivocally not there.

Nevertheless, there is a little bit of data that suggests that they may be very useful. Unfortunately, you are at a stage where the proof of principle is not there and we are trying to have the debate in a very clear manner. I think that is a very hard thing to do because we are just not at that stage. I think we do need two to three years of scientists—all of us here—

working very hard to see which one of these alternatives is going to go forward in a way that will lead to real therapy.

So I am having a bet each way, as you can see here. I am in the camp saying that embryonic stem cells certainly have not shown a proof of principle. There is a degree of difficulty, about which I am prejudiced because I work in the field of endogenous stem cells, to say that is easiest way to go forward, but in no way am I suggesting that we should not have a shot at seeing if embryonic stem cells really can fulfil a potential that these other cells cannot. In the nervous system, I am finding it hard to imagine what that potential is, but as a scientist I know that discoveries do not often come in a linear manner; they come from left or right field. So I would never cut off a potential cure base or a potential discovery because of the thought that you know the answer. I will finish there; I have gone on far too long. Thanks very much for the opportunity to speak.

CHAIR—Professor Rowe, do you wish to add anything, briefly? We are starting to get squeezed for time, so if your comments could be fairly brief.

Prof. Rowe—I am the venerable one here. I am a research physician, trained at the University of Sydney, and I was on the faculty at Duke University for some years. I have been, for the last 38 years, interested in the prospect of genetic or cell therapy, particularly for childhood inherited disease and developmental abnormalities. Most of the work in our organisation is related to the process of differentiation: how we become what we become. That is the very thing that Perry and others here are talking about.

We have just conducted our first adult stem cell therapy in a child, following 12 others that have been done in France and in the UK. The child will remain unidentified for some years. This is at the hard end of the business, because when you face the decisions of what to do with a particular case and a particular child, and delivering cells and genes which may or may not have impacts you cannot fully appreciate, you have to make sure that the science behind it is as good as it can be. To me, at this stage, human embryonic stem cells have very little to offer. We need to know, just as Perry said, what are the signals that say what this cell is going to become, what is going to stop it becoming tumorous and what do we know about the genes that are switched on and off in different tissues. We can do that in mouse embryonic stem cells, if we wish to do that. We can do it in stem cells that the other speakers here have referred to—Catherine Verfaillie has done some of this, and others as well. We can do that sort of work and identify where the real issues are and where the biology is—the very important biology—and that is going to take some years to achieve. One could not even contemplate going with any of these therapies into any person at the present time for any of the particular diseases that have been enunciated.

I have an interest in a number of these things that are thrown around in the press, particularly things like Alzheimer's, diabetes and Parkinson's. These are very complex disorders. To say that you will cure them by putting in a few cells is a joke. We do not even know the genetic basis. We know that there are environmental factors. We know that Alzheimer's is a global disease; what are you going to do—replace the brain? So we are looking at a very simplistic approach here to treat people. It is not even sure that Parkinson's disease is primarily caused by specific self-generated damage within the particular part of the brain which is responsible for producing the symptoms. It may well arise from a systemic disorder, and work has been done to suggest that that is the case. In which case, you put cells in and you get the same process occurring again. There is a genetic basis to many of these conditions. If you go putting in cells derived from whatever source you might think, they are going to be subject to exactly the same processes, so you have problems on your hands there.

I am very anxious to see this sort of work advance. My sole aim is to understand these processes of differentiation. I think the public, as Michael has suggested here, has been grossly misinformed as to the potential. I think that is a pity; I am not sure of the motives driving it. I feel that there is a lot of work that could be done on human embryonic stem cells, but to what end? Because I do not think we are ever going to use them in any form of treatment, not in the next foreseeable 20 or 30 years, if even then.

I fully agree with Perry's assertation that we should be looking predominantly at adult stem cells, which avoids all the problems that Michael and others have referred to. That work can be done—you can generate large quantities of adult stem cells, both from mice and, hopefully, from human beings in the future with the appropriate scientific advances—and we can look at the science. We are at the very early stages of this whole field, and I think we need to be very careful if we intend to move down this path into the widespread usage of human embryonic stem cells, with all the problems that are associated with that.

I do know that there is a market in many parts of the world for human embryonic stem cells. There is one operating in New York now called the '$5,000 dollars a flush' for females to produce a number of eggs for those purposes. I am concerned about those sorts of things and I really feel that it is important that, if we do choose to go down the route of utilising human embryonic stem cells, it is done with very tight controls as to what is going on to prevent the entrepreneurs—and what I call the shysters—from interfering in an area which has potentially great importance for the future of all of us. Thank you.

CHAIR—Thank you, gentlemen. I might just ask a few questions, if I may, of Professor Good or Professor Rowe. Are you opposed to using surplus stem cells on the basis that you do not believe that research should be done on embryos or are you just saying that it has been proven conclusively that ES cells are ineffective and will never be any good? I am very confused about this, because we have so many people who are saying, 'Let us keep both avenues open,' and we have others who are definite, like yourselves, saying, 'No, we must only use adult stem cells. We must not use embryonic stem cells and we must not research them.' To me, the whole idea of research is finding out whether they are effective or not, and if one shuts the gate on fighting out whether they are effective, we will never know.

Senator HARRADINE—Madam Chair, are you talking about experimentation on human embryonic stem cells or on animal stem cells?

CHAIR—Human embryonic stem cells.

Senator HARRADINE—I thought the good scientists were talking about experimentation on animal models first, as per the principles of science.

CHAIR—That is exactly right and that is why I asked the question: are you just opposed to the use of surplus human embryos or are you saying that this just should not go ahead? I want clarification of that.

Prof. Good—This is such an important question—you have really got straight down to the central issue here. Before I could answer that, I would like to see all the other avenues exhausted. If we were to come back here in 10 or 20 years time and we were saying, 'We've done all the animal experimentation, we've done all the adult stem cell work and we've done more and more research on animal models of embryonic stem cells. The adult stem cells don't work in people. We can't position or activate the endogenous stem cells. The embryonic stem cells are working in mice. Why don't we try them?' you would have to then look at that situation at that point in time.

CHAIR—Isn't that 20 or 30 years lost?

Prof. Good—No, because in that 20 or 30 years you can do the vast majority of what you are talking about in animal models and with adult stem cells. I am saying that we have not got the answers to these fundamental questions of the alternatives in place yet. To date, there is not one single therapy using embryonic stem cells which is successful. There are successful therapies with adult stem cells. It may be that, as I said, in 20 or 30 years time you may have tried all the avenues and you cannot find a cure for diabetes myelitis or a cure for Parkinson's disease or whatever using adult stem cell therapies and the animal models, in the interim, have demonstrated success using embryonic stem cell lines. That would be the time to re-examine this question.

CHAIR—I understand that. That is the position that you put before. The question that I am asking is: are you just fundamentally opposed to using these surplus human embryos created through ART or not?

Prof. Good—At this point in time without that other information, I would be opposed to it, because the other information is not at hand.

CHAIR—What about the 'owners'—for want of a better description—of those surplus embryos in 60 or 70 per cent of cases wanting to donate those embryos to research? Are you saying that they should be denied that opportunity for future research?

Prof. Good—I have come here to answer this from a scientific perspective. Members of the Senate and the House can obviously, like me, have their own moral perspective on this issue. My moral perspective on the issue is not what I am an expert in as it were: I have come here to argue the scientific angle. If I, and the other people here, can give you the scientific background, you senators are in an equally good position to make your own moral decisions about whether or not couples should be allowed to donate their embryos. I am not an expert in that aspect; I can give you the scientific background and say that, at this point in time, there is no reason whatsoever to proceed with that.

CHAIR—I fully understand and appreciate the position you have put. The perplexing part from where we sit, as I think you would understand, is that we have eminent scientists, like those sitting at the table before us now, who have differing views. They say that we should be pursuing both lines so that, if one is ineffective in certain areas—whether it be as Dr Simmons said in heart, kidney, diabetes and lung disease—then we will not have lost that valuable time in researching other possibilities.

Prof. Good—That is a very fair question. There is a limited amount of research money available in this country. You could say, 'Let's do research on embryonic stem cells and let's do research in parallel on adult stem cells and see where we are in five or 10 years time.' You could then pick the best, obviously, and go ahead. As a punter as it were, from where I am sitting now, I would be unbelievably shocked and surprised if human embryonic stem cells were ever to make it into cell therapy because of the major problem of immunological rejection.

CHAIR—Are you saying that we do not know that yet?

Prof. Good—There is an amount of data in animal models that the embryonic stem cell derived tissues are rejected. I brought along a lot of these papers, which I can make available to the committee. Of course, we do not know that in the human situation, but there is an amount of data in models where animals receiving ES cell derived tissues are immunosuppressed for the purpose of preventing rejection of the ES cell derived tissues. In animals that are not immunosuppressed, the tissues are often rejected. So, when there is a limited amount of money for research in this country—I deal with this issue every day and am

trying to increase the amount of funding for research—why would we waste it on putting something into human embryonic stem cell research that, in my estimation, will never make it into a therapy. We already have some therapeutic potential demonstrated in the adult stem cell work. The really exciting science is learning how to activate those endogenous adult stem cells with the chemical and hormonal stimuli and moving that way. If you asked me to make a bet, I would say that that is where the money should be spent. I do not know whether that answers your question or not.

CHAIR—Unfortunately, we are not in the gambling business.

Prof. Bartlett—I think Michael is saying that, if the proof of principle were there in the model using animal embryonic stem cells, the debate would be much clearer. I do not think he is saying, 'Do not go ahead with research in embryonic stem cells'. He is saying, 'In order to drive this, let's base this on the science and get some proof of principle and then go forward.' Michael is talking science about immunology: tissue is rejected. We have known for 50 years that, if you put a foreign piece of tissue in an animal, it will be rejected. It is even rejected in the brain, although there is some misnomer about the fact that the brain is a privileged site—it is not, things are rejected in the brain. Am I wrong, Michael? Are you saying that you think that embryonic stem cell research should go ahead in animal models to see whether it works?

Prof. Good—Definitely.

Prof. Bartlett—And that no scientist would ever say, 'Don't work on X.'

CHAIR—I understand that.

Prof. Bartlett—Michael is an eminent scientist in the field of immunology, unequivocally.

CHAIR—I am trying to focus on the bill, which is dealing with the question of human embryo research.

Prof. Bartlett—Yes, I know.

CHAIR—Dr Simmons, would you like to make a comment?

Dr Simmons—I have a small point to make, just to take up what Michael was saying about immunosuppression. Yes, I fully accept the likelihood that there will be some immune rejection phenomena going on, but, to be fair, in kidney transplants patients are given immunosuppressive drugs and they may be on those for many years, as a means of combating rejection in that setting, and that is viewed as a perfectly acceptable therapy.

Senator HUTCHINS—Professor Good, I am not a scientist and do not have a background in science. You say that, in your estimation, BresaGen's claims that 600 to 1,000 is all that is required for this research to be successful are not correct.

Prof. Good—I do not believe that is correct at all. I can elaborate if you wish me to.

Senator HUTCHINS—Yes.

Prof. Good—This was one of the very first questions that was put to me when this debate hit the public airwaves, and I went and did some research. The research I did was to think of the analogy, and go to the Australian Bone Marrow Donor Registry and look at the analogy of the size of the donor bank that is required for successful bone marrow transplantation.

Senator HUTCHINS—When you talk about this bank, am I right in saying that, on the figures, there are 53 per cent of Caucasians of that seven million? Can you explain what you mean?

Prof. Good—There are seven million people worldwide who, if they are asked to, will donate their bone marrow to a patient, if that patient has leukaemia. For the patient to find a match within those seven million people, the chances are 53 per cent if you are Caucasian and approximately 10 per cent if you are Asian. Bone marrow is a foreign tissue. The principles will be similar in that for different tissues there may well be more or less rejection, and we know that. Skin, for example, is a highly sensitive organ and is quickly rejected. Brain, Perry tells us, is rejected. Most tissues—all tissues that I am aware of—are rejected. The principles will be the same, so you would be looking for a bank of embryonic cell lines of approximately 10 million to get a reasonable chance, a greater than 50 per cent chance, of getting a match.

Senator HUTCHINS—Not 600?

Prof. Good—Definitely not 600. There are two chromosome sixes and each has five main HLA molecules—A, B, C, DR and DQ. So there are 10 molecules and two chromosomes. There are 500 different alleles or different variants of these HLA molecules. They can be mixed and matched in every possible way. When you do that, you get millions and millions of people. There are some exceptions—some are more common than others—but, in general, your tissue type might be unique in the world. There may not be another person—

Senator HARRADINE—I reckon it is.

Senator HUTCHINS—I feel that it is, anyway.

Prof. Good—So the 600 figure is just not right. The people from BresaGen should be challenged to justify why they say 600, because I have done the research and I have spoken to the people who deal with this as a clinical problem. For them, this is not some sort of airy-fairy mind game. They deal with patients every day who need bone marrow and they are the figures that they tell me. That data is published.

Senator HUTCHINS—How would you get 10 million stem cell lines?

Prof. Good—Under the current legislation before parliament, as I understand it, you would not. I believe there are some 70,000 'surplus' embryos. There are nowhere near 10 million. You would not be able to get 10 million. I do understand that this has been already banned by the parliament, but the alternative that people say is, 'Let's do therapeutic cloning,' where you take the nucleus from one of your cells, put it into an enucleated egg of a woman, make a little clone of you and use those cells to make tissue which would be identical to you. But that has already been outlawed by parliament.

Prof. Bartlett—That is precisely why it was allowed in the British act, to overcome this problem.

Senator HUTCHINS—Of the therapeutic cloning?

Prof. Bartlett—Yes.

Senator HUTCHINS—But to get 10 million, you would have to think of something like that, wouldn't you?

Prof. Good—You would have to make the embryos.

Prof. Rowe—A big market.

Senator HARRADINE—Yes, that is the sleeper.

Senator HUTCHINS—Professor Good, you mentioned commercialisation. You had a big question mark about this push. As an observation, is that where you see it coming from? Professor Rowe seemed to. If you want to, jump in, Professor Rowe.

Prof. Good—I am not a commercially oriented person but, as much as I can know, there is no future in cell therapies. There are already ES cell lines which will not be affected by the act, which could be used for research. They are already there; they will not be blocked by the act. So why do they want the embryos? The only reason I can think of is that drug companies may wish to use them for screening. I have not done the commercial trail here, but if you go on the Web, there are plenty of embryonic cell line companies that are looking to make lots of money out of getting hold of these embryos.

Prof. Rowe—For example, you can take embryonic stem cells and make them differentiate into certain tissues, like blood vessels. They would be very good to test certain drugs that you might want to stop this process in, say in tumours, because the approach to many tumour treatments is blocking the growth of blood vessels which support them. That is the sort of thing that you want them for, to be able to approach that sort of treatment in the test tube. The other thing that always worries you with all this sort of thing, particularly using embryonic stem cells, is that ultimately you are going to put them out of a test tube into a human being. In the human being they are going to be exposed to a hell of a lot more growth factors and influences on a cyclical basis—the time of day and so forth—where they will behave in an entirely different fashion, whether they are differentiated or partially differentiated. So this is the unknown question. As you say, with many of these embryonic stem cells, you put them into a rat kidney capsule or a mouse kidney capsule and you get a massive tumour in there in a few days. It will not necessarily work that way out of the test tube. It is a different environment; you are taking a theoretical basis of something that is in a test tube, subject to culture conditions, and you are hoping it all looks nice and has a few markers in there that make it look like a nerve cell or a blood cell or what have you. But then you are putting it back into a human being where it will have an entirely different set of biological conditions controlling its behaviour and development for the rest of its life. They are the sorts of things that worry you when you are working in this area.

My very strong view is: pursue the mouse stuff, see where it goes to. Martin Evans, who was the man who described the evolution of the mouse embryonic stem cell was very strong on this. He said, 'For God's sake, let's do the science in a readily accessible source. Sure, it is not a human being, but let's do it on a source; let's understand the biology of the processes that are involved in differentiation, as far as we can. Test it in a mouse model and, if people feel, and society is pluralistic and humanistic enough to want to proceed to work on these sorts of human embryonic stem cell lines, take it from there.' But I have got the same views with regard to the immunologic problems.

I would like to readdress one more question, again with regard to diseases. Diabetes is not going to be cured by putting in a cell which makes insulin or a pancreatic cell. Diabetes is a multigenic disease, particularly juvenile onset diabetes. All of you know children who have got juvenile onset diabetes. I have got two grandchildren with it. They get all sorts of complications, some worse than others. Some are virtually dead by the time they are 25. They are blind with kidney disease, peripheral neuropathy and God knows what else. Others, who never look after their diabetes all their lives—like a friend of mine from Arizona, now 75 years old, who spent most of his adult life drunk when he was not in the clinic—are working fine.

Senator HUTCHINS—He is not a surgeon, is he?

Prof. Rowe—No, he is a clinician, actually. He was the head of the diabetes unit. But the real point is that it is a multigenic disorder. There are whole patterns of genes within this that control the various complications that kill you from diabetes. It is not the sugar that kills you;

it is the complications that kill you. I made the point earlier with regard to Parkinson's disease. A close colleague of mine works on Parkinson's disease, which is a long, slowly progressive onset disorder. The process is continuous. If you start putting cells in there, what is going to happen to them? They will be destroyed by exactly the same process that was there before. So, let's not be simplistic about it. The Christopher Reeve stories are a farce. I can understand his desire to give hope to others. It is the most appalling condition, quadriplegia. But it is not likely to be solved by the use of these sorts of technologies in the near future. If you are going to go it, for God's sake go the adult route which gives you at least some hope of being able to look after your own tissues in the way they are supposed to be looked after—not foreign ones.

The issue with regard to immunosuppression is not quite the same thing when you are talking about renal transplants. A lot of people who have renal disease prefer to have dialysis rather than a transplant, believe you me, because the complications of the drugs are often worse than the disease. That is something that people do point out occasionally.

Prof. Bartlett—I was just going to address the commercial question. In fairness to companies like BresaGen, they are aware that therapy is 10 to 20 years away. Stem Cell International's CEO has said publicly that therapy, in their eyes, is 10 to 20 years away. So they have to generate some form of income along the way. To use stem cells for screening and diagnostic purposes is a perfectly understandable use of such cells. I do not think there is anything terribly nasty about what comes first in the use of these cells; in fact, it may well be that their patch is being used to screen large numbers of molecules for particular types of drugs.

Prof. Rowe—But on the other side, Perry, it would be fair to say that putting out to the general public—on the front of the *Age*—that one of the major uses for the time being of human embryonic stem cells is screening drugs for pharmaceutical companies would not be a big seller.

Prof. Good—I think the cell therapy angle is an afterthought by the proponents of this research. The reason I say that is: why would you have some people saying you need half a dozen, others saying you need three dozen and others saying you need 1,000? They have not done their homework, as it were, and they are scrambling to sell a story that the public will buy, and that is cell therapies. You do not go into any grant application or any experiment without having a clear understanding of the numbers—whether it be mice, patients or whatever groups you need—before you go to an ethics committee. To hear these numbers differ vastly between different people just tells me that this is an afterthought: 'We hadn't really thought about cell therapy, but we had better put some numbers up because we want to find some numbers that'll fit under the legislation.'

Senator BOSWELL—I raise a point of order. This is very interesting, but I think we are getting a debate between the experts where we would like to get some knowledge from the experts. Madam Chair, I wonder whether you could ask them to shorten their answers so that we can—

Senator HARRADINE—We are getting plenty of good information.

Senator BOSWELL—It is terrific, but they are winding the clock down.

CHAIR—I think our witnesses have been given the message. We have another group of witnesses due at 5.30.

Senator HARRADINE—Let us extend the time. This is one of the problems: we do not have enough time.

Senator BOSWELL—I am happy to extend the time.

CHAIR—I am sorry, but we have another group of witnesses scheduled to be here at 5.30.

Senator HUTCHINS—Professor Good, in your submission you talk about the proposed development of a tissue bank for all human embryo stem cell lines. Then you say that 'women would have to undergo superovulation.' Would you like to expand on that?

Prof. Good—The superovulation would apply to therapeutic cloning. The tissue bank idea was put forward by a number of proponents of this research to make sufficient numbers of cell lines available to overcome the problems of tissue rejection. The paper I referred to by Drukker et al in the proceedings of the National Academy of Science this year is the one that says that, to get around the problem of rejection:

… one option is to form a histocompatibility (i.e. tissue type) bank in which all human ES cell lines will be stored after being HLA-typed. Ideally, if large numbers of cell lines from genetically diverse populations can be maintained, adequate levels of isotype matching with patients may be achieved …

That is a concept that is well understood by the proponents of this research, and that was from a leading journal this year.

Senator MARK BISHOP—I wanted to ask Professor Bartlett a question. You were having that discussion about proof of principle as a precondition to any large-scale work on human embryos, in due course. Is the existing supply of ESC lines sufficient to establish real proof of principle?

Prof. Bartlett—My point is that that drives the debate quite dramatically. As I said, it does not really matter if that proof of principle comes from the animal or it comes from human ES cells to some degree. I can see one caveat by which restriction of human ES cells may be a problem in terms of obtaining proof of principle; that is, you do not really want to be doing experiments on cell lines that have been passaged for hundreds and hundreds of passages. If one were restricted to very few cell lines, whether they be mouse or human, the likelihood of being able to obtain that proof of principle may be difficult. You would want to be dealing with cells that were in the best possible state, if you want to see if they could replace certain tissues, whatever they might be. I do not think, in general, I can put a number on that. All I can say is you would want to have the best shot at trying to prove proof of principle.

Senator MARK BISHOP—If you chose to go down that path.

Prof. Bartlett—I can see no reason why you would not want to obtain proof of principle. As scientists, none of us would ever cut off an area in which proof of principle has not yet been obtained but has the opportunity of going forward.

Senator MARK BISHOP—So you cannot say whether the existing supply—

Prof. Bartlett—Experiments are being done with the existing supply, and I have to say that the data to date is still very early. There are no real indications that we have good enough data yet, using that material, to say that proof of principle has been obtained. I may well be wrong here, but the only two areas which have shown proof of principle are the areas of Parkinson's disease in a rat model, which many former trials have shown to be effective using engineered other sorts of cells, whether they be fibreglass or anything else—because they are just factories of dopamine—and to some degree in diabetes. In the more complex diseases that are talked about in terms of what the therapy will address, there really is no proof of principle. In terms of the nervous system, which I know best, there really is no compelling proof of principle to say that you have had functional repair of nervous system tissue.

Prof. Rowe—There is a small point that you might add there, that these cell lines will not be enough because, as Professor Bartlett just referred to, you do not like to keep these lines going for a long time. If you want the best result, you keep generating new ones. That has already been well established in the mouse. I think we have 400 lines in our labs. We keep regenerating new ones. So think about it.

Senator MARK BISHOP—Does that mean you need a constant resupply of new cell lines from different embryos in the future, if you are going down that path?

Prof. Rowe—Yes.

Senator MARK BISHOP—So once you open the door and the degree of research expands and goes into new fields, you constantly need new and additional cell lines derived from different embryos?

Prof. Rowe—Correct.

Senator HARRADINE—In science, in order to develop proof of principle, this is done in principle on an animal model before a human subject—is that correct?

Prof. Bartlett—Where it can be done, that is totally true. One of the problems in neurological diseases is that some of the animal models are in fact deficient in terms of reflecting the actual disease process. This is because we do not actually know what causes Alzheimer's disease or what causes motor neurone disease. So you have animal models that result in a similar complaint, but they may not reflect the underlying cause of that disease.

Prof. Rowe—We just treated a child with gamma c deficiency, a very specific form of immunodeficiency—'boy in a bubble'. The French have done 10 children, as I referred to, over the last three years. That was preceded by many years of study using that sort of approach, the gene therapy in a mouse model, which was an easy one to create because it was a single gene defect.

Senator HARRADINE—That was an adult stem cell, was it?

Prof. Rowe—The child's own stem cells, yes.

Prof. Bartlett—Animal models that are perhaps very similar to human models are those related to trauma so that when one damages tissue, you can be fairly sure there is no other underlying genetic or disease process going on. Certainly obtaining proof of principle for repair after trauma in an animal model would be required to go forward in a human model. So in that case, one would seek scientific proof of principle in an animal model of trauma before one would proceed.

Senator HARRADINE—There is no such proof of principle yet.

Prof. Bartlett—I do not think there is.

Senator MARK BISHOP—Professor Rowe, I want to go back to that discussion that you and I were having. I had gained the impression from a previous set of witnesses and a number of the written submissions that, whilst there might be 70,000 surplus human embryos deriving from ART procedures in this country, with the decision of President Bush in the US and the distribution of the cell lines around the world, the need for additional cell lines from human embryos was going to be minimal and something less than 500 or 600. Now, I am hearing you say that, if this legislation is ticked off and authority is granted across the board to people in a whole range of research capacities in the medical and scientific world, because of demand factors you are going to need essentially unlimited numbers of cell lines from human embryos to cater to the needs of the scientific community. Is that correct or did I misunderstand you?

Prof. Rowe—It depends which way it is taken, which parts of the scientific community get involved and for what purposes the embryos are used. If you are going to do a serious study of differentiation processes—and I am not sure to what extent many of the commercial companies are going to do that—it is going to take a lot more than the few lines that are out there now. Let us say, it is obvious in the submissions you have received that generating a cell line from an IVF embryo is not a simple matter for humans; even for mice, it is not that simple. There are a lot of tricks—the way you hold your mouth. There is a certain amount of alchemy involved and what time the sun sets and things like that. It is not simple. The success rate will improve as they attempt to do more. I do not doubt that at all. They started trying to make human ES cells in about 1983 or 1984. They got their first published one in 1998.

Senator MARK BISHOP—The reason I ask is that, having followed the advances of science and technology through the ART debate, there was a whole range of surplus embryos created 10 years ago. Now that science has become so advanced, you are coming down to two or three only being surplus when a couple want to create a child. I am hearing from you that that means we have a relatively finite number of surplus ART embryos, 70,000, and that may marginally increase in the next few years, but not greatly. In a number of states, they have to be allowed to be destroyed or passed on or whatever, so the numbers are going to decrease over time. As this bill gets passed, research—pharmaceutical, scientific, medical, whatever the theory of testing or the field of endeavour might be—is going to create a huge demand for embryos.

CHAIR—This has a time limit on it.

Senator MARK BISHOP—Is the proposition I am putting correct?

Prof. Rowe—Obviously, you have to get the science to show that it works in the first place. That is totally feasible. Scientists are like that—if something works, yes, you want it.

Senator MARK BISHOP—Where are those human embryos going to come from?

Prof. Rowe—You can buy them.

CHAIR—But they have to be pre 5 April in Australia.

Senator MARK BISHOP—But that expires in three years, too.

CHAIR—But we are only looking at this legislation at the moment. We cannot crystal ball gaze down the road. This committee is only looking at this legislation and the provisions contained in it.

Senator MARK BISHOP—Yes, but I am hearing these witnesses say that if this legislation is passed, as there is a finite number of human embryos in existence that is going to decline and the pressure is going to come on for, essentially, tens of thousands of human embryos to be created for a whole range of worthwhile purposes—

CHAIR—That is a consideration beyond this committee.

Senator MARK BISHOP—With due respect—

Senator BARNETT—It is the heart of the matter. It is the absolute heart of the matter.

Senator MARK BISHOP—I am sorry, Madam Chair. That is totally inappropriate.

CHAIR—Can I ask for people not to display fits of temper like that?

Senator BARNETT—It is not a fit of temper; it is the whole point of the discussion.

CHAIR—I am just asking for some courtesy.

Senator MARK BISHOP—That is not your role. I am entitled to ask that question.

CHAIR—I am just asking for courtesy. That is all I am asking for.

Senator BARNETT—Madam Chair, you have made an interpretation of the bill which, in my view—and, I think, in the view of other senators around the table—is entirely incorrect.

CHAIR—That is fine. We are all entitled to our own view.

Senator STOTT DESPOJA—As I understand it, many of my questions have been pre-empted as a result of the evidence presented today. I thank all of you. I am sorry that I was not here for your entire evidence, due to another committee commitment. But particularly I thank you, Professor Good, for your incredibly well-reasoned contribution. Your submission was a very good read. There is, though, something that concerns me in relation to matters of science and discovery. Is it not the case that, whether we are talking about quantum physics, computation or any other scientific breakthrough, scientific breakthroughs tend to take a long time, often decades?

Prof. Good—Yes.

Senator STOTT DESPOJA—Are you not concerned that it is premature—and perhaps Professor Rowe might answer as well—to stop or to put constraints on this particular research, regardless of the ethics of this debate and just in terms of the actual science? For example, Professor Rowe, you identified the fact that the first isolated and characterised embryonic stem cells were successfully done in 1998, in Wisconsin I believe. That does not seem a terribly long time ago.

Senator HARRADINE—I think it was in 1983.

Senator STOTT DESPOJA—He talked about 1983 but the actual one was in 1998. But that is not a long time ago. Are you concerned that we are shutting the door on the science? I have no doubt about the adult stem cell debate, which you have all provided us with evidence about today.

Prof. Rowe—Many us like to think about why we are doing the science, too.

Senator STOTT DESPOJA—Absolutely. Please, do not think that I refrain from any ethical discussion. But we are talking about a number of components here today, including the 'is it possible' discussion of the science. I am just wondering if it is premature to be shutting down this line of research. We have evidence telling us that ES cells have the potential to develop tumours. We know that clinical trials are still some way off, if indeed the problems are ever overcome. Is now—2002—a little early for us to say no to this line of research?

Prof. Good—I think that is an excellent question. It bears resemblance to Senator Knowles's question to me before, also. I think the issue right now is let us get proof of principle in an animal system. Right now, there are not to my satisfaction animal models that have shown that ES cells work conclusively—none at all. I would say in this very difficult situation of dealing with human embryonic stem cells it is so important, it is so sensitive in the community, that I think we owe it to the community in general to make darn sure that we have exhausted all possible other avenues.

As I see it, purely scientifically, and as I have said in my submission and verbally, I believe that adult stem cells have a far greater chance of developing cell therapies than embryonic stem cells. Let us not kill the embryonic stem cell research but let us do it in animal systems. It is relatively inexpensive, it is not contentious and at the same time we could put the very limited amount of money that we have in this country for research into something that in my estimation has a far greater chance of success.

In the meantime, people overseas may well do human embryonic stem cell research which may answer some of the questions that we all want answers to. Australia contributes a pretty small amount to the world research. We have no control of what people do overseas. I am saying that, with our limited money here, let's put our bets on something that is far more likely to succeed—particularly with something that is so sensitive in the minds of the vast majority of the population. The proof of principle just is not there. In all the scientific papers that I have seen, the proof of principle is not there yet in animal models. Let's wait till that is there and let's wait till we can demonstrate that adult stem cells do not work before we consider going down the path of human embryonic stem cell therapy in this country. I just do not see that it is ever going to work from the immunological perspective. I would not say it would never work—as a scientist, I never exclude any possibility—but you have to say that it is highly unlikely.

Senator STOTT DESPOJA—Dr Simmons, you have obviously placed on record your support for parallel research, both adult and embryonic stem cell research. I am not sure if you have been asked about this specific of the bill, but I have two questions. One is whether you have an interest in or a comment on the date to which the chair referred—5 April—and whether or not that is sufficient. Does that not provide sufficient certainty for scientists? Is it too ambiguous?

Dr Simmons—I have no real comment on that date.

Senator STOTT DESPOJA—The second question in relation to the bill is prompted by your reference in your submission to Professor Weissman in relation to some of the work that he has done. I am also aware that he not only defends embryonic stem cell research, including somatic cell—

Senator HARRADINE—He has got an interest in it.

Senator STOTT DESPOJA—I am not questioning whether or not people have an interest, but I am referring particularly to research that he has done in relation to the somatic cell nuclear transfer issue—

Senator HARRADINE—He has got a pecuniary interest in it.

Senator STOTT DESPOJA—Obviously, this legislation does not—unlike in other countries—allow that. Do you have a view that you would be willing to share with the committee as to whether or not that is appropriate within the context of this legislation?

Dr Simmons—Yes, I would want to comment on that. Speaking purely from a scientific perspective, I think it is somewhat unfortunate that, in this country, that is not currently allowed. It has, as a research tool, some amazing possibilities—for example, in rare genetic diseases—to actually create, through what would be described as a therapeutic cloning route, ES cells which would represent an inexhaustible source of cells to create models to actually approach and attack disease, which currently we have no ability to do. I am not talking about therapeutic cloning for the purpose of cell therapy but as a means to create models of diseases which currently we have no real models for. That, I think, is something that will be going on in other countries. Scientists by their very nature will go where the research is happening. In this country, I think what it is going to say to those people, if they are driven to do that kind of research, is that they go where it is going to happen. It will result in a loss of some very good scientists to this country.

Senator McLUCAS—I want to go back to the question that we were talking about earlier about putting off embryonic stem cell research for a period of time until we have proof of principle through the animal model. What would that do to the retention of our science

community if we were to say we were going to delay any research on human embryonic stem cells for a period of 20 to 30 years? What would happen in terms of the retention of those scientists and, potentially, in terms of the new scientists in the community?

Prof. Good—I think all scientists—in particular, stem cell scientists—do find stem cell science an amazing, interesting and exciting field. I think you would find that they would put their efforts into adult stem cells. Some may well be tempted to go overseas—there is no question about that. But I think the majority would say, 'Let's look at adult stem cells and let's see what we can do there,' which I think would be good.

Dr Simmons—I beg to differ on that one. If you are actually driven, as I said before, to do a certain kind of research, you will go where it is done well. If embryonic stem cell research is something that really strikes you as having amazing possibilities, you will go to good labs overseas where that is actually possible. I do not think it would be a question of a default, to just work on adult stem cells. Scientists are very driven, focused, ambitious people in that regard—they want to go where it can be done.

Prof. Bartlett—We are stating the extreme case here. We are talking about being on the verge of being able to obtain that proof of principle. We are not talking about 20 or 30 years; we have the wherewithal to test these things in the next two to three years. To take up Michael's point, it is not a question between adult stem cells and embryonic stem cells. It is a question of having the selection on the basis of the science. What we are all saying is, 'Let's work very hard over the next year or so to get proof of principle in some of these animal models, in order to come back and address this question in a way in which we can prove something that is scientifically based.' That is the frustrating point we are at. It is a very exciting point because we have the tools and we have everything ready to go, but animal model proof of principle takes time. We should be able to obtain that proof of principle in the next two to three years. If we do not then there is something wrong—either there is something wrong with the approach or it is not going to happen. Science works very rapidly when it is driven to answer a question that is big enough to win someone some prizes. Things do not take long in science; they do not hang around for 20 or 30 years. Putting a drug to market takes that long, but getting a scientific answer with a team of people takes one to two years.

Senator McLUCAS—I was using the 20 to 30 years from Professor Good, I think.

Prof. Rowe—That is the next big step: when you start looking at what is involved in transferring it to human beings. That is the big jump.

Senator McLUCAS—At the risk of causing another problem in relation to what we went to earlier, you would be aware that the legislation outlaws trading in human embryos. Do you have any view about whether or not that is an appropriate structure to cover the sort of discussion that we were having earlier?

Prof. Good—Can I answer that question with a question. It outlaws trading—does it outlaw a handling fee?

Senator McLUCAS—A handling fee?

Prof. Good—I think the answer to that question is that it does not. I think you will find that there are significant handling fees associated with it.

Prof. Rowe—There is a huge market already in the US.

Senator McLUCAS—Can you explain the handling fee some more, please?

Prof. Good—You might say that the value of goods is zero but the handling fee is $15,000.

Senator McLUCAS—Are you saying that the legislation is not clear enough?

Prof. Good—I was asking a question. Is it specific enough to outlaw that sort of thing? It is very objectionable to be trading in human tissues when we cannot trade in blood in this country.

Senator McLUCAS—I think that most people would agree with you. Are you suggesting that the legislation is deficient?

Prof. Good—It has been suggested to me—and that is why I asked the question—that that may be a loophole. There may be significant handling fees which would not be covered by the legislation. That has been suggested to me; I am not an expert in the field.

Prof. Bartlett—I am not either, but I know that the fee is quite high at the moment for distribution of cells. You can understand why it is: to maintain these cells in a state that you want to use them, to look after them is a very expensive business. You would have to weigh up the cost of maintaining those cells for distribution against what is actually being charged. Quite frankly, I do not know what the answer is. All I know is that the fee being charged for distribution at the present stage is quite high.

Prof. Good—In comparison to that, in science we exchange cell lines—not embryonic stem cell lines, but cell lines, proteins and more common products—for nothing. They are just handed across. So that is the difference.

Prof. Rowe—But if you were paying $5,000 to $10,000 for a primary source of eggs in New York City and then developed a cell line from it, you can imagine what the on-costs were going to be. There is a significant black market trade in New York in eggs.

CHAIR—Can we move on to another question?

Senator BOSWELL—We were told by previous scientists that there were enough stem cells there to do the research that is necessary. Professor Rowe, you said that you need more. We have listened to other scientists who have said that there are enough stem cell lines in Australia to do the research required to get proof of principle. Is that correct?

Prof. Rowe—I would say that is true.

Senator BOSWELL—That is all I want to know. Having said that, I will ask Dr Paul Simmons a couple of questions. On the government's biotechnology web site, you are listed as a member of the Biotech Centre of Excellence in the scientific management team. That is right, is it?

Dr Simmons—I am on the executive of the centre of excellence.

Senator BOSWELL—BresaGen told us on Tuesday that no funds had yet been distributed to the academic participants in the centre. Is that correct?

Dr Simmons—That is correct.

Senator BOSWELL—When do you expect the funds to be available?

Dr Simmons—That is a $43.5 million question.

Senator HARRADINE—I am sorry, I did not hear.

Dr Simmons—That is a big question.

Senator BOSWELL—Have any funds been received by the centre of excellence from federal or state government grants or any other source?

Dr Simmons—I believe that any funds from other sources are contingent upon us obtaining the funding from the BCE.

Senator BOSWELL—So you have no other state government grants or grants from any other source?

Dr Simmons—They are promised based on our successfully obtaining the primary funding source. If that does not come through, I do not know that any other funding will come through.

Senator BOSWELL—What about expenditure? If you have not got any money, it would have been difficult to have any expenditure.

Dr Simmons—Correct.

Senator BOSWELL—And there are no orders to supply goods or equipment?

Dr Simmons—Not that I am aware of; there is no money to pay for it.

Senator BOSWELL—Can you tell us how the negotiations are going for the signing of the deed of agreement with the government?

Dr Simmons—I am not party to that. The COO who was appointed to the centre is dealing with that.

Senator BOSWELL—And do you know whether anything has been signed?

Dr Simmons—I do not know.

Senator BOSWELL—And who is the COO?

Dr Simmons—The COO is Diana Devore.

Senator BOSWELL—What is your position in the centre?

Dr Simmons—I am on the research executive committee; I am there as the adult stem cell participant in the centre.

Senator BOSWELL—Wouldn't you know whether or not there was a deed of grant signed?

Dr Simmons—We only had our first executive meeting a couple of weeks ago and that was not discussed. You have to remember that this is a national stem cell centre. It has participants throughout Australia.

Senator BOSWELL—I take it that you cannot get any money until the deed of agreement is signed.

Dr Simmons—I would assume so.

Senator BOSWELL—I suppose you are getting pretty anxious about the funds and when they will come through?

Dr Simmons—I am, yes.

Senator BOSWELL—Dr Simmons, you made a statement that the adult cells are not being used in heart disease. Could I ask Professor Good to make a comment on that statement?

Prof. Good—I noticed that, too, when Paul made that comment. There is in fact a publication by Paul Kiddell in *PNAS* 2001 putting bone marrow stem cells into the mouse, and either growing those cells in vitro and grafting them directly onto the heart or mobilising those cells in vivo with a stem cell factor in G-CSF and showing enhanced function of myocardial infarct in the rat or mouse model.

Dr Simmons—My comments actually were specifically to do with human studies. I am not talking about mouse studies. I should also point out that the Orlic study has not been reproduced in any lab I am aware of.

Prof. Good—There were two papers: an initial one in *Nature* using the transplanted cells, and a subsequent one in the *PNAS*, which is a very prestigious journal, using the in vivo mobilised ones which gave essentially the same results but in a far more exciting way, being able to mobilise your endogenous stem cells with the G-CSF—

Dr Simmons—It has great potential, but I am aware that the company that actually markets the cytokine they used to do that has currently, to my knowledge, not been able to reproduce that observation themselves.

Prof. Good—I think this is where the excitement of science really is. This is a fairly recent publication. I totally agree with you that things have to be reproduced in other laboratories, but it is very early days. To get two papers published using an extension of the primary technology in *Nature* and *PNAS* means it has obviously gone through good peer review. Let us wait and see if it is reproducible. If it is, this is where I was saying the excitement of science is—mobilising your endogenous stem cells. The embryonic stem cell stuff is by comparison so trivial and boring I cannot believe it would excite anybody scientifically.

Senator BOSWELL—Professor Good, in Professor Trounson's submission he offers a press release from Stamford University about blood forming stem cells in mice. He says that this proves that adult stem cells will not work. Could you comment on that?

Prof. Good—I am not sure which publication he is talking about, but there have been a number of publications looking at adult stem cells in the mouse. There is the bone marrow one we just talked about leading to the heart regeneration, and another interesting one where they took brain stem cells—and Perry could comment more on this—and introduced those into the blastocyst of a mouse embryo and were able to track those cells through various tissues—in the mesoderm, mechaderm and endoderm of the mouse in multiple tissues. There are other ways to interpret the data but, at face value, it looks like those neural stem cells were able to differentiate into multiple tissues. The more compelling and, to me, far more exciting result was the bone marrow transplant of putting male bone marrow into female human volunteers and seeing those bone marrow stem cells in liver, gut and skin. So I would certainly challenge Professor Trounson on the significance of that data.

Senator BOSWELL—I have two more questions. In BresaGen's submission they say that the matching is not needed when you are dealing with the central nervous system and ailments like Parkinson's disease, spinal cord injury and stroke. Could anyone comment?

Prof. Bartlett—The idea of the central nervous system being an immune-privileged site goes back to some experiments done some 60 years ago in chickens, I think. The interpretation was totally wrong, in fact. The experiment actually was not done appropriately. My group many years ago, in a publication that appeared in *Nature*, showed very well that the brain is not an immune-privileged site. You put things in there and they get rejected—perhaps a little more slowly, but nevertheless they get rejected. The idea that you can stick anything behind what is called the blood-brain barrier—this barrier which is made up of blood vessels that stop a lot of molecules getting across—and somehow not worry about immune rejection is totally wrong.

Senator BOSWELL—Dr Simmons, we were told by the last lot of witnesses that we had that we would need seven million stem cells to get a match. Professor Good has said 10 million. I do not know what the other two scientists at the table would say. To get a match and

to actually put a stem cell into anyone's body, would you agree you would need those huge numbers of stem cells to get the matches?

Dr Simmons—It is a very good question. The first comment is that since no-one can agree on a number there is really no consensus, this is just numbers.

Senator BOSWELL—But would you agree on the principle of getting a match?

Dr Simmons—As Professor Good has already said, the degree of tissue matching varies according to the tissue you are trying to transplant. For example, a blood stem cell transplant requires a high degree of matching and greater than four or six HLA types is generally required. For transplantation of solid organs it can be a lower degree of matching. I cannot generalise and I am not going to commit to a number either—

Senator BOSWELL—Professor Silburn has put a figure on it. He said seven million. Professor Good has said 10 million—

Dr Simmons—But is that 10 million based on a calculation or is it just something—

Senator BOSWELL—He has given the figures.

Prof. Good—It is not based on any mathematical modelling and calculation; it is based on data, looking at the actual number of people in the bone marrow donor registry worldwide. It is very difficult to actually model this. Our scientists have tried many times to model this mathematically. It is surprisingly very difficult. You have to look at the actual number of people there and go through many iterations and see what your chance of getting a match is. With those seven million people you get about a 50 per cent match; that is your chance. I think the point is that they are big numbers.

Senator BOSWELL—Do you agree with Professor Good's line of thinking on this?

Dr Simmons—It seems perfectly reasonable to me.

Senator HARRADINE—Dr Simmons, you are in an area of great importance to a lot of people, particularly those people who have cancer running through their families. Are you comfortable with the overall program of the centre of which you are a participating member to integrate embryonic stem cell research with adult stem cell research?

Dr Simmons—I am completely happy with that concept. It is the reason I wanted to join the centre. Again from scientific principles, I think we serve both groups, if I could put it that way, in that the adult stem cell researchers and the embryonic stem cell researchers will benefit from understanding the two systems. In the end we both benefit. I think integration between the two is really very important. There is a synergy there and it is a driving force for discovery which neither field of stem cell research alone would likely produce.

Senator HARRADINE—The work of your centre depends on public support.

Dr Simmons—Yes, indeed, and peer reviewed grant funding.

Senator HARRADINE—In that public support there will be a large number of people in the public who will be concerned about therapies which might eventually be applied to the person with the cancer meaning that they would be placed in a position, if this integration takes place, of saying, 'I don't want to have a treatment which involves a human embryo.' The second thing is, what about scientists and students who have a conscientious objection to working in that field if they are then required to ensure the integration of the research? Integration is the word that the centre uses. What about them and their prospects?

Dr Simmons—When I say 'integration', it is an integrated centre in that it brings together researchers working on both embryonic and adult stem cells. That does not actually mean that

all the researchers in that centre will be working on both embryonic and adult stem cells. What we have in that centre is a way of sharing and disseminating information and data that we obtain in our respective labs, looking at our different stem cell populations, getting together and actually moving on and benefiting from the sharing of information. I will not be working per se on embryonic stem cells; I am working on adult stem cells. As I said up front, I am participating in the centre of excellence as an adult stem cell biologist, but I am excited by the prospect of working alongside people who are working on embryonic stem cells because those cells are amazing cells and I think I could learn a lot about how better perhaps to manipulate my cells from looking at embryonic stem cell biology.

Senator HARRADINE—You might, but there will be a number of scientists and students who would not. Therefore, by integrating—

Dr Simmons—Sorry, who would not what?

Senator HARRADINE—Who would not wish to be involved in the integration of the research, even the utilisation of information—

Dr Simmons—In my lab at present, we do not work on embryonic stem cells at all. There are no embryonic stem cells.

Senator HARRADINE—I did not say you did, Dr Simmons. It is a condition of your participating in the $46.5 million of federal taxpayers' money to involve yourself with the integration of the embryonic research with the adult stem cell research, isn't it?

Dr Simmons—That is correct. But, again, the integration is at the level at which individual laboratories work on those particular stem cells. It does not mean it has to happen in the one laboratory. Again, my laboratory, as an example, will not necessarily be working on embryonic stem cells at all.

Senator HARRADINE—What you mean, 'necessarily'?

Dr Simmons—At this point, without any funding, I am not even talking about what we are going to be doing—it is all up in the sky, as far as I see it.

Senator HARRADINE—What about project No. 15 of your centre?

Dr Simmons—I do not have a copy here—

CHAIR—Can you give Dr Simmons a hint?

Senator HARRADINE—It is to do with the integration of adult stem cell research with human embryonic stem cell research.

Dr Simmons—Sorry, I would like to see a copy of what No. 15 would actually be.

Senator HARRADINE—But you are on the executive, aren't you? Even I know what No. 15 is.

Dr Simmons—I am afraid I do not.

Senator HARRADINE—It is, as I said, the development of a program all about the integration of human embryonic stem cells with adult stem cells. You are saying that the people in your institute will be cooperating and collaborating with persons who are doing human embryonic stem cell research.

Dr Simmons—That is correct.

Senator HARRADINE—That might be okay for you, but I can envisage that that would not be okay for quite a number of scientists and students. Would it be a requirement of your centre, even if you do not do embryonic stem cell research, that you take account of what has

occurred in other laboratories in human embryonic stem cell research? Would that be part of the job of the scientists and students in your centre?

Dr Simmons—Yes.

Senator HARRADINE—I emphasise that this could be a very serious matter of conscience.

Dr Simmons—In a pluralist society, which Australia is fortunate enough to have, that would obviously extend to any students who would be working in this area. Students will work on projects if they wish to. There is going to be no undertaking to force them to work in an area. If they have a religious, ethical or moral problem with working with embryonic stem cells, they will not be working with them.

Senator HARRADINE—To get a job, they will be forced to do it.

Dr Simmons—Not at all.

Senator HARRADINE—I am sorry, you said to this committee—

Dr Simmons—Our funding in my laboratory will not just come from the centre of excellence; I have funding from completely other sources which is entirely devoted to adult stem cell work.

Senator HARRADINE—And from the public, might I remind you, and from persons who support cancer research—from people whose families are affected in that way.

CHAIR—Senator, I need to draw attention to the time. I have been trying to negotiate an extension of time, but I am aware that three of our witnesses have planes to catch. What time is your plane?

Dr Simmons—My flight is at 7.50.

Prof. Bartlett—7.50, I think.

CHAIR—Would you be kind enough to give the committee about another 20 minutes of your time.

Dr Simmons—I would be delighted.

CHAIR—Thank you very much, gentlemen.

Senator HARRADINE—I am not going to be blamed for keeping people here.

CHAIR—No, Senator. I have tried to negotiate an extension of time, and the gentlemen have enough time to give us that. All I was worried about was that we had a quorum. We now have a quorum to proceed for a little longer tonight. So if you wish to proceed, Senator, followed by Senator Barnett, and Senator Stott Despoja has a couple of questions.

Senator HARRADINE—What were the arrangements that you made with the centre? Who contacted you?

Dr Simmons—I was contacted, as I recall, by Professor Martin Pera out at the Monash Institute, who asked if I would consider becoming part of this centre, and my involvement would require my writing a project or so to submit as part of a large portfolio of projects for the centre. I believe Perry was asked the same question, in fact. That was where my involvement began.

Senator HARRADINE—And it entailed the use of embryonic stem cells?

Dr Simmons—Sorry?

Senator HARRADINE—It entailed your support for a centre which involved experimentation on human embryos?

Dr Simmons—It entailed my support for a national centre for stem cells and tissue engineering. That is what I am supporting.

Senator HARRADINE—Which would involve human embryo experimentation.

Dr Simmons—Which would involve embryonic stem cells, yes.

Senator HARRADINE—It involves more than that, doesn't it? That is only a minor part of it.

Dr Simmons—It could involve the embryonic stem cell lines that already exist.

Senator HARRADINE—But what about the testing of drugs? I am talking about the 15 programs that are part of that—

Dr Simmons—Again, you are asking me questions about aspects of the centre that I am not personally involved with. I am simply there to conduct research on adult stem cells.

Senator HARRADINE—And the integration of the information and research.

Dr Simmons—Correct.

Senator HARRADINE—You said in your submission:

... I have long appreciated how vitally important it is that the community receives accurate and balanced information regarding important biomedical issues.

What about your director?

Dr Simmons—What about my director? He is not directing anything at this point.

Senator HARRADINE—No, Professor Trounson.

Dr Simmons—He is not my director. At this point the centre does not exist.

Senator HARRADINE—But he will be.

Dr Simmons—One would hope so certainly. He is actually the CEO.

Senator HARRADINE—Aren't you rather concerned about the recent episode of Professor Trounson quoting from an unpublished account?

Dr Simmons—I think it was very unfortunate.

Senator STOTT DESPOJA—I think there is a question that this is hypothetical. The witness is not expected to answer a question about something that does not necessarily exist. Certainly we should advise the witness that he does not have to answer questions that relate to someone else and their research if he feels uncomfortable about it.

Dr Simmons—Thank you. I will take that opportunity.

Senator STOTT DESPOJA—Senator Harradine, please restrict your comments and questions to—

Senator HARRADINE—Is he a part of the centre or not?

Senator STOTT DESPOJA—My understanding is that the centre to which you are referring and the director of the centre is not in existence, and certainly you might care to act cautiously in the area of questioning a witness about another scientist, especially if the witness does not feel comfortable about responding.

Senator HARRADINE—I think it goes to the credibility of science. All scientists would be concerned about that credibility. Is it not a fact that academic and scientific integrity requires that discoveries are written up and submitted to a peer review journal to be accepted?

Dr Simmons—That is the process.

Senator HARRADINE—That process was not applied.

Dr Simmons—In what specific case?

Senator BOSWELL—In the handout that Professor Trounson gave the joint party room, he claimed—

CHAIR—Senator Boswell, I am sorry to intervene here. Dr Simmons cannot rightfully be expected to answer questions about another person.

Senator BOSWELL—I was just responding to Dr Simmons. He asked me a question and I am replying.

CHAIR—I am just making a general observation, and particularly about a position that does not exist.

Senator HARRADINE—So we have given $46.5 million to a centre that does not exist. What are we talking about?

Senator STOTT DESPOJA—They have not got it yet.

CHAIR—They have not got the money yet, Senator. You are asking Dr Simmons to answer questions about another person and about a position that does not exist. If there are other questions, I am sure that Dr Simmons and the other witnesses are prepared to answer them.

Senator BOSWELL—I did not think that was unreasonable questioning. I thought Senator Harradine's questions went to the heart of the matter. We had a rat that had no relationship to the stem cells. We had a handout that I was given that had no relationship to the research. Surely it must disappoint Dr Simmons.

Senator HARRADINE—I am not proceeding with it.

CHAIR—Senator Boswell, you have asked for Professor Trounson to be here next week and he has agreed to come as a witness. I am therefore questioning why it is necessary to ask a witness about another witness's evidence. I think there are many other questions that we could proceed with that the witnesses before us could quite capably answer. Any other questions?

Senator BARNETT—I am happy to ask questions if Senator Harradine has finished his questions.

CHAIR—That is what I am trying to evaluate. We have 10 more minutes.

Senator BARNETT—I know Senator Collins and Senator Stott Despoja would like to ask some questions, so I will try to be brief. Professor Rowe, you said that, in New York, $5,000 had been paid for human eggs.

Prof. Rowe—That was the going rate referred to last year.

Senator BARNETT—Can you describe what the circumstances were and why that was necessary?

Prof. Rowe—I was referring to the general fact—Michael has alluded to it, too—that just as there is a trade in organs, if you like, there is, similarly, a trade in eggs.

Senator BARNETT—For what purpose?

Prof. Rowe—I would presume it has something to do with the generation of clones. I understood that some of them ended up in a company that published an article, I think in the journal of—whatever it was.

Prof. Good—Alternative medicine?

Senator JACINTA COLLINS—I am sorry, we did not hear that.

Senator BARNETT—Professor Good or Professor Rowe, can you advise us what that journal was?

Prof. Rowe—I cannot say exactly, but this is the sort of activity that has been going on. You may not be aware that there are quite a number of human clones in America.

Senator BARNETT—I am trying to see if there is any relationship there to human embryo stem cell research. Do you think there is? If so, is it related directly or indirectly?

Prof. Rowe—As human cloning is not going to proceed, I presume they are going to be used for the generation of stem cell lines. That is the only assumption I can draw. I was staggered when I heard about it, but the source was impeccable so I had to accept it. Given the patterns of behaviour with regard to other tissue being supplied at a price, I am not surprised.

Senator BARNETT—Can you, either now or at a later date, forward to the committee details of that information regarding that $5,000 or whatever the circumstances were that you were describing?

Prof. Rowe—I think that would be betraying the confidence of the individual involved.

Senator BARNETT—Is there any other evidence to support the contention that there is a value placed on human eggs?

Prof. Rowe—I was very surprised that a young woman would put herself through the superovulation process to generate eggs for that particular purpose. But, as you are well aware from many sources, a lot of organs are sold throughout America for what is called a service fee. So, in the broad context of things, I am not particularly surprised.

Senator BARNETT—We heard earlier today about this trading fee in human embryos. I think Professor Good and others talked about it. You mentioned a figure of $15,000. That is what I am trying to link. Is commercialisation of human embryo stem cell research possible under this legislation?

Prof. Good—That is a question I had for the Senate, actually: is it indeed possible? I have heard of a handling fee of that order. We have never ordered any such cells, so I have never been charged that money. But I have heard a figure of that ilk mentioned.

Senator BARNETT—It would appear that the handling fee is a possibility under the legislation, but that is for the Senate to consider. Professor Bartlett, you mentioned that, in the UK, one of the reasons for therapeutic cloning was to avoid the need for tens, hundreds or thousands of human embryos for research use. Was that what you said? If so, can you clarify it?

Prof. Bartlett—We spent a lot of time talking about immune rejection. One of the ways around that is to replace the foreign nucleus with the host nucleus, so that the cell is not recognised as foreign. That is one simple approach to overcoming the problem of having to have 10 million different lines.

Senator BARNETT—That is what I am confirming. In Australia, under this legislation there would be—you can use whichever word you think is appropriate—an imperative, a requirement or a very strong influence to have a very large number of human embryos. This is a point Senator Bishop touched on earlier. Is that correct?

Prof. Bartlett—At first sight, that would be one remedy. Difficulties create invention. There are alternative ways one can envisage of engineering cells so that they might be less immunogenic than they are now.

Senator BARNETT—This is a very important point for the committee. We have 70-odd thousand so-called surplus human embryos from this 5 April deadline. Then, under the legislation, there is a sunset clause where that disappears. You have talked about seven million or 10 million being required; we have had other scientists saying, 'We only need 10, 20, 50 or a couple of hundred.' This is a dilemma. Which scientist do we believe?

Prof. Good—I would ask you to challenge the people who say you need 600 or 1,000 or 60 and ask them to justify their comments, in the light of the fact that the number is of the order of 10 million from the bone marrow figures that we have available to date in Australia.

Senator BARNETT—Thank you for your answer.

Senator STOTT DESPOJA—I just want a clarification in relation to a question I asked Dr Simmons. I used some evidence from Dr Weissman and I got a few snide remarks from people regarding potential commercial interest—I am not talking about the panel; I am talking about from senators present. Dr Simmons, can you confirm for us that the commercial interest that I understand Dr Weissman has is in two companies that deal with adult stem cell research?

Dr Simmons—Yes, that is correct.

Senator STOTT DESPOJA—Thank you.

Senator JACINTA COLLINS—I have two hopefully fairly quick questions. One relates to an earlier question that Senator Boswell asked. I am interested in Dr Simmons's response to this. In Germany and Switzerland, their national ethics committees are looking at drawing this line at existing embryonic stem cells. On the basis of the discussion we had earlier—where I think it is relatively clear that at least three of the gentleman here view work on animal embryonic stem cells as adequate at this point in time to allow further research to try and prove concept, so to speak—in your view, Dr Simmons, what are the problems with the existing lines of human embryonic stem cells to allow further work along the lines of the basic research needed to establish concept?

Dr Simmons—That is a good question. Again speaking from a scientific perspective only, one thing that it is important to realise is that the conditions required to grow human embryonic stem cells are somewhat different to those required to grow mouse embryonic stem cells. There is justification in my saying that we do not know the optimal way to grow human embryonic stem cells yet. For example, one fundamental difference between a human and a mouse embryonic stem cell is that human embryonic stem cells apparently have no requirement for a molecule called LIF—a molecule discovered at the Walter and Eliza Hall Institute—and at the moment there are a lot of people I am aware of internationally trying to find the best feeder cells to grow human embryonic stem cells. So it could be argued that some of the human embryonic stem cell lines we have now have not been established under optimal conditions, so that we have not got an absolutely optimal pool of embryonic stem cells at this point. That would be one argument I could raise in favour of the possibility of creating more lines. I think the other tangible issue, though, is that, if any of these lines were

to be viewed in the future as therapeutic products, the fact they have been established on mouse feeders would essentially define them as xenogeneic.

Senator JACINTA COLLINS—Yes, that refers back to the earlier discussion we had, where it was foreshadowed that that was a long way away and that, if we were looking at the immediate term, the issue was that we needed appropriate embryonic stem cell lines to do basic research.

Dr Simmons—Right.

Senator JACINTA COLLINS—I was not going to that therapeutic level; I was asking what might be the issues in terms of basic research.

Dr Simmons—My first answer, I think, would still pertain. We do not actually know that they are created under the ideal conditions, so any properties we see of those cells may reflect cells that have been derived under less than ideal conditions.

Senator JACINTA COLLINS—I am conscious of time limitations here, so I do not want to replicate some of the discussion. If it could be established that, in the current supply of embryonic stem cell lines, there were disaggregated human embryos that had not been put in mouse feeder tissue and were available to conduct the sorts of tests you are saying need to be done, is there any other reason?

Dr Simmons—Not aside from the potential that the conditions under which they were derived in the absence of feeders still may not be viewed as absolutely optimal.

Senator JACINTA COLLINS—Are you aware that this was one of the arguments had between members of the US committee dealing with this issue, and it was refuted there?

Dr Simmons—Is that right? No, I was not aware of that debate.

Senator HOGG—I would recommend the *Hansard* of that hearing.

Senator JACINTA COLLINS—The remaining question I have, which I hope one or all of you gentlemen might be able to assist me with, relates back to Professor Trounson's mouse slide. Can anybody explain to me why human germ cells were used on a mouse?

CHAIR—I think that question should be directed to Professor Trounson.

Senator JACINTA COLLINS—No, he did not conduct the research either, so it is a general question to scientists about the science involved.

Prof. Rowe—I must admit, I never saw the word 'human' appear.

CHAIR—I do not think they were human cells.

Prof. Good—They were human.

Senator JACINTA COLLINS—They were. I have looked into it for this reason—and this might inform the nature of the question. They were human germ cells which were taken from a five- to nine-week old foetus. There is a question over a five- to nine-week old human foetus compared with a five to nine-week old mouse foetus, which is why I established that it was a human. My question is: why would you be using human germ cells on a mouse?

Prof. Bartlett—The work was done by John Gearhart at John Hopkins University. He was the one who published the initial paper on deriving those types of stem cells. They were not embryonic; they were gonadal stem cells. Gearhart has been the driving force behind using these types of stem cells in therapy. He was seeking proof of principle of human embryonic stem cells in an animal model; that was the driving force. He has done several other experiments, although they have not been published, in order to replace types of nerve cells. I

do not know whether he has tried rat into rat—I am not aware of that—but other people have done those experiments.

Speaking as a neurobiologist, I have to say that a lot of those experiments, whereby you inject cells into animals and the animal then subsequently shows some improvement in walking, are often not related to repair mechanisms. A series of experiments has been done over the last 20 years, whereby one shows that an animal will recover, to some degree, its walking pattern where such recovery is not related to reconnection of the spinal cord. In fact, what happens is that there is a release of factors that seem to stimulate what animals have in their rear limbs, which is a pattern generator whereby they can walk independently of the connection between the signals coming from their brain and their rear limb. These types of experiments have been done using a whole variety of stem cells, including one that was done in Australia recently using olfactory stem cells from the olfactory bulb. There is a fair amount of literature out there to say that rat into rat has been done, although I have to say that the data shows that it has never been due to reconnection but to some stimulation of a hind limb generating pattern. I guess he was building on that sort of data but trying to show that human stem cells could do something similar.

Senator JACINTA COLLINS—But, from a scientific perspective, the question I do not understand is what research concept human to mouse or rat actually proves?

Dr Simmons—Maybe I should answer that because, again, it relates to the comment I made in my last answer to your question, Senator. Going from human to mouse is an attempt, as I would see it, to validate the biology, the properties of human stem cells in an animal model. For example, in my laboratory we make extensive use of adult hemopoietic stem cell transplantation. The way we would explore the biology of those cells would be to lethally irradiate a human being and transplant those cells in them—and obviously that is not ethically possible. That is what is done for a marrow transplant patient. So we use a strain of mouse that has no immune system and so it does not reject human cells. We are actually putting human adult hemopoietic stem cells into a mouse. That is a way of showing that these stem cells can indeed create human bone marrow, but in a mouse. I think what Gearhart was doing was very much analogous to that.

CHAIR—Thank you very much not only for giving us your time but also for extending that time. We are very appreciative of your having done that.

Prof. Good—I would just like to make a comment that relates to something written by Professor Trounson about the problem of rejection. This point has not been raised by the committee today and that is why I am raising it. He claimed, in my presence and in writing as well, that it is now possible to 'tolerise' a person to foreign tissue—which is the immunological phrase—by transplanting it into the thymus of the person.

Senator HARRADINE—What is the thymus?

Prof. Good—The thymus is a gland which is integral to the development of the T cells, which are the cells involved in the surveillance of all immune parameters and in graft rejection. If that argument and hypothesis is put forward, it has to be clearly understood, I believe, that it is merely a hypothesis. The experiments were done in a juvenile rat, and in a human at puberty the thymic gland involutes and disappears. If it were as simple to tolerise people to foreign tissue by putting embryonic stem cells or any foreign tissue into the thymus gland, transplant surgeons around the world would currently be doing that—and they are not. It would be wonderful if it was possible, but that is building a hypothesis on a hypothesis.

Senator STOTT DESPOJA—You mentioned that that had been put 'in writing'. Would you be prepared to table that for the committee, please?

Prof. Good—It might actually be mentioned in my submission. I will just check. If it is not, I will put it in writing for you.

Senator STOTT DESPOJA—I would be happy for you to take it on notice, but it would assist us to have it in front of us.

CHAIR—Thank you, Professor Good. You can email that, if necessary.

Senator HUTCHINS—Can I just ask: why is there a difference in donor match between Caucasians and Asians?

Prof. Good—That is a very good question. Basically, our tissue types have evolved over millions and millions of years in response to infectious agents which are present in different parts of the world. For example, malaria is in Africa and smallpox might be somewhere else. These molecules have evolved to combat infection, and we have been selected on the basis of having the best possible tissue typing set of molecules to combat infections. So when people migrate all around the world and come together—different races and so on—we bring together a totally different set of genes. It is like a memory of where we were millions and millions of years ago and of what our environment was at that time. Our immune system was never invented to be involved in graft rejection. That is a modern-day afterthought. It has evolved in response to the infectious load that we all face from early childhood.

CHAIR—Thank you very much. I am afraid we are out of time, and we bid you farewell.

[5.59 p.m.]

COULEPIS, Dr Anthony Gregory, Executive Director, AusBiotech Ltd

HEARN, Professor John, Deputy Vice-Chancellor, Research, and Developmental Biologist, Australian National University

SERJEANTSON, Professor Susan Wyber, Executive Secretary, Australian Academy of Science

SHINE, Professor John, Secretary, Biological Sciences, Australian Academy of Science

WHITE, Professor John William, Spokesperson on Human Cloning, Australian Academy of Science

CHAIR—Welcome. Witnesses are reminded that the giving of evidence to the committee is protected by parliamentary privilege; however, the giving of false or misleading evidence may constitute a contempt of the Senate. We are running a panel style of discussion. We have your submissions, except for Professor Shine.

Prof. Shine—My submission very much forms part of the Academy of Science submission.

CHAIR—Thank you. Therefore, if you would like to make some brief comments in addition to your submission, we would be happy to hear from you. Professor Hearn, would you like to kick off?

Prof. Hearn—I am here in a personal capacity, as a reproductive biologist and stem cell biologist. I have been a member of the academy's subcommittee in this area, but my submission and my comments are my own, and the academy bears no responsibility for them. I would like to highlight a couple of points that I made in my submission. Broadly, I speak in favour of the legislation that is coming forward because I see that it is firmly derived from the earlier House of Representatives report, which I believe is the most balanced of the international accounts in this area as a result of the very broad consultation in Australia.

The committee report made a number of recommendations on the legislation. The House broadly accepted them, with the exception of the issue of the six to four minority recommendation that a number of embryos in freezers might be made available for research to derive embryonic stem cells. That balance and proposition is one of the major focuses before us. That report was published a year ago, and I would like to make a couple of brief comments on events since then. In one year, globally, there have been a number of developments in this very fast developing field.

Firstly, the definitions of embryonic stem cells, foetal germ cells and adult stem cells are becoming a little better understood. Secondly, the issue of acceptability of the approximately 60 human embryonic stem cell lines that were available six months or a year ago, has clarified. These are still available for basic research, but the proposition has been put that they are not acceptable in the broad sense because they are not available for any therapeutic application. Therefore, this is an argument for why some new stem cells need to be derived, based on a wholly human cell preparation of both the stem cells and the feeder cells. I am happy to respond to any questions in that area.

Thirdly, the balance over the last year, surveying all the publications globally, is that progress in adult stem cells inevitably—because that is the most recent area of the field—has gone forward very rapidly. There is some encouraging early evidence that not only are adult stem cells pluripotent in that they can become several tissue or cell types but also that purified

adult stem cells can be integrated into a number of cell lines and indeed will adapt and be helped into the local area cell type—for example, as tissue in the heart and pancreas and, possibly, in nerve and muscle.

This is an encouraging development, but I would like to stress that it is very early days, as I am sure you are well aware. The focus on embryonic stem cells in humans is only four years old and in adult stem cells, really a bit less than that. So our knowledge of whether adult stem cells or embryonic stem cells are going to deliver the best benefit, either in advancing knowledge or in advancing potential therapies, is still open to major question. I would say that, after the last year, adult stem cells have come along a fair way. With embryonic stem cells, the work is at a more basic level, and there the objectives largely are to see what are the principles that drive a cell in one direction or another—for example, towards brain tissue, pancreatic tissue or muscle and so forth.

In my own view, and it is a judgment, I would say that embryonic stem cells are still a very long way off application to therapy. They are important to understanding cell lineage choice and they will be important to understanding what the factors are that make cells go in one direction or another—and of course that knowledge holds the opportunity for major new therapies, possibly major new drugs. I would say that, because of expense and risk, it is unlikely that embryonic stem cells per se will be applied to patients in any near future. I will move on, although I could hypothesise on a number of lines in which embryonic stem cells might give us greater knowledge at a basic level.

My last two comments underline my next one, which is that I believe it is unhelpful to have unqualified statements and sometimes emotional statements about the promise of this field, where we are at a very early stage, and in particular statements that refer to individual patients, such as Christopher Reeve, or individuals who have afflictions where this field may in the long term bring new approaches. It is quite wrong to expect—or for those individuals to expect—that in the next five to 10 years, in the normal course of science and the normal progress of clinical trials, there is going to be anything that resolves those problems. I hope I am wrong there, but I would put that point.

A further and separate point is that the approach of cloning embryos using somatic cell nuclear transfer—that is, the Dolly procedure of taking an adult cell nucleus, reprogramming it in the egg and forming an embryo from it—has been put forward as a hot new possibility for developing therapies. For at least two reasons, that is unlikely. My emphasis is not that the research should not be done—because we need to know how that process works; it is an astounding process, reprogramming a nucleus—but that it is quite clear from recent papers, including one this week in the *Proceedings of the National Academy of Science*, that a high proportion of genes in cells that are treated in that way are, if not abnormal, certainly altered. We need to know a great deal more about that process, because both cell lines coming from that process, including embryonic stem cell lines and the embryos themselves, are unlikely to go very far. Again, that is an opportunity for basic research, but I personally would not feel it was a strong argument for any soon to be achieved therapeutic advance or test.

I will just say in passing that the intellectual property related to these areas is significant. Australian scientists have a strong position, after 30 years in the field, both in the science and in the intellectual property that derives from it. Whether we are talking about embryonic stem cells and the agents or biochemicals that will alter cell choice or whether we are talking about adult stem cells, I believe that we need to support both in order to preserve Australia's opportunities in this area, which may, as we all have heard, be a revolutionary new approach to aspects of medicine and ageing.

Finishing up, I will make a couple of points on regulation and the public debate. Internationally, the situation is changing and one does have to say that the legislation coming before the Senate is quite conservative by international standards in that many of the procedures related to embryo cloning, formation of embryos for research and use of spare embryos—so-called—are now completely available in Britain and France and in the private sector in the United States. On your earlier discussion of the private sector in the United States, I think it needs to be quite clearly understood that whereas in the United States federal funds in the public sector cannot be spent on embryo research—and again I would be happy to answer questions on that—in the private sector there are no such restrictions and there is very limited review in terms of ethical committees—only at a local level as far as I am aware.

I have made a comment about suggested criteria for embryonic stem cell research because I believe that Australians do know and understand many of these issues—and this goes to the over 600 submissions we had in the House of Representatives review and report. Although Australia is a very pluralistic society, we understand the specifics. The specifics need to be quite open and transparent concerning the special status of the human embryo if research is to be allowed on it; to restrict the use of embryos to stem cell derivation and not to general pharmacological testing—say of teratologic agents; to prevent deliberate formation of embryos for research, which is currently part of legislation; to keep numbers to a minimum, and that is quite possible through the normal proposals; and, to require evidence that the research question cannot be performed on adult stem cells or other stem cells or indeed on animal stem cell surrogates.

CHAIR—Could I just ask you to wrap up now?

Prof. Hearn—Yes. My final comment goes from that. I am delighted that the public debate has been so broad and deep. I think that it is incumbent on us to be absolutely open in that debate. If we are going to make embryos available, even a few, for research and for applications, we need to say that. We should not be trying to escape by talking about when life begins or asking whether it is at fertilisation or implantation. They are embryos. If we are going to use them, it is a trade off. That is what we are doing. Let us be honest about it.

CHAIR—Thank you. Professor Shine?

Prof. Shine—I apologise in advance. I also have to catch that 7.15 plane to Sydney. I have a brief opening statement from the academy's point of view. As the senators are all aware, we live in incredibly exciting times in medical research with the whole human genome project now more or less complete and an enormous database of knowledge about our genes, and in more recent times the developments with stem cells and the potential for cellular therapy. Recognising that, the academy, virtually as soon as some of the initial developments following Dolly the sheep hit the scientific press, realised that like all rapidly developing new technologies, things were going to happen very quickly and there would be an exponential increase in our knowledge—and that is happening now—about cells and how a cell becomes a heart cell, a nerve cell or a blood cell.

In recognising that, we all realise that, in this particular area, the goal at the end of the day is to take one of our own cells, a skin cell or a blood cell, put it into culture, multiply it up, add the appropriate growth factors and transfer it or reprogram it into a nerve cell to treat Parkinson's or a pancreatic cell to treat diabetes. That is the goal at the end of the day. But to get there, the academy, and all of us as scientists, recognise that we have an enormous amount of information that we have yet to gain—a lot of knowledge we have to learn—about what triggers cells and how they reprogram themselves in this situation, which raises very complex, very difficult, very emotive issues about how to progress that. The academy, under the

guidance of Professor White, set about a very intensive consultative process throughout the Australian scientific community to gauge views on those issues, to try to plot the best way forward. In a nutshell, I believe—and my academy colleagues will tell me if I am wrong—we are here today to fundamentally support the proposed bill as a very realistic and very fair balance between not impeding unnecessarily the potential of this research so we can gain that knowledge but, at the same time, trying to recognise the very valid concerns of many members of the community. It is a matter of trying to get that balance right.

Science moves very rapidly and we are very concerned that, while we need to put in place the safeguards proposed in the bill—a total prohibition on human reproductive cloning, with limitations and strict regulations on the use of embryos from the ART program that would otherwise be disposed of, coupled with the ability to review that legislation in a few years time—we also need to ensure there is flexibility so that, as our knowledge expands and the science changes, we can act appropriately.

I remember in the late 1970s when gene cloning was first developed and we cloned the insulin gene, for example. There was enormous concern at the time that, when you put a human insulin gene into a bacterial cell, there is a theoretical potential for that to spread around and infect the population, and everyone would die from low blood sugar because they would be making human insulin. They were legitimate concerns. But the regulations that were put in place were flexible enough then so that, as we sit here today, all the millions of diabetics around the world are taking human insulin, made from genetic engineering techniques, which has dramatically improved their quality of life and saved enormous numbers of lives. We want to make sure that flexibility is also put into the legislation and we believe the current proposed bill does that.

CHAIR—If no-one else has a plane to catch tonight, I will do something a little unusual and ask honourable senators whether they have any questions for Professor Shine, in particular, before we hear from the other witnesses.

Senator STOTT DESPOJA—I want to pick up on your last point on the requirement of flexibility and you mentioned the current arrangements. I want to get clarification specifically in relation to the legislation.

Prof. Shine—As I understand it, there is an ability to review the situation in three years time, to take account of developments, because there will be enormous developments in science. We are been having a debate here today because of events over the last few months. The ability to ensure that the situation is not locked in stone so that it does not prevent the science and the good for humanity developing at that point in time. It would seem to me very reasonable to have a situation where, in a rapidly changing environment like this, you have a very substantial review in that sort of period of time.

Senator STOTT DESPOJA—Do you believe that the flexibility to which you refer is actually encapsulated in the bill? I talk about two areas of the bill, in particular, to which you have referred in your submission—certainly, Professor White you have mentioned. One is, of course, the date, 5 April, and the second relates to what Professor Hearn was taking about, the somatic cell nuclear transfer and the issue of whether or not prohibiting that in Australia is an appropriate course of action.

I was going to ask you a question, Professor Hearn, based on your comments. Yes, we are aware of the difficulties of that process. I think you finished your comments by saying, 'Until we learn more, how can we allow this?' You talk about the need to learn more. My question to you—and perhaps to Professor Shine—is: how do we learn more about that process? Do we

rely on the UK? Do we rely on the scientific work that is undertaken overseas or do we amend this legislation to provide for it in Australia?

Prof. Shine—Perhaps I might briefly answer that. The Australian Academy of Science believes that it is very appropriate at this point in time to achieve the balance that I have mentioned between not preventing the research moving ahead and knowledge being gained, and, at the same time, addressing legitimate community concerns. A moratorium for a few years on therapeutic cloning is a very reasonable road to take. During those few years, the knowledge that we will gain about that particular aspect of new therapies will come not just from overseas groups attempting or doing that but also from our knowledge about embryonic stem cells, adult stem cells and the whole process of embryo genesis and cellular differentiation—it will not just come from therapeutic cloning. I am sorry but I have forgotten the first part of your question.

Senator STOTT DESPOJA—It was in relation to 5 April.

Prof. Shine—Again, I believe that the academy supports that as a balanced view. I heard a lot of discussion whilst we were sitting in the audience from the previous submissions about numbers of cells that were needed et cetera. Looking at pursuing in the next few years the research to gain the knowledge that we will need to even contemplate proper therapeutics in this area, I would say that the numbers—and I do not know what they will be—will depend upon legitimate research proposals to the proposed NHMRC committee. There will not be a massive number of proposals; but there will be a significant number, and this is to understand it at the research level. I believe that the compromise of 5 April provides enough resources to carry out the research, given that there is the opportunity to review it in a reasonable period of time.

Prof. Hearn—I would agree with that as well.

Prof. White—So would I as the chair.

Senator STOTT DESPOJA—I have a general question for the academy: do you believe that you are in a difficult position from which to advise the community legislators and this committee in particular? Do you have any vested interests in this area that we should be aware of? I have asked other witnesses whether or not the academy is an appropriate and credible body to provide information. I know that, in the past, I have certainly relied on a lot of the work that you have done.

CHAIR—Senator, can I just ask that your questions be short, because Professor Shine has to go and Senator Collins wants to ask some questions.

Senator STOTT DESPOJA—Certainly, I am quite happy to leave it at that. I just wanted to establish whether or not there were specific interests.

Prof. Shine—I certainly believe that under the charter for the academy, which is to promote and progress excellent research in Australia for the benefit of the Australian community, we represent a diversity of researchers across the country. We have all of the normal groupings that you would expect in any population. Obviously we have a vested interest in the sense of wanting to ensure that the pursuit of knowledge for the betterment of our community—and, in this case, of quality of life and humankind—is most appropriately aligned with ensuring that we bring the broader community with us. It is a difficult area and we have to walk that line.

Prof. White—Perhaps I could also comment on that. The principal reason that this inquiry was undertaken—after the Dolly cloning—was to inform the public as clearly as possible, drawing on the best scientific information that we could. That was the principal reason: to

ensure that public discussion was informed and, indeed, to promote it. So I would say that your interest, honourable senators, in further discussing it and bringing it to the public's attention here is exactly what the Academy of Science would wish to happen.

CHAIR—Thank you, Senator Stott Despoja. Senator Collins wants to ask Professor Shine a couple of quick questions.

Senator JACINTA COLLINS—Professor Shine, a couple of issues in your submission relate to areas that I hope to explore in a bit more detail, and perhaps I will explore these areas with Professor Hearn as well. You say in your submission that it is essential to maintain public scrutiny. One of the areas, for example, on which I have some quite detailed questions on notice to the NHMRC is the fairly basic question of what has occurred to date. As I understand it, there is going to be significant difficulty in providing this committee with the details of what the NHMRC or health ethics committees have approved to date in relation to their current guidelines, which are under review. I query that first point that we are maintaining public scrutiny, because I am not sure that it has been achieved yet.

That leads to my next question, which is on the principal concern in relation to this bill: how do we build adequate regulation if we go down this path? Professor Hearn has outlined a number of issues in his submission and in his comments earlier. You indicated, when you opened your comments, that Professor Hearn was, in a sense, part of the process that led to the academy's position. Professor Hearn indicates some issues that are not adequately covered in this bill, such as that research be restricted to embryonic stem cell derivation only, as one example. The restriction of numbers is not something that is clearly outlined in the bill, and some of these other issues may or may not be adequately developed through the NHMRC process but certainly do not amount to regulation, which is referred to by Professor Hearn. When you are saying that the bill is adequate for the academy's purposes, I am interested in what process you have been through to reach that view. Professor Hearn's view, for instance, is a bit askew to that.

Prof. Shine—I will ask Professor White to address that last question, and I will touch on the first one. I know that any research on human material of any sort—as I am sure senators are aware—must go through a human research ethics committee at a particular institution. At the institution I am at, the Garvan Institute at St Vincent's Hospital, we have an appropriately constituted ethics committee with extensive lay representation et cetera. These are all very public committees with very public documentation. I would be very surprised if it was difficult to find the extent of any research on human adult or embryonic stem cells at this point in time.

Senator JACINTA COLLINS—The questions I have amount to things such as what the extraordinary circumstances are—that is one of the provisions in the current guidelines—that have been taken into account by the Health Ethics Committee. At this stage, informally, I am told that this sort of information is going to be very difficult to gather for this committee—in part due to the time frame, but perhaps also in part because it involves—

Prof. Shine—I would have to take advice.

Senator JACINTA COLLINS—My concern is that this information has never been centralised, and yet we are told that AHEC is currently reviewing the guidelines. You cannot conduct an adequate review without assessing current practice.

Prof. Shine—All I can do is reiterate that the current practice for any sort of human experimentation is well documented, and I thought it would be well available. I would myself—although I am not a stem cell expert per se—be very surprised if you would find any

human embryonic stem cell research to any extent having already occurred in Australia, simply because the state of technology is still so very early. A lot of what we are talking about is all potential, and the vast majority of research has been on animal cells.

Senator JACINTA COLLINS—No, we have already been told that there has been some work done in New South Wales. Professor Tuch, for instance, seemed confused that, in relation to already established embryonic stem cell lines, he needed Health Ethics Committee approval. Yet the NHMRC submission told us that you do not, which is another issue that we are still trying to clarify.

Prof. Shine—I am sorry; I cannot answer.

Senator JACINTA COLLINS—The only point I meant to make is that you have indicated we need to maintain public scrutiny, and I am indicating that, at least from what I have discovered so far, there are big questions over what public scrutiny already exists.

Prof. White—Perhaps I could say a word.

CHAIR—Could I intervene for a moment? Professor Shine, if you wish to leave, I think many of the questions can be directed to the academy.

Prof. Shine—My colleagues will be more than adequate to answer them.

CHAIR—Thank you very much for giving us your time. I am sorry that we were delayed; it was unavoidable. We will rely on your colleagues to fill in for you.

Prof. Shine—Thank you all very much for your interest.

CHAIR—Professor White, I am sorry to have interrupted you.

Prof. White—I direct the senators' attention to point 4 in the academy's submission, which reiterates the principal position we took in the green paper on human cloning of 1999. To address the point the honourable senator has raised, the focus of point 4 was to maintain peer review and public scrutiny. We have now been saying for three years that there has to be public scrutiny. We do not want to follow the path the United States has followed, where private enterprise can go its own way and, as John Hearn has already said, is going its own way.

It is essential that Australia do this in an open way, and that the regulatory procedures that you set up in writing this bill—and in amending it if necessary—are ones that deal with the problem of gathering the existing information. The academy would fully support that. Secondly, we favour a two-tiered process: one at the local level—such as the ethics committees you have just heard Professor Shine talk about—and also a national one that is specifically for this type of research. It has so gripped the public's imagination and so gripped people from the point of view of the ethical consequences and the moral aspects of it that I think only some form of publicly responsible body dealing with the regulation nationally would be of value.

Senator JACINTA COLLINS—Would you concur with Professor Hearn, then, that that level of accountability should come back to the parliament? For instance, a provision in this bill allows for the sunset clause to lapse without recourse back to the parliament. Implied in Professor Hearn's comments about regulations is that such things are disallowable instruments and there is ultimately some parliamentary recourse, whereas that would not occur under the bill as it is currently framed.

Prof. White—I think the National Health and Medical Research Council has to table a report to parliament. It seems to me that, if it does not do that, it is an omission. If it does table such a report to parliament as a national body, this should be one of the components of

it, so that parliament is regularly informed and can conduct the review that is necessary after three years.

Senator JACINTA COLLINS—One of the issues with the regulation is that we are told that, for example, underpinning the provisions that are set out based on the current NHMRC guidelines in relation to destructive embryonic research is a review of such provisions conducted by AHEC. We are also being told at this stage that AHEC is not likely to make the outcome of that review available to us in time for us to see if we believe that those guidelines are an adequate way to assess the provisions as described in the bill. So that does not have recourse to the parliament; that just has recourse to the NHMRC.

My view is that the best way to regulate this area is to clearly specify what we mean by such things as 'significant advance in knowledge', rather than leave that in the hands of AHEC or the NHMRC. One way around that is to do it in such a way that you allow the NHMRC to advise us. Then, perhaps, the government regulates and the parliament has control in relation to it being a disallowable instrument. But, at the moment, the way the bill is framed does not allow that recourse to parliament at all, and we are asked to make a decision before we have even seen the NHMRC's assessment of the way the current guidelines are working.

Prof. White—Off the top of my head, I would say that we should expect that that review would encompass what has been discussed; namely, an essential reviewing and reporting mechanism. I would suppose that they are the competent people to advise you about it because they are the experts. So they should have the responsibility to prepare advice for you that is clear.

CHAIR—I plan to go back and hear the opening statements which we have not yet heard, and then reopen to questions. Before I do that, Professor Hearn, do you want to make a quick comment on what Professor White and Senator Collins were discussing?

Prof. Hearn—Senator Collins, I believe the points I made earlier and in my submission are compatible with the legislation. They are just straightforward, logical questions that I would ask if I were reviewing any proposal for embryo research. They should be able to be answered relatively simply, justified and, indeed, reported back. I cannot speak for the NHMRC or AHEC.

Senator JACINTA COLLINS—Where does the bill provide for your concern about embryos being destroyed for pharmacological purposes? Where is that provided for in the bill?

Prof. Hearn—I do not know specifically where that could be dealt with, but I think the criteria to allow embryo research need to take that on board.

Senator JACINTA COLLINS—Yes, but are we just to hope that happens or should we seek that in the bill?

Prof. Hearn—I do not know whether that would be covered or not, quite frankly, in the current provision.

Senator JACINTA COLLINS—I believe not.

Prof. Hearn—I am speaking from experience in the United States, where I would not have been satisfied with procedures in the private sector.

Senator JACINTA COLLINS—Thank you.

CHAIR—Could I come back to opening statements, halfway through the event. Are there any comments that you would like to make, Professor White? Then we will move on.

Prof. White—I think the first comment to make is that the statements made by Professor Hearn and Professor Shine say a lot of things I was going to say to you and I am very glad they have been said, so why say them again? The second point, though—and perhaps the most important of them—is that there has been a lot of progress, a lot of development, in the last year or so and it is very important that we should take notice of that. I have been listening to your proceedings. I came on Monday or Tuesday, I think it was. I heard the difficulties that the committee has in understanding why some scientists will say this and some will say that. I have to tell you it is generic.

Senator JACINTA COLLINS—That is scientists.

CHAIR—It is life, isn't it?

Prof. White—It is life. Maybe I can just read into the record a matter which actually came up at something which has been referred to a couple of times in your dealings, the discussions on the ABC 'Future of the Brain' program in August, where Professor Blakemore—and I do think this is the moral lesson of these difficulties—said:

We do ourselves a disservice—

And I read this from the point of view of the academy—

if we give the impression falsely to the public that science works in terms of leaping from one miracle to another and science is always going to deliver the new miraculous cures [tomorrow].

He then said:

... science is propagated and empowered by controversy, by differences of opinion, by disagreement, by unresolved findings, by contradictions, by a lack of understanding; those are the things that really describe science, we mustn't give to the public the impression that science always speaks in terms of certitude ...

Please, Senators, remember that there is incoherence, perhaps, in the evidence that you are getting because of this. The Academy of Science has tried as a body which understands science to bring together as informed a view as possible about this difficult subject, both at the level of human cloning—which was our first paper—and at the level of the stem cell research as it was a year or so ago. I think Professor Serjeantson has copies of that document if you wish to have copies of it.

But there will be uncertainties and, if there is a principal argument that we wish to put to you, it is that the research itself—by this staggering process that I have described—will resolve some of the difficulties, at least some of the ambiguities, that you are faced with. It will not resolve altogether the ethical questions. I think they are of a different order, and I respect those people who have a different view to that which we in the Academy of Science have taken. But there is a variety of views in this country, as has been shown. So we are trying to speak with a scientific voice about the possibilities scientifically and what we think is worth doing.

CHAIR—Thank you.

Prof. Serjeantson—I will take a step back and just explain a little about the Australian Academy of Science, given Senator Stott Despoja's question. The Australian Academy of Science was established by a royal charter in 1954 and it is a private organisation of about 330 of Australia's leading research scientists. They have been elected to the academy for their personal contributions to science across a very broad range of disciplines. The fellows occupy senior positions in universities, in the CSIRO and in industry.

The academy recognises research excellence. It advises government; sometimes when it is asked, sometimes when it is not. It organises scientific conferences and has national science forums. We publish scientific books and journals; we conduct international scientific relations; we foster science education; we prepare textbooks for junior, secondary and primary school students; and we hope to promote public awareness of science and technology. I hope that it will be seen that we do not have a vested interest in anything more than increasing public awareness of science and bringing informed and balanced comment to the debate.

In our submission we have put forward the idea that the Australian Academy of Science considers that research is warranted across a range of sources of stem cells in the hope of developing tissue for use in repair of damaged tissues. We would all be very happy if we thought that scattered adult stem cells could be used for tissue repair. The ethical dilemma would then go away, with it being set aside. But we think it is unlikely at this time that the different types of stem cells—whether derived from germ cells, blood cells, adult tissues or embryonic stem cells—will all have the same characteristics; we think it is unlikely that they will all have the same potential to develop into particular tissues. So, at this stage of the development of scientific knowledge, we can only say that our knowledge is flawed, we admit that it is flawed, and we plead for flexibility in the legislation so that the rapid advances that are taking place in this field can be revisited from time to time.

As you have heard from Professor Shine, the academy accepts the current draft legislation that makes it illegal to create an embryo outside a woman's body for purposes other than assisted reproduction or by a process other than the fertilisation of a human ovum by human sperm. We think this is an appropriate position to take at this stage of the debate and at this stage of community acceptance. However, we also commend the original statement by COAG that acknowledged the rapid pace of scientific developments in this area. COAG agreed that arrangements for research using excess ART embryos should be reviewed within three years. We support that review. We think it is very strict legislation that introduces the criminal code and that the NHMRC licensing committee may, in the goodness of time and public debate and in the interests of increasing scientific knowledge, have its powers extended under the review of the bill.

CHAIR—Thank you very much, Professor. Last, but certainly not least, Dr Coulepis.

Dr Coulepis—Thank you, senators, for this opportunity. I am here in a slightly different capacity. AusBiotech represents here, today, the voice of our members. They include companies, researchers, stakeholders and, more importantly, the community, which often comes to AusBiotech for comments and information. We are at the edge of academia and industry, and the community often comes to us for information and debate. Therefore, without taking up too much time, I wish to deliver a few simple messages which summarise our very simple submission, which has come from our membership and the people we have consulted.

The first message concerns the extensive two-year process that led up to the Andrews report. Let us not forget the amount of work that has happened but be cognisant that, with some of the information you are receiving, the research—as my colleagues have said—is moving so fast that, at any one point in time, all you are seeing is a snapshot of where science is going. We need to understand that process. Many of my colleagues who called me before I came here today were keen for senators to understand that trying to crystal ball gaze where science is going to lead is a very difficult thing, and it has not been done. Apart from this sort of debate, no-one actually asks scientists to crystal ball gaze about what is going to happen the next time they look down a microscope. So we are looking at a snapshot, and the extensive two-year process cannot be underestimated.

Secondly, the outcomes of the COAG meeting offer a national approach. Our members were very solidly behind the benefits of a national approach and national legislation that covers all states. They are concerned at the ramifications, if this bill does not get through, of states going out and doing what they want to do—as a number of premiers have said. Therefore, the national approach offered by this legislation is an important factor that should not be underestimated.

We agree wholeheartedly with Professor Hearn and others. AusBiotech certainly does not wish to promote or enter into the hype of the immediacy of cures, nor that all research will be successful. Very often, you need to do several experiments to get the successful one that takes you to the next stage. But, being cognisant of the fact that we are not entering into the hype and that it could be five, 10 or 15 years before we get a tangible benefit, the input from a number of our members, and especially from the community, has been: why would you simply not take the position that human suffering deserves the exploration of avenues to ease that burden, knowing that in some cases there are no met needs for these cures? So we are not saying that it will happen, but why not explore the option of relieving pain and suffering?

The second last point concerns the regulatory regime of legislation. The currently existing elements of regulation in Australia, such as OGTR, are not insignificant and actually do enable a foundation by which we can move forward.

I would like to finish by mentioning the community element. The community—those who have communicated with us—is looking at an element of hope. Why would our political leaders deprive the community of that element of hope? AusBiotech members, feeding into the AusBiotech directors, have taken the position of urging our political leaders to move forward, with the legislation unamended, in the interests of starting the process. We could debate every paragraph in this legislation for the next 20 years and still not get to a point where we have some consensus. So AusBiotech is urging that we start by passing the legislation and then, as in all due political process, if there are things to be fixed or corrected they will come out as the knowledge emerges. As my colleagues have said, science is a moving target. The simple message is: let's get moving and not delay something that could potentially have a significant impact on the community.

Senator McLUCAS—It was put to us earlier that we could delay the introduction of this legislation so that we can get more significant proof—I think the scientific term is 'proof of principle'—in the animal model. One witness put it to us that we could wait some 20 to 30 years for that to occur. Another witness put an alternative point of view that we could have proof of principle in the animal model in a couple of years time. The question I want to go to is: what happens if we do not have a piece of legislation regulating the use of embryonic stem cells? What would happen to our science community if that were to occur? It has been put to us that we would lose scientists and those people from Australia who have done a lot of good work internationally if we were not to have this type of legislation. I am interested in your comments.

Prof. White—I think this is a great opportunity to have Australia-wide legislation, as has just been said, so I commend this opportunity to the senators. A lot us, certainly in the Academy of Science, are very keen that the situation should be clear for all Australians about what should or should not be done. It seems to me that the legislation, however imperfect it might be, does actually provide that. What is why, as my colleague has said, we support the legislation as it is at the moment, with the provisions that it could be revised in three years and so on. That is the first point. Concerning your second point—namely, what will happen if you do not support it—it is a speculation and scientists do not like to speculate.

Senator McLUCAS—That's our job!

Prof. White—Of course people will do what they want to do and, on the whole, scientists are very driven by their interests—that is why a lot of them work so late in their laboratories and all that. So I suppose that for reasons of personal interest—and I would put it like that; it sounds a little blown up but it isn't as there is an enormous commitment from scientific people to what they are doing—some might well leave, if I may speculate. I think that others would try to make the best of what they could do. As John Hearn has mentioned, I think a very key thing is happening in Australia: people are identifying the factors which say to the embryonic stem cells, 'Please become a nerve cell,' 'Please become a muscle cell' or 'Please become something else.' That is world leading research in Australia, and it seems to me that those sorts of indications are reasons that lead the academy to say, 'Please let us move forward.'

Prof. Hearn—Firstly, I would say that the advantage of having unified legislation across Australia, covering the private and public sectors, is substantial. Secondly, there is major advantage in having scientists, industrialists or whatever knowing exactly where they stand. Thirdly, it is an opportunity for Australia to put some really balanced legislation in place and establish that position in the international competition.

Dr Coulepis—We have some fairly straightforward feedback from our members. We have, as part of our membership, four of the companies involved. Again, the position we are taking today is a general position of all the industry. We have BresaGen, ES Cell International, Stem Cell International, and there is one other that does not come to mind. Two of those companies support the position we are taking. Two actually wanted us to go a bit further, but we feel that the position we have taken is the one that covers the broader industry. Senator, I hope that covers your point—that we are looking at the broad picture rather than any particular stakeholdings.

All four companies have said quite clearly to us that they believe they are at the cutting edge. If this legislation does not go through, they are first of all going to turn to their states—which is why we believe that the senators who are concerned about this legislation would be less concerned if there were national legislation which then controls what we do in the country, as opposed to allowing the country to go its own way. One of the cautions we are getting from our stakeholders is that national legislation will give us that degree of unity to be able to say how we can control this better. So the companies are saying, 'If this does not go through, we will first turn to our states. If we cannot get any relief from our states, we are going to go offshore.' It was very disappointing for us.

We had our national conference in August. We had some 1,400 people attending that national biotechnology conference, with about 150-odd international people attending. There was a strong delegation from the UK, and they were simply saying to us, 'Come to the UK. Why lose that cutting edge in the technology that you have got? Come to us.' The reality is that you will see the industry starting to say, 'If we cannot cut it in Australia, we have to go somewhere else, because we do not want to lose that cutting edge.' That will also drag the scientists, because the scientists are at the cutting edge. They wish to publish, they wish to do some good, they wish to make a mark in the community and—I agree with my colleagues—they are not going to be stopped. They will go. Therefore, in terms of the national approach, the national legislation gives us that element of safeguard. The national approach also helps us retain the cutting edge we have here and retain the scientists who would ultimately drift away. So do not underestimate the impact of the scientific community saying, 'We are

passionate about this. Will we stop doing what we are doing or will we go somewhere where we can continue to do it?'

Prof. Hearn—If I may comment on proof of principle, I would suggest that proof of principle for the field is there from the earlier animal work and the recent human work. If the principle is: 'Here is a potentially revolutionary new area of biomedicine and the astounding new understanding of cell flexibility and potential application,' I think the principle is there. If we are talking about the principle in a more specific way, of either embryonic or adult stem cells or whatever, that is not there. It is going to take longer to understand the rules.

Senator McLUCAS—Could I ask you to speculate on what is longer, because this seems to be an issue—how long can we wait?

Prof. Hearn—Looking at other areas that have developed in the last 20 or 30 years, as I say in my submission, it would wise to be talking of at least of five to 10 years before practical application. I hope I am wrong. You can never predict whether a line of stem cells might be applicable to heart disease, and there is some early sign that that may be so. But my timing in that prediction is that I would expect, unless in extreme cases, that application would need to wait for the scientific process and for the clinical trials process.

Dr Coulepis—The scientific process may be a number of years, but if you look at the time to take a therapy to market, you are talking eight to 14 years. So even after you have got the therapy, you are talking about a period of eight to 14 years to get it through the regulatory regime and onto the market. We are not talking about a quick fix, but we are talking about something that could have an impact in the lifetimes of people who are currently living, something that would go through the system and have a beneficial effect should the research come out to be positive. Again, we do not know that anything will come out of this. The consensus with all science is that you do not know until you have explored all the options.

Prof. White—I think that is quite right; I would support that.

Prof. Hearn—And we do not know what products will come to market. Embryonic stem cell applications would be hugely expensive and may never come to market. Principles that are derived from studies of those cells is something that might be more pure. Adult stem cells possibly, derived from the individual and applied back to the individual, might.

Senator STOTT DESPOJA—Professor Hearn, is it a correct or sweeping statement for someone to state that adult stem cells are superior to that of embryonic stem cell lines?

Prof. Hearn—I do not think that statement can be substantiated at present. Whether it is superior or inferior is a relative term. It depends on the precise question. We do not know enough about the biology of either embryonic or adult stem cells to make those precise comparators.

Senator MARK BISHOP—Your response is completely the opposite of that of the three or four professors who sat here in the previous session, and that is why Senator Stott Despoja asked the question. They repeatedly made the point that there had been significant, documented, peer-approved or reviewed advances in particular fields with the use of adult stem cells and that there had been none in the area of embryonic stem cells. And now you say the opposite in response to Senator Stott Despoja's question.

Prof. Hearn—No, I am not saying the opposite. Indeed, my submission says exactly the same—that in the last year there have been some very encouraging signs with adult stem cells, keeping in mind potential application. In embryonic stem cells—as I say in my submission—I think the focus is rather more at a basic level, an understanding of cell behaviour and cell flexibility.

Senator MARK BISHOP—I am sorry; I understand.

Prof. White—I could add one thing to that, though. Just as there have been encouraging things, there have been discouraging things—cultures of adult stem cells have adhered and so on. There are matters to be sorted out.

Dr Coulepis—My colleagues might wish to correct me from the scientific perspective, but it is also an element of time. Adult stem cells have been in the arena a lot longer than embryonic stem cells. John, is it correct that there has been a lot more work done on adult stem cells because of the element of time and therefore you would expect there to be a larger volume of information there?

Prof. Hearn—I do not think that is correct actually, Tony. I do not want to go on at length, but embryonic stem cells initially were discovered in rodents and before that in frogs and so forth, going back into the fifties. The break to primates in our lab came in 1995-96. It was a continuum. The concepts have been around for a long time. Adult stem cells, because of the huge interest in the last two to three years and the potential for alternatives to the use of embryos—which we all want to see—have got a great push in that period.

Senator BARNETT—Professor Hearn, in the third paragraph of your submission, you say:

> The proposal is that a small proportion of the 60,000 embryos in storage in Australia might be used to derive embryonic stem cell lines for basic research in cell biology and the development of therapies.

Can you advise the committee of your definition of 'a small proportion'?

Prof. Hearn—I will not put a number on it and I will gently point out that in *Hansard* on 29 August, Senator Barnett, you commented that I had provided advice that a maximum of 200 of the 70,000-odd embryos might be needed. I cannot make that statement. Also, 'for cure purposes' was mentioned in *Hansard*. Stem cells may not actually cure a disease; they may be of interim assistance, but the underlying disease may still be there. So, without wanting to go into detail, I make that point.

But to your question now: I think anyone in the field would like to see as few embryos used as possible. The purpose of the study of embryos and the derivation of new embryonic stem cells is one that one does not want to rule out but wants to see developed—and I am speaking personally here—under rigorous conditions that justify it. But I could not say, as you have suggested, that 200—

Senator BARNETT—You are an expert in the field, Professor Hearn. You are sitting here as an expert witness.

Prof. Hearn—I am here after 20 years work in implantation and stem cell biology.

Senator BARNETT—You have said in your submission, 'A small proportion'. Can you give us a figure?

Prof. Hearn—No, I cannot give you a figure.

Senator BARNETT—Professor Hearn, you made a submission to the National Health and Medical Research Council consultation committee.

Prof. Hearn—I did.

Senator BARNETT—Are you prepared for that submission to be made public?

Prof. Hearn—Absolutely.

Senator BARNETT—Thank you. In point 6 of the paper, you say that this raises the moral dilemma of whether a few tens of these embryos should be used for stem cell studies. 'A few tens' to me would describe 10, 20, 30, 40 or maybe 50. I am not sure. Do you want to expound on that?

Prof. Hearn—I would be glad to define it. I think we are talking here about a moving field, in terms of the knowledge of what stem cells can do, and indeed how one can derive them and how few or many embryos might be needed. For example, during the House of Representatives inquiry, we were told in some submissions and by some scientists that we did not need any more derivation of new stem cell lines. That position changed, with the changing of the science, and it became apparent after that inquiry—because of the issues of the growth of existing stem cells on mouse feeder layers—that there may be more of a case for a number to be used. That number will depend on what the legislation and the regulation permits in terms of the questions being asked. I cannot put a number on it—and that is a personal statement—because, hopefully, advances in adult stem cells in the next two to three years will restrict and make unnecessary the use of many embryos.

Senator BARNETT—Professor Hearn, in your submission to this committee, you have talked about 'basic research in cell biology and the development of therapies'. Earlier in the debate today, there was some discussion as to whether that included drug testing. What is your definition of research?

Prof. Hearn—My definition of the more basic research and the sort of research I have been engaged in is understanding the fundamental processes—in this context—of how cells behave and the potentials of cells, and our astounding new understanding of how cell nuclei can be programmed and reprogrammed and how cells can be pluripotent. I would not personally put testing of pharmaceuticals on cells or embryos in the realm of basic research.

Senator BARNETT—This question is directed to the professors from the Australian Academy of Science. I want to clarify what Professor Shine said earlier today. I understand that he said that he supported a moratorium on therapeutic cloning. Can you confirm that?

Prof. White—As you see, we have retained our position about therapeutic cloning, and we do not wish to disguise the words by calling them cell nuclear transfer or something of that kind. We have always spoken bluntly about this matter.

Senator BARNETT—The Academy of Science supports a moratorium on therapeutic cloning?

Prof. White—That is correct.

Senator BARNETT—Can you say how long for?

Prof. White—We think that is something that should be revised in the light of experience. It is a compromise, I have to say to you. The position of the academy is quite clear—namely, that we think that ultimately, if there is to be derivation of stem cell lines which have immunological compatibility with individuals, something like that will have to be used. And at the moment the position of the academy is that it is unwise to close that off as a possibility in the future.

Senator BARNETT—That is why I am asking you what is the position of the academy. You support a moratorium and yet your submission, in black and white before the committee, says that the academy supports therapeutic cloning.

Senator HARRADINE—The last line.

Prof. White—We do support therapeutic cloning as a possible way ahead for the production of appropriate stem cell lines if that turns out to be what is needed to produce them. However, I have to say to you that the position that has been put by the Andrews committee, as I understood it, was that there should be a moratorium on that, and that is why that particular word comes up.

Senator BARNETT—I am not asking about the Andrews committee; I am asking about the academy. There is a difference between a moratorium and supporting therapeutic cloning.

Prof. White—Yes. I would have to say that we support therapeutic cloning.

Senator BARNETT—Right.

Senator HARRADINE—Could I clarify that term. In your submission you use the words 'therapeutic cloning'. Are you aware that the National Health and Medical Research Council's Australian Health Ethics Committee has repudiated the use of that term?

Prof. White—I am not aware of that. I read the transcript of 29 August where that statement is made and I would like to turn to my colleague Professor Serjeantson who has done some research on that matter.

Prof. Serjeantson—Only a little, Senator, but I did hear you ask a similar question on Tuesday and I have not been able to find a public document where AHEC had repudiated that term.

Senator HARRADINE—Could I help you there?

Prof. Serjeantson—I have had a telephone conversation with officers in AHEC today and they informed me that I cannot have access to that document. It is not a public document. It was a private submission that was given to the Andrews committee, so I am not aware of it.

Senator HARRADINE—I received a copy of it from an official source. If I can get it, surely you can get it.

CHAIR—What source was that, Senator Harradine?

Senator HARRADINE—I can check it up.

CHAIR—It was not among the documents that were provided in confidence the other day?

Senator HARRADINE—No. This is in the parliament; it is public. I must admit it was after you used the words 'therapeutic cloning'—I think that was in 1999 that you first—

Prof. White—It was.

Senator HARRADINE—This was subsequent to that. I am not trying to reflect on what you said. Could I point out that on 15 January 2000, AHEC stated:

> The more recently coined term 'therapeutic cloning' collapses both (a) the distinction between therapeutic and non-therapeutic research on embryos and (b) the distinction between destructive and non-destructive experimentation on embryos.

In other words, you are talking about destructive cloning. It is the same process, is it not? Cloning is cloning is cloning—it is a somatic cell nuclear transfer. It is exactly the same whether you eventually put the human embryo into the uterus of a woman or whether you destroy it for the purpose of getting stem cells or whatever. It is the same process, isn't it?

Prof. White—Senator, I am glad to agree with you. It is certainly cloning, and the academy has never resiled from that point of view. It is the method, which was used to produce the sheep 'Dolly', that can actually allow the DNA from any particular donor to be expressed in embryonic stem cells. The only virtue of it from the point of view of future

science is that that particular potential is the only way we know to go about that point. So, of course, it is destructive cloning—I am afraid I have to agree with you.

Senator BARNETT—Dr Coulepis, in your submission you state:

AusBiotech did not at any stage support reproductive cloning as an acceptable avenue to achieve research advances.

Is that right?

Dr Coulepis—That is correct.

Senator BARNETT—What is your position on therapeutic cloning?

Dr Coulepis—The same. As was the case with my colleague, you might support it as a good thing that should be done at some point in the future, but not something that should be done right now. So our position is that we do not support reproductive cloning. The position of our members is that therapeutic cloning is in the same category at this point in time, knowing that, as knowledge evolves, as the situation evolves, there may be another debate down the track—whether it is six months, one year, two years—that may actually us in put a different position.

Senator BARNETT—Do you support a moratorium?

Dr Coulepis—At this point in time, we are supporting the legislation as it stands.

Senator BOSWELL—That is in complete contradiction to what Professor White has just said. You are 180 degrees apart, because Professor White stuck to his submission while you are going off at a tangent.

Dr Coulepis—I am sorry, how can you say that?

CHAIR—Dr Coulepis is sticking to his submission; it is not the same submission.

Dr Coulepis—It is a different submission.

Senator BOSWELL—I am sorry. Are you putting different submissions up? I thought you were all members of the academy. I apologise.

Dr Coulepis—I am AusBiotech.

Senator BARNETT—Dr Coulepis, in your opening remarks you talked about two of the four companies wanting to go further. Can you expand on that and advise us which two companies?

Dr Coulepis—One of them you have a submission from, so I am happy to talk about that. BresaGen was very keen for the sunset clause date of 5 April to be brought back to 2002. That was one of the companies. The other company has not made a submission, so this was hearsay; therefore, I would like to leave it to the company that has actually made a submission to the Senate committee. From our perspective, we have taken the broad consensus of the membership that listened to the debate, read the Andrews report, listened to the outcome of the COAG meeting and felt that the legislation as it stood was the way to start the process and then, as knowledge is gained, there would be an evolution—as would occur in most legislation, I assume.

Senator BARNETT—Finally, how many human embryos do you think will be required for stem cell research?

Dr Coulepis—If my learned colleagues the scientists could not answer that question, I certainly could not. The view of our members, though, is that, because we are at such an early stage of the research, anyone who wants to hazard a guess at the number is purely crystal-

balling—we really do not know. I am not sure if my colleagues can expand on that, but at this point in time it is just too early.

CHAIR—I have been most remiss. I have not asked for your approval to proceed a little while longer—until, say, 7.30. Is that suitable to you?

Prof. White—That is fine with me.

Prof. Hearn—I think that Senator Harradine's definitions were correct—that Professor White's and the academy's position confirm that. I have just circulated a diagram which I drew for the Andrews committee. Whatever terms we use must be clear and must be open to the public. If we are talking about a cloned embryo, it is a cloned embryo. But if we are talking about therapeutic cloning which derives from a cloned embryo, it is therapeutic cloning.

Senator HARRADINE—I think there is a problem there. You were agreeing with me, but that is not what I said. I was quoting the NHMRC's Australian Health Ethics Committee, which stated:

> The more recently coined term 'therapeutic cloning' collapses both (a) the distinction between therapeutic and non-therapeutic research on embryos and (b) the distinction between destructive and non-destructive experimentation on embryos.

Under those circumstances, the terms would be 'destructive' cloning of human embryos and 'reproductive' cloning of human embryos. It is the same process.

Prof. White—I understand the point that you are making.

Senator HARRADINE—Not me; AHEC.

Prof. White—Yes, that AHEC is making. Thank you for mentioning that. I think that the purpose of using this term—which we picked up from the royal society, by the way; I have to be honest about it—is that the intention is expressed in the word therapeutic. It does not deal with your point about destruction; I am quite happy to admit that. But the intention is expressed, as it were. The wish of our body would be that that intention would be the only reason that one would wish to clone.

Senator HARRADINE—But, Professor White, the term 'therapeutic' is like the term 'humanitarian'. It is a very warm and cuddly term. It is not terribly therapeutic to the embryo, is it? When the embryo is cloned by the somatic cell nuclear transfer process—whether that is for reproductive purposes or for the purposes of developing therapies or whatever—the distinction has been made clear by the Australian Health Ethics Committee, which is the senior body in Australia on this question. Under the act, the National Health and Medical Research Council has to take its view, its attitude. Are you saying, then, the National Academy of Sciences notwithstanding—and I am prepared to give the document; the statement by the NHMRC's AHEC—you are going to proceed with this term 'therapeutic cloning' which is unscientific? It is not therapeutic to the human embryo that is cloned, is it?

Prof. White—In matters of that kind, I think you yourself said that we had used the word in 1999 first of all. Of course, we do not have the document which you have and we would certainly, obviously, wish to take account of what that document has to say. But we will see what we do.

Prof. Serjeantson—I think debates of this nature are terribly helpful in generating words that everybody can understand. For example, 20 years ago, when scientists were dealing with mice experiments, they coined the term 'embryonic stem cell'. In actual fact, that is a misleading term in the sense that it conjures up the idea that, should an embryonic stem cell

be placed into the womb of a woman, it would develop into an embryo. We do not believe that that is the case because it no longer has the cells that will support a placenta.

My experience over time on a number of these sorts of committees, particularly the recombinant DNA committees, is that it is very important to have lay people on these institutional ethics committees because ultimately new words pop up that everybody can understand. Sometimes scientists have come up with words that are not particularly useful in conveying the reality. I can think of a number of other examples as well. Therapeutic cloning is one way of conveying, in a simple, shorthand way to some people, what we mean by what the senator is calling 'destructive human cloning'. We are not alone; the chief medical officer from the United Kingdom set up an expert advisory group on therapeutic cloning. So it is an international word; it is not one that has been dreamed up.

Senator HARRADINE—Professor, are you now ruling out consideration by the Academy of Science of the use of this term? Are you then rejecting the National Health and Medical Research Council's view and AHEC's view?

Prof. Serjeantson—I have tried my best to get hold of that document. I first heard about it when I heard you refer to it here on Tuesday.

Senator HARRADINE—It is a public document.

Prof. Serjeantson—If it is so important, why don't they put it out there?

Senator HARRADINE—It was referred to in detail in the Australian Senate.

CHAIR—By whom, Senator?

Senator HARRADINE—It is a crucial point. It appears you are saying that the public should feel good about the cloning of a human embryo if we use the word 'therapeutic'. As I said, it is a motherhood word. It is like 'humanitarian'—you all bow and scrape to that. As AHEC has said, it is not descriptive of what occurs or what the effect on the embryo is.

CHAIR—Senator Webber now has the call, followed by Senator Boswell. We need to conclude by 7.30 p.m.

Senator HARRADINE—Madam Chair, I have a number of other very serious questions to raise.

CHAIR—Senator, this meeting was scheduled to finish at seven o'clock.

Senator HARRADINE—I know, but that is not my—

CHAIR—We extended it. The original program was set due to Senator Hutchins having another appointment tonight, and that was the original timetable that was set at the original meeting at which you were present. I have deliberately sought the approval of members of the committee to extend the hearing tonight, and I have kept a quorum present to do so. The agreement was that we would extend it for half an hour to an hour, and that was as long as I could get a quorum for.

Senator HARRADINE—I am sorry, Madam Chair; I had hoped that members would then be able to come back and attend a further meeting.

CHAIR—Senator, we have a very heavy timetable, as you know.

Senator HARRADINE—This is a very, very important question which I need to ask because it goes to the essence of the matter.

CHAIR—Senator Webber, are you prepared to—

Senator HARRADINE—No, I don't want to interrupt Senator Webber.

Senator WEBBER—How much further time do you think you need, Senator Harradine?

Senator BOSWELL—Could I suggest this, Madam Chair: you have allocated three lots of questions. Senator Harradine is still in full flight; Senator Webber wants to ask a question; and I would like to ask a question.

Senator HOGG—So do I.

Senator BOSWELL—I have been sitting here for two hours, so I would be very disappointed if I were not allocated at least three or four minutes.

CHAIR—How long do you want, Senator Boswell?

Senator BOSWELL—About three or four minutes.

CHAIR—How long does the committee wish to stay here this evening? The witnesses have been given a commitment that they would be out of here by seven o'clock. They have kindly agreed to stay until 7.30 p.m. I have kept a quorum until 7.30 p.m. Could honourable senators tell me how long they would like to stay?

Senator HOGG—Chair, my suggestion is this: I understand the timetable of this committee but it would seem, given the hour of the night and the commitment to the witnesses, to be proper, if the witnesses are prepared to do so, to come back at another time.

Senator BOSWELL—It is very expensive for them.

CHAIR—Our timetable is fully taken up.

Senator HOGG—Chair, I understand that.

Senator BOSWELL—You can't ask everyone to fly back. Unless we are going to provide them with tickets, we can't ask people to fly around Australia—

CHAIR—Could I ask that we proceed, because the time we are wasting in talking about this could be used to ask questions. Senator Harradine, do you wish to continue? If someone can give me an indication as to how long they wish to continue this hearing, then we can make a decision, but I do not know that answer.

Senator BOSWELL—Put me down for five minutes.

Senator WEBBER—I have to leave by 7.30 p.m. because I have people waiting in my office.

Senator HARRADINE—I will go to the vital issue of the legislation which says:

A person commits an offence if the person intentionally develops a human embryo outside the body of a woman for a period of more than 14 days, excluding any period when development is suspended.

What is so special about 14 days?

Prof. White—The matter was very much considered 20 years ago in connection with the—

Senator HARRADINE—The Warnock thing, yes.

Prof. White—Yes, the Warnock matter, but also I believe in this parliament and in other places, in discussion of this whole business of assisted fertility. All of that should be wired on to the discussion, as I think it was fairly thoroughly discussed at that time. What is more, I do not see that very much has changed except that there has been a considerable increase in knowledge about early embryology. In a very quick answer, in deference to the chair and to the senators, I will just say that much, although I could of course carry through with a discussion of it. I am familiar with the question because you asked it on 29 August and I have read the transcript from 29 August. I am aware of your concern about that matter and indeed

the idea that it might be arbitrary—the idea of the primitive streak and so on. In some sense, that is true, but nevertheless a date has been fixed and a pragmatic arrangement for the treatment of early embryos has been arrived at both in law and in practice.

Senator HARRADINE—So it is pragmatic and nothing to do with science?

Prof. White—It is a point in science where a discernible, bilateral symmetry is apparent in the early embryo in the cluster of cells—the first sign of a nervous system and of right-handedness and left-handedness. That particular point was chosen by Warnock for that reason.

Senator HARRADINE—Yes, but in respect of the development process, that was there at the beginning, wasn't it? What is it 14 days from?

Prof. White—Fourteen days from fertilisation in the fallopian tubes.

Senator HARRADINE—Is it not a fact that at the time of conception our unique genetic endowment organises and guides the expression of our particular nature, its species and individual character? That happens from the time of the zygote.

Prof. White—I do not wish to make a big digression, because I am sure that you want time.

Senator HARRADINE—It is a very important question and a very important issue.

Prof. White—It is a very good question and one which I think deserves reflection from the scientific point of view. It also deserves reflection from a moral, ethical and religious point of view.

Senator HARRADINE—I am talking about the scientific.

Prof. White—Speaking only from a scientific point of view, one of the things I have been most struck by was talking to Craig Venter, the person who decoded the human genome for the first time. He spoke to me at dinner about the so-called junk DNA. One of the most striking things scientifically that came from that conversation was this: you say that our unique genetic arrangement is determined by the genes at that time, but it turns out that the junk DNA appears to be some form of pause. While the genes are being read, some pause occurs and something happens—so environment comes into it. I was most struck by the fact. It seems to me a Lamarckian rather than a Darwinian argument about the way in which the gene was expressed. What I am beginning to suggest to you—and I think it is a matter of scientific debate and well worth while pursuing and thinking about—is that the extent of the effect of DNA as it is being expressed in the early embryo is something we do not understand properly.

Senator HARRADINE—But the Senate Select Committee on Human Embryo Experimentation, adopted the usage of 'embryo' in its 1985-86 report to mean:

genetically new human life organised as a distinct entity oriented towards further development ...

Is that how you would see it?

Prof. White—I think 'oriented towards further development' is a key phrase.

Senator HARRADINE—So it is a distinct human entity?

Prof. White—Yes, I think I would agree with that.

Senator HARRADINE—At the time?

Prof. Hearn—I would agree with that.

Prof. White—I think 'oriented towards development' is the important matter.

Senator HARRADINE—Yes, but internally oriented?

Prof. White—That was what I was beginning to suggest may not be totally the case.

Senator HARRADINE—Are you seriously suggesting that, in some way or other, there is not a human entity in existence at that time, a human being existing at that time?

Prof. White—I am suggesting that, as you say, a human entity is there, certainly.

Senator HARRADINE—So it is in existence, it is human; therefore, it is a human being. Is that right?

Prof. White—I am not sure I understand that declension. I said 'entity' because the view that I and many other people would take is that, in embryology and in the development of the human person—and, indeed, even theologically, in the implantation of a soul—it might well be a gradual process.

Senator HARRADINE—I am talking about the human embryo, scientifically.

Prof. White—And, scientifically, I think that it is certainly an entity.

Senator HARRADINE—And it is a human being at that stage? You started your life as a human embryo—

Prof. White—I hope I did; yes.

Senator HARRADINE—from fertilisation.

Prof. White—I am distinguishing between 'being' and 'entity' because—

Senator HARRADINE—Why? We are talking about existence. Does the entity exist or doesn't it? If it exists it is a being, unless I am confused about the English language.

Prof. White—I do not think I can easily chop words with you, Senator. There are many overtones to the word 'being' that I would build into it, and perhaps you would build different ones in. Therefore, I find it difficult to deconstruct what you mean by it and what I would mean by it. But I am quite happy to agree to 'entity'.

CHAIR—There are two other senators who want to ask questions. We are now getting over time.

Senator HARRADINE—We are getting to some of the heart of the matter.

Senator HOGG—Professor Hearn, I refer you to the second dot point under the heading 'Acceptability of cell lines' in your submission. In the second last sentence you say:

Recently human feeder cells derived from abortus material were used successfully.

Are you able to advise the committee of where that happened? Was it in Australia or overseas? Do you have the literature on that?

Prof. Hearn—My understanding is that that research was carried out in Singapore. I would need to check those facts.

Senator HOGG—Was that included within the existing 60 or so stem cell lines out of the United States?

Prof. Hearn—No; these were a new stem cell derivation. Again, I would need to check the facts.

Senator HOGG—If you could find the where and the when and provide that to the committee, that would be helpful.

Prof. Hearn—Certainly; I will provide that by tomorrow.

Senator BOSWELL—Who are the Academy of Science? Who do you represent? Can anyone who is a scientist pay a membership fee and become a member?

Prof. Serjeantson—I think you were absent from the room when I mentioned that the Australian Academy of Science was established in 1954 by royal charter. It is a private organisation of about 330 of Australia's leading research scientists. They are elected on the basis of their personal contributions in science and there is a quota: a maximum of 16 per annum at the moment are elected through that process.

Senator BOSWELL—Have you consulted all your members about your submission and the conclusion you have come to, particularly in relation to calling for therapeutic cloning?

Prof. Serjeantson—We issued a statement in March 1999, when we first used the two terms 'reproductive cloning' to produce the human foetus and 'therapeutic cloning'. We subsequently developed, in April 2001, another booklet, which is called *Human Stem Cell Research*, where these terms were used and defined, and it has had fairly wide dissemination.

Senator BOSWELL—That did not answer my question. The question is: do any of your members oppose therapeutic cloning?

Prof. Serjeantson—The council of the academy is now made up of 17 members. At the time we first developed the statements, it had 16 members and the council unanimously supported the statements.

Senator BOSWELL—Is Professor Jack Martin a member of the Academy of Science?

Prof. Serjeantson—Yes. He was not a member of the council.

Senator BOSWELL—He opposes therapeutic cloning, doesn't he?

Senator HARRADINE—Where are you likely to get all the eggs from?

Senator BOSWELL—I will ask that question, Senator. I have it that he has opposed it.

Prof. Serjeantson—Have you?

CHAIR—Then why ask the question, Senator?

Senator BOSWELL—Because I want it confirmed. I am asking it because I want to know whether this is a universal vote or how you reach a conclusion. Does the Academy of Science make executive decisions or does it consult its members? I think it is a pretty fair question. Could you explain why you want therapeutic cloning and what you hope to gain from it?

Prof. Serjeantson—We feel that it is premature to be closing the doors on some areas of research practice. My background is in medical research in transplantation biology. My specific task was to improve the matching of donors and recipients in transplantation. So, I am very aware of the very many different tissue types that are in the human population and the difficulty of matching tissue for patients. For example, if we were typing for the ABO blood group, you would not use just two antisera, anti-A and anti-B, as it would give you A, B, O and AB. Even 20 years ago, for tissue typing, we were using more than 180 different antisera to look at the different patterns. We are fearful of closing the door on this approach simply because of the compatibility between the donated tissue and patient. If a stem cell could be taken from the patient, by definition it would match that particular patient, so we are reluctant to shut the door on that technique.

Senator BOSWELL—In another submission, Professor Jack Martin of the University of Melbourne says that it is 'virtually impossible' and 'presents major practical difficulties'. He says that every single application of therapeutic cloning would require eggs donated by many women, 'sometimes as many as 20'. Where would you get the eggs?

Prof. Serjeantson—Our understanding at the moment is very flawed, but we are reluctant to shut the door. For example, how many scientists could have predicted that Dolly could have been programmed from an adult stem cell from a mammary gland? So, with the greatest respect for Professor Martin, what he is saying is correct at the moment, but we do not know where our research advances will take us.

Senator BOSWELL—So you do not know where you would get the eggs, but how many eggs would you require? Can you answer that because, as I understand it, this man is a member of the Academy of Science?

Prof. Serjeantson—Talking about the recent advances in science, one of the possible applications is that the adult stem cell could be placed into an embryonic stem cell. I think I heard a witness explaining that to this committee on Tuesday. So that could be one other alternative.

Senator HARRADINE—But there were enormous qualifications.

Senator BOSWELL—Have you considered the side effects and the costs of getting eggs by superovulation? If you are going this way, you need eggs. How many would be required? Around this table, there are people of very many different trades. There is a union delegate; there are lawyers and doctors. I am a seller of paintbrushes. I rely on people like you to tell me how you are going to do something, and you come in and say, 'We really don't know how we are going to do it, but one day we might be able to find some way to do it.' I suggest to you that giving me that sort of information is not very helpful. But let me continue.

CHAIR—I do not think it is fair to put words in the mouths of witnesses, Senator Boswell.

Senator BOSWELL—No, they were my words and I am entitled to make those comments.

CHAIR—But you said that the witnesses had said that.

Senator BOSWELL—I read out what a member of the science academy had said that poses these questions. When I asked Professor Sue—

CHAIR—Serjeantson.

Senator BOSWELL—Serjeantson, she said, 'One day, we might be able to find something, and we are not going to rule anything out. One day, something will evolve.'

Prof. Serjeantson—But, Senator Boswell, the point—

Senator BOSWELL—Let me continue.

Senator EGGLESTON—But is that not how most things work? That is how science proceeds.

Senator BOSWELL—No.

CHAIR—Isn't that research?

Senator EGGLESTON—Nobody can predict an outcome, otherwise there would not be the research.

Senator BOSWELL—As I understand it, Senator, what happens in science—you are a doctor, and you may correct me—is that you get an idea and you work it up in a laboratory until you come up with a conclusion. You test it on animals, then you put it out for peer group submission and they assess whether you are right, wrong or indifferent. What is happening here is totally different from the way I understand science happens. I have listened to various professors and I have been told that this is the way science works in Australia—that, not for

profit, you put out your paper, your peers examine that paper and say, 'It is a good idea,' or otherwise.

Senator HARRADINE—They are entitled to say what they do. But the whole point is: can you give a guarantee that you will not support destructive cloning of a human embryo until after the research that you were talking about—the placing of an embryonic stem cell—has proven correct and is part of the scene?

Prof. Serjeantson—Yes, Senator. This is exactly why we have taken the line that we are relaxed about having a moratorium for three years. It is completely compatible with our feeling that we do not want to shut the door on therapeutic or destructive cloning.

Senator HARRADINE—Can you give a guarantee that until that—

Prof. Serjeantson—If it is in the bill, we—

Senator HARRADINE—No. Can you give a guarantee that, until that particular program that you referred to earlier is up and running, you will not support embryonic cloning?

Prof. Serjeantson—I think it is a trick question. I am not quite sure what the question—

Senator BOSWELL—They do support it, Brian. It is in their submission, so they support it.

Prof. Serjeantson—We support it, but we are relaxed about the moratorium.

Senator HARRADINE—No, you misunderstood. In answer to Senator Boswell, who was raising the question of the hundreds and hundreds of eggs that would be required, you said, 'There is another scientific experiment proceeding'—and I know it—'which involves the development of embryonic stem cells in another way.' Will you give us a guarantee that you will not support, and in fact vigorously oppose, destructive cloning of a human embryo, until such time as it is not warranted?

Prof. White—Perhaps I could help.

Senator BOSWELL—I would like to get this on the record, too.

Prof. White—The academy supports what we call therapeutic cloning. Hence, it does mean that there is a possibility of destruction of that embryo. The other thing which we have said here is that we do hope that the whole of this research—indeed, you can see that our recommendation is comprehensive—will be properly regulated. I would insist that that regulatory process was one which had due respect to the procedures. For example, if you have to flush a woman to get 100 eggs to try that experiment, I would personally say that would be unacceptable. There will be some limits which any sensible people—lay people and scientists together, and that is the proper constitution of an ethics committee—will argue through in the way that we are arguing through on this occasion. I trust ordinary people to have commonsense about such matters.

Senator BOSWELL—You told me that you belong to the Academy of Science. You get there by invitation and it is only the best who get there. And then you say in your submission that you support therapeutic cloning. Then when you are asked, 'Where would you get the eggs?' You say, 'If they are so hard to acquire, we wouldn't do it.' How many eggs would you require? You do not know. Surely, as the top of your field, you should know. You should come to us and say, 'We support therapeutic cloning. We know the side effects. We know how we'll have to do this. This is the risk; this is the assessment.' I would not even sell paintbrushes that way. I would know what I was going to do and what the result would be. And you come in and ask us to take your word for it.

CHAIR—Professor White or Professor Serjeantson, do you have anything further to add on that subject? We are going around in circles.

Prof. White—I have one anecdote which might help the committee. When I talked about this to a church group in Canberra, one young woman, who had been completely quiet during the whole of the discussion, said, 'Well, Kerry Packer's pilot gave a kidney so Kerry Packer could live. I'd be willing to give an egg if someone could live.' That is only an anecdote. All I say to you is that it would be totally unacceptable if there were not procedures set about to make that a realistic process to apply to a particular person.

CHAIR—Professor Serjeantson, do you wish to add something further?

Prof. Serjeantson—No, I would not.

CHAIR—There being no further questions, I thank you very much for your time and for your ability to stay beyond the prescribed time. We are very grateful for your contribution.

Committee adjourned at 7.48 p.m.