

Greenfield Speech

March 16, 2009

Victoria

When Science means Business - an address by Baroness Susan Greenfield

Thank you very much, John, it's a great pleasure to be here and be back in Australia. I'm coming back, compared to when I was last here at a time when I think people are in a very different mood from when I was here last time. And let me start by saying I know there's an elephant in the room and the elephant in the room is the recession or economic downturn or whatever polite words we're going to use. And I think, therefore, the kind of speech that I may have given six months ago, a year ago, is very different. Six months or a year ago I would have promoted to you a society full of renaissance men and women where one bought science into one's general thinking and lifestyle and one has the leisure and the time and the money to sit back on one's chair and to think about genes and black holes or whatever, and tsunamis, whilst filing one's nails at the spa or on the golf course or whatever you do in your spare time here. I think now, however, we are much more focussed and much more worried, and some people think that because of that science really should take a back seat and this is all a bit to blue sky, all a bit too rarefied, all a bit too much of a luxury for people that may be losing their homes, may be out of a job, may be running out of businesses. And I think that that is really quite wrong and what I want to do is really focus now in a much more sombre way than I would have done and try to explore with you how I think science and technology really does and must meet business now. Not in an evening dinner party tactic that way but in a hard grind Monday morning way.

Let's take first the area of neuroscience, as my subject, because I think that before any other science can perhaps explain and help with some of the questions that are on the mind of the business community. The first is why did we get here, how did we get here. And the second is how do we get out of here, how do we get away from here. Well, of course, I hope that's what you're thinking. A lot of people in England, and we're six months ahead of you in misery, are sitting around on their hands saying where's the plan, where do we go from here. This is very sad for a country that survived The Blitz, where instead of saying, why isn't it like it was in the 30s, at that time people said, well how do we get out of here, how do we get on with this. And I know this country has particularly that attitude of mind so let's hope that you won't be dragging your feet quite as much as the UK is. But as Obama said, and this is a slight misquote and I know, but I can't remember the exact quote, but he effectively said something like, this recession is partly due to greed and recklessness, and if you think about it, it is a man or woman made scenario where on the one hand people had aspirations and a here and now, want it now mentality that made them borrow, or want to borrow. Here me talking as I'm an

economist, as I think is the case, and similarly fuelled by financial services that wanted to take risks that were reckless and very happy to grant people loans that they couldn't afford. And I gather that is at least in part some of the problem. But I do immediately give way to any economist who tells me I'm wrong. And I'm sure there's many of you in the room who know more about this than me. Suffice it to say that I think neuroscience can help us understand a little bit about recklessness, about risk taking and about greed. And I also think it can help us if we're trying to think of how to get out of this situation. It can help us understand about the mind set of the current consumer, the mind set of the marketplace and what kind of goods and services you might be wanting to go into in order to be on the money, almost literally. So let's take first, the mind set, and I feel quite happy talking about this because at last I can actually *3.49 economics and talk about something I know about vaguely which is the brain. And do bear with me business folk who think it's daft that a neuroscientist should talk to you because there is a point in this, so do bear with me for about five minutes, even though it might seem I've gone off into my own comfort zone.

Let's think first about recklessness. Now a neuroscientist, if asked to talk about risk, our first strategy is to say, okay what neurological conditions do we know of where people show excessive risk, more recklessness than normal. And that's quite easy to answer, I can tell you that damage to the frontal part of the brain can result in excessive recklessness. This was first shown in a rather famous and interesting story of someone called Finneus Gade, who in the States in the 19th century, got a camping iron, that's a big four foot long iron bar through his head, like this, because he was pushing down dynamite, explosives, on a railway because he was supposed to be getting rid of the debris for the laying of a railway track and he was putting this iron bar down and, of course, any story involving explosives clearly it went off prematurely driving the bar through the front part of his head and you might wonder, why am I telling you this story because he must have died. Well, he didn't die, he lived to tell the tale and was fine, could see and hear and talk and think and walk, just fine, but when he went back to work, gradually it was noticed his character had changed. And among his many flaws was that he had become excessively reckless. This is a syndrome now known in neurological circuits as a frontal syndrome which is characterised and sadly there's been far more cases of this where people were so, among other things, an enhanced recklessness. For example, on gambling tasks, they will take more risk.

This kind of recklessness can also be seen in other conditions that might not seem to be related to people with damage to the frontal part of their brain. For example, schizophrenics and children and of all things obese people. Now what's that all got in common. Well, what's very interesting is that obese people, it's been shown that the body mass index, that's to say how fat you are, is actually negatively correlated with the metabolism of this frontal part of the brain. I'll say that again, the fatter you are the less active the front part of the brain basically. Similarly with children, we know that this part of the brain comes on stream much later in life during adolescence and we also know that obese people take more risks on gambling tasks than their thinner counterparts. We also know in schizophrenia, the front part of the brain is under active, so what have these conditions got in common that link in with an under active front part of the brain. Well, it is a premium on the here and now. On the sensations, the thrill of the moment, you might see where this is heading now, over the consequences.

So, for example, obese people, everyone, everyone knows the consequences of eating, we all know this but somehow the thrill of eating, the sensation of that lovely tasty food in your mouth somehow outweighs the consequences. Similarly gamblers, compulsive gamblers, they know very well the risk of gambling but the thrill, the excitement, the adrenalin rush of the roulette wheel going around somehow trumps the consequences of losing all your money. So one can think of a world or a syndrome where people put a great emphasis on the here and now, the thrill of the moment, over the consequences and such people therefore would take more risks because the consequences are not as important as they are for other folk. Now imagine a world where, and I've been completely, harrowed by the press over there because I said this in the House of Lords two weeks ago and I think it's quite interesting. Imagine a world where you were brought up in the moment, where everything is strong sensations, everything is the thrill of the moment, where you're living moment by moment, there's no consequences, where when you play a game you can just play the game again, if you lose you play the game again and nothing has lasting consequences.

And I'm talking, of course, of living in two dimensions, living in the computer world. For the record, because I know there's some journalists here, I never said that computers rot the brain, as was the front page of one of our less fastidious newspapers. But what I did say was that we should very carefully at a generation brought up, brought up in two dimensions, which is what the computer world is. If you're living six hours a day or more in two dimensions, might that not perhaps have some kind of affect on what kind of brains you might have, might that mean you could be more reckless. Now the reason I say that is because, again, my starting point has been, and there is evidence of this, complete evidence, is that your human brain is very, very sensitive to the environment. So unlike say a goldfish, and I hope I don't offend any goldfish lovers here, you have a unique personality and whereas goldfish are not known for their individuality too much, are they. Such that if a goldfish died and you had kids, you could sneak off to the pet shop and buy another goldfish and the kid would come back and know no different. You couldn't do that with a cat or dog, you certainly couldn't do it – although they might want you to – with their brothers or sisters.

And this is because the more sophisticated the brain, the more you shift from instinct to learning, to adaptation, and if you have individual experiences then guess what, you become an individual. Now this is so-called plasticity and it's something that neuroscience is exploring more and more and getting increasingly excited by. And in a way, it's both scary, it's as scary as it is exciting because it means that your brain is the only example of its kind for the 100,000 years our species has stalked the planet. No one has a brain like yours, no one every will again. Unlike your liver, your heart, your lungs, all of which can be transplanted and exchanged with great ease.

Your brain is unique. Now this means it's also very vulnerable. If it's shaped by the environment then it can be suitably vulnerable as well as being bought up and having its potential realised by the environment which is why we have to consider the environment very, very closely. And if the environment, at least in western societies, is one increasingly dominated, as it is, by the screen, we should question very carefully what kind of brains we are driving, what kind of brains we are shaping by the screen. Now I've already suggested

that it's one of recklessness, possibly, and I'm not saying that's responsible for the economic downturn necessarily but perhaps it is responsible at least in part by poor decisions made by a generation brought up in this way. I'm just trying to look at the link. Might also be responsible for the three fold increase in Attention Deficit Disorder. That's if you go by prescriptions. Three fold increase in Ritalin, at least, in the UK over the last ten years. Might also be responsible for the increase in Autism, again, a rise in this condition where one can't attribute thoughts and feelings to others very easily.

When we are all on Second Life or living in a computer world, we are much more autistic. Autistic people are very comfortable in the computer world because you're not needing to take cues by tones of voice or by body language or by pheromones, those sneaky molecules that you smell but you don't realise you're smelling from person to another. And because you don't have all these other cues because you're just what you see is what you get, someone is acting like some kind of object, that's a much easier sanitised world to deal with than one where there's lots of subtle and difficult cues that autistic people are very hard to get in on. So we're living in this world then, perhaps, where we are more reckless, tending almost to lack of empathy, perhaps a faulty sense of identity. I'm fascinated by the rise of Twitter, how many people are on Twitter? [laughs] I'm not going to ask you questions. Everyone's suddenly looking very worried. Well, Twitter I gather is things like, I have just got up, I'm now cleaning my teeth, now I'm cutting my toenails, now I'm putting on my earrings. And this, for me, I find very interesting because it's almost like a small child saying, look at me, look, now I'm doing this. It's almost as if you have a shaky sense of identity that needs to be shored up by a constant kind of feedback.

What I'm coming to now then is not only in trying to explain a little bit about the mindset that might have brought us at least in part into this current situation. But also now thinking about what goods and services people in that way might want. And my own bottom line and then I'll elaborate on it, is I think they will want experiences rather than goods. They will want sensations rather than just owning objects. And that's my ball hypothesis, if you like. And let's explore that a little bit. Think about the new technologies. The new technologies are based on challenging all the frontiers that previously have defined you as an individual. So not only are the cyber technologies challenging the barrier between the real world and the cyber world, such that some can now no longer make a distinction, I just wonder whether this horrendous new trend supports the fact you knife someone on You Tube, this happens in the UK, where almost as if people didn't understand that someone bleeding is meaning they're in pain. It's almost as if it's a game and perhaps it is for some people. They can't actually, if they're hour after hour playing World of Warcraft, they can't actually realise that people are truly suffering. So it may be that we're in this new type of world where people don't have a sense, so much possibly, of identity with the cyber world and the real world.

Biotechnology, and I know there are some biotechnologists here. If I had to sum up the difference that biotechnology will make in our lives, again it's challenging a division and I'll suggest a generational division where previously you may have defined yourself as a child or as a parent or as a grandparent, even a great grandparent – obviously no one in this room is a great grandparent, no, no one here is a grandparent even, you all look so young to be that –

but nonetheless at the limit one could say that already reproductive life is being expanded by the new technologies. Perhaps in the end anyone of any age or sexual orientation, if they didn't mind IVF, would be able to use genetic material from sources other than sperm or egg to have other children which means a child could have a child, a grandparent could have a child and given we'll all be so much healthier and better looking anyway, thanks to biotechnology, one could almost imagine growing up, being an adult and then dying without that narrative by which sometimes people see their lives. Because when you think about it, the way you define someone's age or the way you evaluate them is by what they look like, whether they're working or not, how healthy they are and their reproductive status.

If all those things are challenged or changed or at least blurred then perhaps you won't define yourself in that way anymore. And then there's nanotechnology, engineering on the scale of a billionth of a metre, which permits not only to live in a world of new kind of materials as baffling perhaps they will be to us as plastics would have been to someone in the Middle Ages, imagine trying to explain to someone in their [wattle and daub [park] 15.16 what plastics were and the difference that plastics would make to their life. And that's what I think nanotechnology is doing for material sciences but even in biomedical sciences it is actually permitting us to have devices that actually interface your body with the outside world in ways which are unprecedented.

So if someone said once, can you imagine cleaning your teeth in the bathroom mirror and the toothbrush says to you, you better watch out, you're going to lose all your teeth in ten years time, you've got gum disease. And then you, somewhat sobered, urinate and the lavatory pan speaks to you and say, you might have diabetes, get yourself checked out, it's analysed your urine stream. Not only that within the brain, some pioneering and amazing work in the States now that's really helping quadriplegic patients with implants in their head where they can will a cursor to move on a computer screen, just by thinking about it.

And another colleague of mine, *[name] 16.05 who's actually transmitted the readout from the brain of such a person to a chimp and enabled a chimp to move in a similar way in Japan. I mean, it's just quite incredible work. Where the neuroscience is coming of an interface between a thought and an action, between the idea and the reality, previously divided by the *16.24, finally there's an interface. So just summarise, crudely this new world and for the consumer the kind of world they're living in, there's going to be a world, even before the recession, there's going to be a world where people don't have the normal divisions, where your body and the outside world no longer have that firewall where reality and fantasy no longer has that clear division and where one generation to the other no longer has that clear division.

Now imagine what kind of world you're going to be in. How are you going to see yourself? What will be your identity in such a world? And what kind of world would you want? Well, my own suggestion, especially fuelled by the screen is the world of the here and now, of the sensational and if you do that, if you say it's a world of the here and now and the sensation of experience where you're not developing a long term narrative with someone, then, a, you might want to with goods and services, if you buy into the idea as I certainly do that that's part

of the human conditions, or you might want to appeal to the sensationalist and the here and now. I think both are very interesting and both would open up prospects but certainly I think the days of the Burberry umbrella possibly are gone and that we have to think of new ways forward in terms of what goods and services people want. But that should be driven, not just by what the consumer wants or thinks they want, but what we would like our society to be and I think that's a very interesting ethically, slightly dodgy question, of course, but it's because the brain and the environment are so interlinked, it's like chicken and egg.

The brain and the mind set will drive what the consumer wants but at the same time the environment will second train certain aspirations and ideals. But I think clearly we are in a world of the here and now, the sound bite, the lack of metaphor and the lack of seeing one thing in terms of another, the lack of abstract concept. My little brother is 13 years younger than me, which meant when I was 16 and he was three I could bully him, perhaps like some of you may have done with your younger brothers and part of the torture involved teaching him Macbeth which he had to learn off by heart and did. And as someone said, that must have gone down a storm in play group, so he walks in saying, *[quote]18.38, so anyway he learned this because I was bigger than him so he had to learn this. Now if you take that speech which some of you may know, a very famous, *[same quote], how would you actually show that on a screen? Think about it. How would you show a metaphor, Out, out brief candle, life is but a poor player who struts and frets hi hour upon the stage.

Or how would you show TS Elliot's Hollowman, we are the hollowman, we are the dead men, leaning together * [quote]19.07, alas. How would you show that? Or Robert Frost, The Path Less Travelled Through the Woods, how do you show those things as metaphors? Show a bloody path going through the woods and one not so travelled, of course not. This is the thing. How, and I'm sure many of you are parents here and I'm sure you would like your kids to have a grasp of those kind of concepts and feelings and nuances and it will not come, it will not come with just visual images on the screen, unless, and this is my big consumer bit, we all sit down together and design software possibly, ways possibly, that do give people a sense of metaphor even though they are addicted as they are to the screen which comes onto another thing. Why are they addicted? Again, science can come up with the answer partly by studying the brain and the reward system to the brain and drawing an analogy, dare I say it, with drug addiction. Now obviously I could go on. I'm just looking at the Chairman, how much longer have I got, John? Twelve minutes, okay.

I hope I'm giving you a feel for the kinds of ways in which certainly neuroscience, haven't even got onto other science yet, how neuroscience can help us understand why we've got what we've got and to designing products and services that may shape or be of use to the current generation. Abstract concept similarly, I looked up honour the other day, just out of interest, in images on Google and this is a UK Google so it had the Queen tapping someone on the shoulder with a sword and it had a shield, and if you said that to a child they would not have a sense of what honour was or to honour. So these, again, I put to you in the business community, would be very useful if indeed you want the next generation to have a grasp of metaphor and abstract concepts, that we ought to think about ways in which we can do that otherwise you're going to have people literally seeing what you see is what you get and just

taking things literally at face value, living in a world where people no longer have feelings or inner separate thoughts, where it's action all the way, it's sensation all the way and it's a fast paced moving environment all the way that doesn't have any consequences whatsoever. Where, by extension, your own life has no consequences because you're just there in the sound bite of the moment.

Being reckless because it doesn't matter what happens, it doesn't matter because you just play the game again if you fail. And when you play the game to rescue the princess, you don't care about the princess, do you, you don't care about her, but if you read a book you care about the princess. And I think it's that difference that we have to be careful with of process versus content. The content of a book where you're reading the book because of the narrative, because of the consequences, where you end up different, you end up a different person intellectually compared to playing a game where it's just for the thrill of the moment. Never before in the history of humans have adults played games on their own just for the sake of playing a game on their own. Yes, we'll play bridge or poker, or charades or sports but usually they interact with each other as a means to an end. Or if we're doing something solitary it's to train ourselves or to learn something but increasingly now, adult human beings are spending time and money just for the experience of playing a game. And I find that rather strange that after 5,000 years since the Greeks, we are having people sitting on their own going, yuck and wow, and yuck and wow, in a kind of glassy eyed stare at the screen. Now, it may be if we want that kind of society, maybe we should just produce more software like that but I would love us to harness the new technologists to get us beyond that stage, to get us into a more fulfilling narrative, literally a narrative where life again has a meaning and identity again has a meaning.

So I've written on my notes, I've still got my notes out. It's just my preamble and I've got 10 minutes now to talk about what I really wanted to focus on. Which is really where we go from here. And that's all the bad news. I think the good news is that the more we think and talk about it, across disciplines, across sectors where the business community and the science community does actually talk about these things, the more we will have a chance to actually create a new type of world because when has innovation ever come out of fat city, when has innovation and really bold new thinking ever come out of complacency and prosperity with everyone at the spa or on the golf course. I doubt it. Whereas when your backs against the wall, when you have to survive, rather like my parents did in The Blitz, then new things happen, new qualities come out of you that you never realised were there. You stretch yourself in new ways, as my parents in The Blitz, never realised were there before. And what I'd like to think is now we're in a position to do that rather than just sit around moaning. There's a choice, we can sit and moan or we can do this, it's not going to change. The economic downturn is not going to suddenly reverse, this is not a computer game, this is change now. And I think that what we should do is start thinking about innovations of the type I've just outlined very crudely.

But there's other thoughts as well, and I've just scribbled these down here. One is women in science and I'm delighted there are so many women here and I gather there's more women than usual here, I was told, and I hope that's because I'm a woman and it's great that we are

actually being more and more represented but it's still a long way to go and I think until we encourage more women into science and *24.26 business, then we are disenfranchising 50% of the population and we are not making the most of our talents. I recently went to a meeting in Paris, run by UNESCO and L'Oreal, L'Oreal do an amazing amount for women in science. And it's very simple, they said the world needs science and science needs women. And this is giving prizes to women on five continents and it was like the Oscars and it was a wonderful upbeat moment and seeing the younger women there and seeing how excited and inspired they were. It makes you realise that they do need active role models, they do need encouragement and we have to think about why science isn't so popular for women. I can do that in the Q & A, if you like, I don't want to focus too much on that.

Next is the ageing population. And again, we are now for the first time ever facing, what two, three, four decades after the kids have left home, after we're 50 say, when you're going to have a healthy life, what are you going to do with your life. And this is the kind of question that no other generation has had to ask because normally one's been bent on survival or in such pain and illness that there's been no choice. But now we are all looking forward, everyone here, is looking forward to an able bodied and clear minded old age, I think. Everyone hopes for that. I, myself, work on Alzheimer's, that's one of the missions I have. We're absolutely going to fight on the beaches and get this thing cracked, so that we're going to be having a life where we're going to have an actively ageing population.

Certainly the baby boomers who are not going to go quietly. I'm a baby boomer and I certainly don't want to go and sit there in a flower pot. I want to go dancing and shopping and doing all the things that one does when one's younger. So I think we need to help to use the ageing population who are now at home but can work from home, unlike in the old days, because there's no longer a premium on mobility or strength but on intellectual abilities which we hope will stimulate their brain. How can we weave them into the world of it? And I think we need to think experience versus product very much. And whether we want to do that, whether we want to just give people experiences of buying a product and that being the premium we're selling or whether we want to go back somehow to persuading people that having things is important, whether or not we wish to or not, that's an issue. We're having women working from home, we're having a grey workforce and I think we've got now a very fertile time for the entrepreneur, for someone that stands out with some new technology, some new idea, some new way of looking at something and normally, traditionally, one would turn to those places, you would turn to the university for that. Digby Jones has said that universities nowadays are a bit like the ports were in the Middle Ages, it should be where this is the hub of technology, this is where the innovation and excitement should first arrive.

Now sadly it doesn't always work like that and I'm aware that when I'm saying this, it may be that the situation in the UK is sadly different from here because I know, having worked here several times, the much more upbeat optimistic attitude of Australia compared to the UK, but let me just say in the last few minutes I've got the difficulties I found in spinning out technologies from universities. First is *27.29 agendas of the scientist versus the investor, the investor immediately needs intellectual property. They will often only invest when they have a strong management in place and where milestones, realistic milestones are essential. All these

notions are alien to scientists, they have a distrust of patents, they think that they are the purer scientists and they don't want to be fettered by *27.50, not realising, of course, that a patent lawyer is quite happy with the abstract of the basic finding, they don't have to have the paper. *27.58 to understand why managers are so important because you can get 60 * students for one manager in terms of salary and anyone paid a six figure sum comes from Mars in academia.

So they can't understand why it's so important to waste, in inverted commas, a lot of money on managers and they have long term hopes and plans rather than immediate milestones because you don't know which way things are going to do. I think that's the first thing, is this *28.27 attitudes which have to be thought about. So in the UK and perhaps unlike here, we have under resourced technology transferring universities, that is to say, folk who are on public sector salaries who have a certain risk of earth mentality, certainly in the UK, because they feel they have to answer to their university. One of them boasted once to one of my investors, they'd never had a company that failed and the investor said, well you're doing something wrong then if you do that. Where there's a poor ration for scientists and so the scientists have to knock on the door and only 1% of scientists will do that because they don't know that they exist or why they should want to do that and my own view there is that one could think of some kind of scheme where a company such as McKinsey's, who I think would be willing to do this, seconded interns to go and actually be on the campuses and talk to the scientists and get to know them and to act as talent scouts, report back to the tech transfer bodies, that would be good for the interns, it would be good for the scientists who wouldn't be deterred from what they were doing. And it would mean that nothing fell through the cracks as it currently does.

There's also lack of appropriate funding models because really scientists need early stage and they need not very much money and neither of these things are attractive to investors. They want it to be later stage and they want to invest a large amount where they will get returns with noble exits and certainly in biotech this doesn't work because the technology is incomprehensible, the burn rate is very high and the exits aren't obvious, which means that we get from the physical sciences, I think, have a more favourable run than we do, in biotech and yet biotech is essential is we're going to think about health care. So we need to think about ways in making biotechnology more attractive and again I don't know about in this country but I would like to see preferential help with taxing, for example, rather like we had for the film industry in the UK. That might be an incentive. So we have to think of ways also of persuading people to invest in something that's high risk and long term and one may be syndicates where you buy for a small amount of money, which is the kind of private sector grants, a kind of entry ticket into access to technology and then when the time is right, you rather than someone else in the syndicate, might want to *30.35 up a company and you give a sweetener to the other ones in the syndicate, something like that. But we do need a new approach to investors.

Other things I've written down here, as well as tax breaks for biotech, mentoring for scientists. Many scientists don't understand at all about the thrills and spills of spinning out companies and therefore more joined up communications between science and business which is where



we came in and my Chairman is looking worried and taking off his glasses, so I think I'll probably shut up at that appropriate moment. Thank you very much.