Faraday Institute, Dinner Discussion
Professor Ken Miller
Tuesday, 28th April 2009

Denis Alexander: I am sorry to interrupt your conversations but we do have work to do this evening, and we would now like to move on to the discussion.

The idea is to have a very broad general discussion where we hope everyone will feel free to join in. It's definitely not a 'Q and A session' with the lecturer, though of course we want Ken to respond during the course of the discussion, and we want it to be wide-ranging while keeping within the bounds of the topic this evening. What we normally do is ask somebody to start us off with a few words and Tim Jenkins has kindly agreed to do this, so I'll hand over to Tim.

Tim Jenkins: I'm a sociologist rather than anything else and this was a talk that really was very well suited to a sociologist's ears. I have two thoughts that I would like to develop.

My first real point of interest concerns what you might call the 'evolution wars' and to ask what is at stake. It seems to me there are what could be called well-worn rituals of provocation and polarisation and that very American ritual of going to court having legal cases – it's happened over and over again, at least through the twentieth century.

In a way what I would like to do is understand more about the fundamentalists, who have of course – whether or not they are a small minority and it's always very difficult to know (they have a leadership and provocateurs and so on) – certain forms of quite wide support which appears in opinion polls and so on, but in states of mind I would say there is a certain distrust really of science as an ally of state providence, something like that.

They are losing all the battles at the moment it seems to me, but they look like likely winners of the war. That's the sort of feeling that you gave us; this rather odd business, you gave us quite stern cautions, as it were, that the battles are not over by any means. Just to go back a bit on the Scopes trial, the fundamentalists actually won the trial and of course lost the public battle; they got sort of in a way corralled in public life.

Ken Miller: John Scopes was convicted and fined one hundred dollars. The fine was set aside because Tennessee law requires all fines of greater than fifty dollars to be assessed by a jury. That fine had been assessed by a judge so the fine was set aside, but neither Scopes nor the prosecutor wanted to try the case again so the conviction stood.

Tim Jenkins: I think the general point that we have a reversal of that situation whereby the fundamentalists keep losing their cases in general, but on the other hand their opinions and views flood into a wider public space. I would just comment here on a book by Susan Harding called "The Book of Jerry Falwell" which describes very well this business of how the politics of the American Protestant right has re-engaged with a public space after a long ideological state of exile and how much of what is going on in these sorts of events is a renegotiation within the church, but it has widespread public effects and in some ways those effects that concern us would be seen as a crisis in the secular experiment.

For a long time we have been able to be absolutely clear in public spaces that you subscribe to science whatever you think in private. That has now ceased in the public sphere; things are much, much more muddled than that and in a way you gave a very splendid account of it. To focus on that it seems to be that the fundamentalists have a very clever use of secular liberal claims: they point to academic freedom, they make claims of equal time and they talk about cultural diversity, freedom of speech, the rights of minorities and so on, so they are actually playing with a modern view of the world. There is really quite an interesting set of politics going on here that's quite hard to define, and it does affect us all. In many ways the success of the Faraday Institute is part of that, the shift in the field that has been created. So that was really my first point; evolution wars need to be understood quite carefully, I think, as some sort of social phenomenon.

My second point is really part of that. I think part of the evidence of this new accommodation, the public discussion of the faith of scientists in forums such as tonight's, is actually a genuine change that would not have happened in the 1950s and 60s. These are really changes in the ways of public behaviour that have resulted in some way from the shifts that are going on. I would just draw your attention to what I thought was the very interesting

last part of your talk which has this declaration of how certain sorts of compatibilities can be made and this very interesting opposition that you raised between caprice, where it really doesn't matter whether it's chance in a Dawkins or a Jacques Monod form, or whether it's fundamentalist intelligent design: chance plays a number of roles. Caprice on one hand is then opposed to this question which I think is a fundamental one, really, of elegance in design. In fact I raised this at the last meeting as a question of just how the subscription to ideas of simplicity in scientific explanation is itself already conceding a great deal to the argument by design and I was very interested that you quite straightforwardly set that out. I think it's a very proper point and one that needs to be examined. But really my basic point is that ten or fifteen years ago we wouldn't have needed to make those public statements, so what I really want to draw attention to is the interesting shift to what we might call in philosophical terms an epistemology of design, even with a materialist ontology.

Denis Alexander: Are there any more sociological reflections about the changing nature of society and to what degree perhaps some of the things Ken was talking about have been 'exported', was I think the word he used. But they crop up in Europe at the moment and it would just be interesting to talk about that.

Andrew Brown: Actually I have an American question. In an American context, would it be fair to describe the new atheists as fundamentalism for the college-educated?

Ken Miller: Absolutely. I spoke last night in the Zoology and I showed the same slide that I showed today with a little slogan on the side of the buses in London that says "God probably doesn't exist so relax and enjoy your life". I have a slide saying "Doesn't evolution say that God doesn't exist?" and I put in an additional phrase for that discussion which was "Only for fundamentalists" and by that I meant fundamentalists of the Dawkins and Jerry Falwell variety because the irony here – maybe it's not irony, it's comment or discourse – is the two extreme points of view validate each other because they confirm each other's worst fears. I think that Richard is very much a fundamentalist in his view of what you might call Darwinism.

Andrew Brown: But do you then expect the new atheism to become a social movement as significant as fundamentalism?

Ken Miller: Perhaps not as significant, but I do expect it to be a social movement in the United States. One of the things that has happened in the last few years is that it has become more common from intellectuals, public figures, even people in the entertainment industry and I would say they are atheists and not to be reproached for it in the way that they might have been reproached perhaps twenty or thirty years ago.

Tom Blundell: I must say that I think this sort of equating Dawkins to the fundamentalist Christians is a copout on your part. I supported the Humanist bus movement and it's quite clearly because we're fed up with having Christians putting "God exists" on every bus. It was a joke and probably was just to make sure that we were on the right side of the law.

But I think that the problem has been that society hasn't accepted atheists, it's been hugely discriminatory – in Cambridge colleges when we become a Fellow we have to say that we're going to support the religious objectives of the college – it's a whole long, hard run and most people have not said anything. What's happened recently is that people like Richard Dawkins have freed us up a little bit and I think that you had better approach the argument in a correct and a proper way rather than just try to equate him with the fundamentalists. It's not a good academic argument.

I should say that just about everything else you said I agreed with.

Ken Miller: Well, two things. One is please don't forget that just a few seconds ago I said that the result of this movement has been to empower people, certainly in the United States, to come out and say publicly that they are atheists without the fear of reprobation. As someone who believes in an open and liberal society (and I don't mean that in a political sense, I mean liberal in the original meaning of the word) I actually think that's a good and productive development.

For example, I am absolutely convinced that eight years ago a senator from New Jersey named Bill Bradley would have won the Democratic nomination for president had it not been widely suspected that he was an atheist, which he is, and I think that's a damn

shame. Because even though I'm a Christian I don't think that the religious convictions of a candidate matter. I want someone who is competent and who can run that office. I think Bradley was an extraordinary intellectual – a former Rhodes Scholar and a politician of great integrity – and he would have been a fine candidate for the Oval Office. But the reality is he just would not say anything about his religious beliefs and I think everybody understood why that was so.

I also take that slogan on the buses to be frivolous, to be a bit of a joke, and that's why I paraphrase the second lines as "Party on, dude".

But I would say this and I'm happy to disagree with anyone on this point. And that is I do think that Richard is fundamentalist, first of all in his understanding of religion and his approach to science and I think that what he argues in *"The God Delusion"* if it is not scientism *per se* is something dangerously close to it. By scientism I mean the philosophical point of view that science and scientific truth is the only truth that exists and there is no such thing as aesthetic truth. There is no other way to evaluate any other idea.

Tom Blundell: I don't think he says that.

David Girling: There are other atheists who will depart from what Richard Dawkins said. After the meeting we were talking about Michael Roots as a good example of an atheist who sees science very much within the scientific field and who thinks that science has nothing to say in the way of proving either the existence or the non-existence of God. He has no difficulty in saying that a scientist can be a religious believer, although he himself would describe himself as an atheist. So I think there's enormous possibility for a valid and productive discussion with the atheist field of people who are not quite as rigid in their views as people like Richard Dawkins and Louis Wolpert.

Denis Alexander: Can I just point out that really the main arena of our topic this evening is God and design, intelligent design and that sort of thing. We could have a long talk about atheism, and that's always quite fascinating, but I think if we can we should bring the discussion a little bit more around the central topic of this evening. I think the whole question of design as a new terminology was interesting to me in a sense that I tend to avoid the

language because it can be so misunderstood for all the reasons that you pointed out. I think in a sense that is a pity because it's quite valid, as you were saying. I thought it would be interesting as well perhaps some time during the evening if we could reflect on whether there's any role at all to use that sort of language in a context of science.

Ken Miller: Let me explain one of the reasons why for about a year I have been advocating using the word "design" to talk about the evolutionary design of living organisms and this probably has to do with where I am from and my age.

I was a university student in the 1960s in the United States, at the height of the Vietnam War in the anti-war movement and I was actually twice arrested in the anti-war demonstrations; in fact when I applied for government fellowships they would always ask you a question "Have you ever been arrested" and I always knew that the only way to get yourself into trouble is to lie on the application and say "No". So I would always say "Yes" and then I would explain it was once in front of the Pentagon and once in front of the White House. I did this quite proudly, and it never caused any problems whatsoever.

If you ever said "No" and it was discovered you had lied, you were banned for life from applying for government research grants. I wouldn't claim to have been heavily involved in the anti-war movement, only peripheral, but there is a book that was published in the late 1960s with the bizarre title of "*The Strawberry Statement*" written by a guy who has since disappeared into obscurity named James Simon Kunen. There is one passage in that book which I remember very well, a recommendation that every time there is a demonstration against the war, every time we are arguing that the United States should be out of Vietnam and that we should end the war and everything else, the demonstrators should march behind the American flag; we should wear the American flag on our lapels, we should sew it on our backpacks, we should wave it in front of us. The reason for that is to prevent the flag from being co-opted as a symbol by the other side. So in other words, do not let the pro-war people say "We are the patriotic ones, we're the ones with the flags and these are the people who are in favour of our enemies". We should use the flag too.

We should not say there is no design in biological systems because to most people that implies that you are arguing that living systems are just sort of randomly and haphazardly put together. Any person who has studied human or any other kind of anatomy will tell you absolutely not. There's this beautiful physiological balance of structure in front which is clearly there. To the ordinary person in plain language that's the design and we talk about the design of the aortic ventricles of the heart. These things have very good hydrodynamic design in all sorts of different ways. So let's use that word 'design', but let's *claim* it for our side. In other words, let's *claim* it for evolution, in the same way that Simon Kunen said "Let's claim the American flag for our side in this controversy". That's one of the reasons I do it, and I have been accused in the US by some of my atheist critics of saying Miller is using the word design and trying to sneak his Catholicism into biology. Actually to be perfectly honest, maybe there is some deep Freudian undercurrent there, but I honestly don't think so. I am really trying to look for the best way basically to propogandise what I think about science. I know this is supposed to be more of a discussion than a Q & A session but I do want to respond to one of the very first things you asked about winning a lot of battles and losing the war.

It's worth noting that the religious right especially, the political religious right in the United States, is going through a period of enormous trouble right now and when the Dover trial was over (in 2005) George Will, who is probably the most respected conservative political columnist in the United States, wrote an opinion piece in the Washington Post saying that the most important election of that year was the school board election in Dover, Pennsylvania.

What happened six weeks before the verdict – no-one knew what the verdict would be at that point – was that Dover had a school board election. The citizens in Dover didn't know what the judge would say but they had seen everything that had happened during the trial. They voted the entire intelligent design school board out of office and – remember he's a conservative – Will's observation was that this is what happens when the religious right becomes political and over-reaches itself, which is that ordinary citizens – in a town that

voted four to one for George Bush in 2004 – became appalled at the effort to inject religion into the politics of the schoolroom, and that's exactly what happened.

It's worth noting that in the last American presidential election the person who won the nomination of the Republican Party was in fact the single candidate least acceptable to the religious right and that was John McCain. Now admittedly he had to make some compromises to get a little bit of support, but John McCain was probably number six on the list of those preferred by the religious right and the decline of that influence in the United States has really been quite substantial.

My wife once described me to someone else – I overheard her saying this – as a pathological optimist, and that's probably true but I don't think that's necessarily such a bad thing to be. It's worth noting that in two of the states where these battles have really been fought out it looks as though permanent pro-science majorities have been established among the electorate. The first was in Kansas, which is tired of being a joke, and therefore has routinely endorsed pro-science candidates in the last few years. The second was the state of Ohio, where it was less contentious but still was relevant. The state right now where the biggest battles are being fought on this issue is Texas. Their elected school board recently adopted a series of science standards that are very subtly worded but most people think allow room for creationist arguments to be brought into the classroom. What's going to happen in a year – it's going to be very interesting – is that entire school boards have to stand for election. You might not think that there are any school districts in Texas where being a politician who is identified with the religious right would be disadvantageous, but that's probably not true. But again this pathological optimist is optimistic that we *can* win the war in terms of securing a good education for kids in the US. I wanted to make sure I addressed that point.

Denis Alexander: Could we throw this out because it's an interesting idea, catching the language so that people can't use it for their own purposes. What do people engaged in science education think? Should we take the word "design" and make sure it belongs in the right place?

Ken Miller: Not to answer but to amplify your question, many of my scientific friends have said, especially to people who work in structural biology, let's never again refer to the design of a single transduction pathway, for example, because design always implies a designer. In other words, let's police our language so we get it out.

Tom Blundell: I'm a structural biologist and certainly we use 'design' when we design a protein. There are plenty of other words to use otherwise.

Phil Jones: I was writing a paper very recently with a biologist and a physicist – an atheist physicist – who wanted to use the phrase "design principle" in a cross disciplinary piece. He was coming from a condensed matter physics angle, which is probably fairly alien to most people in this room, and he said "I want to use the words design principle." I said actually our coauthor is a biologist and he will have antibodies against this. We now regret using the words 'organising principle' but actually that misses the fact that there is a teleology behind this. It's the simplest possible explanation. Let's call it a design principle, why not, do we have to invoke a designer, or do we have to use these terms? I know it implies a designer, but for him as a physicist, he cannot escape the beauty and simplicity of this so technically if wants to use the words 'design principle' why should he not use that? I think I was wrong now to argue against that.

Tim Clutton-Brock: Evolutionary biologists who, like myself, deal all the time with whether behaviour or physiology or anatomy is in some sense optimal face this problem commonly. We tend to talk about adaptations rather than designs, and about adaptive significance. We use 'design' but we are very well aware that if we do use it, there is an immediate risk that people will think it implies a designer; and that's one point. The other point I would like to make is that in the last part you tended to emphasise design, 'there's a grandeur in this view of life' and so on and evolutionary designs sometimes are grand in that way, wonderful in that way. In other cases, even though they are extremely complex, they are not so wonderful. What immediately ran through my head was the absolute beauty of the design of infanticidal tendencies of males which go on in many mammals, including us, where we systematically kill offspring that have been fathered by other males on females that we wish

to mate with. There's an endless list of beautiful adaptations, finely adjusted adaptations, high evolved adaptations, which are in no sense, in the human context, nice adaptations.

Denis Alexander: Just before Ken responds to that, does anyone else want to come in on this topic?

David Girling: I think we have to bear in mind that the public at large have a very developed view of design. When they look at a human being or any biology they tend to think in terms of how beautifully designed that is and I think we must somehow find ways of communicating with the public about the science and validity and importance of evolution, while also respecting what a lot of people will describe and think of as being conspicuously well-designed.

Henry Disney: I would like to point out that one of the powerful pieces of evidence for evolution is *un*intelligent design when you are trapped by developmental constraint. For example, when you're a fish with a short neck it doesn't matter which side of the blood vessel the recurrent pharyngeal nerve in the neck goes, but when you become a giraffe that nerve has to go all the way up and come down again, which is crazy design. What you see is crazy design beautifully engineered by selection. The insect is a supreme example of that.

Ken Miller: And I would add something to what you are saying, that Neil Schubin's '*Your Inner Fish*' makes that point in spades. He's a teacher of human anatomy in addition to being a palaeontologist and he says that the most difficult part of the human anatomy to teach the medical students is the skull because the nerves all go in different directions to the muscles and the usual connections. It makes absolutely no sense, but if you trace the evolutionary history all these muscles and all these nerves go back to the fish. Suddenly you discover everything is in straight lines, everything is logical, everything is beautifully organised. It's only when you morph the fish head into the human head that they get twisted, they make the roots of the nerve that you spoke about and so forth and therefore all the oddities of human anatomy become explicable only by virtue of evolution.

Henry Disney: Well that's right. A perfect example is the blind spot in the eye because we've got the wiring back to front, whereas the octopus has got it the right way round.

Ken Miller: I've had long arguments with the creationists about the octopus eye!

Denis Alexander: Any other views on this use of language?

Rupert Beale: Do you think it's a problem just with the word "design" because of the intelligent design movement or do you think there's a deeper problem with trying to express an even more slippery and difficult philosophical concept of purpose? You have to quote biological purpose of something in biology. If you can't demonstrate that something has got a biological purpose, people ask you the very reasonable question "Why are you bothering to do this piece of research then if it doesn't have a biological purpose you can demonstrate to us?" Virtually purpose is a much more difficult concept than design.

Ken Miller: Yes, I agree with the second, it's not just the intelligent design people who have used this term.

I hosted a seminar at Brown by the late Stephen Jay Gould who gave a marvellous talk, as he always did, and at the end of it he took questions. A young man stood up in front and said Dr Gould "Why do men have nipples?" And as any of you know who have struggled to answer that question, it's actually a difficult question to answer and Steve struggled to answer it. I think he answered it quite satisfactorily when he answered that the easiest way to build a structure is to build it in both males and females as in all organisms, and then to activate either one where it's actually useful. This led Stephen to write a few years later in an essay with one of his usual whimsical titles (it was called I think "Male nipples and clitoral ripples") but I think the overemphasis on the adaptive significance of literally everything has led to this idea – and this comes right out of the Gould essay – that there's always a reason, there's always a design, to everything. I'm not convinced there is always an adaptational reason for design but I think you're right: it's something deeper and it's one of the reasons why I would like to reclaim or stake out the ground for that word 'design' to say that evolution can produce design as well. It just occurs naturally to all of us.

Denis Alexander: Are there any other views on that particular thing? It might be good if we move the conversation on a bit and there might be other things that arose from the lecture that other people might want to talk about and take the discussion in a different direction.

Nicole Maturen: It's basically the issue of where we should put God. In one of your slides you said that God is ultimately basically responsible for the wonder of life and that the atheists or agnostics also see wonder and attribute it to something and both of them want to approach the question scientifically. I'm not sure if that really captures the range of perspectives of where exactly is the best place to put God on this issue. Do we just put him outside and simply say something rather than nothing, is what we attribute to God? Or the origin of life? Or do we simply attribute these things to him without trying to put our finger on this specific point.

Denis Alexander: Ken, it sounded like a question for you.

Ken Miller: It did, and I have to tell you that I am not comfortable at all with an idea of God in which we say OK there's a certain number of phenomena to which we apply reason and explain these and then there's a bunch of other phenomena over here, to which we apply spirituality, miraculous events or something else. It's as if you are logical and scientific part of the time and irrational and mystical part of the time; to me that speaks of a kind of schizophrenia, it has no logic.

What I personally say more than anything else is not the idea of a scientist who is also a person of faith being partially rational and partially irrational as someone might say, but rather the following and that is 'does there exist a spirit within which scientific reasoning in its totality can be closed?'. To me that is the sphere of faith which explains why the rationality exists, why science works and why the natural world is open to rational investigation. So to me I never am comfortable – and it's probably just because I'm a scientist – never comfortable plugging God in as a material explanation for every phenomenon. Rather I see the spiritual as the ultimate explanation for why science and reason work. So I see it as an enclosing sphere, rather than as a point by point explanation. I was asked after my talk tonight by a very nice fellow who started off the right way by saying that he liked the talk very much – it's always a good way to get somebody to listen! – and then identified himself as a Baptist preacher and then at some length, and he was quite sophisticated about it, pointed out that he had been reading literature on the origin of life and didn't I agree that science was

pretty much baffled by the details of the ultimate origin of life on this planet and had no valid step-by-step explanation, in a Darwinian or any other sense, for the origin of the first living cell.

I freely confessed he is absolutely right about it, this is a major unsolved problem. I think it might be the *greatest* unsolved problem, but it's not the only one. There are many that would keep a lot of the people in this room busy for very many years. He said that's where he finds God, he finds God as that explanation. And I said that's fine, think whatever you want, but my advice to you just as a fellow Christian was not to advise a person to hang their faith on the proposition that science would never solve their problem because science actually has a nasty habit of solving insolvable problems and if you do hang your faith on that then on the day that we have a reasonably complete explanation it would be time to lock the doors of the church shut! He wasn't convinced by that – not surprisingly. But certainly in the slide that I showed that you spoke of I have been at pains and put some effort into trying to make a case that not everyone agrees with, which is that religious faith is not an obstacle to doing science or to embracing fully scientific rationality. There are quite a few people – not so much Richard Dawkins – but in my country Gerry Coyne, who has written a great new book called *"Why Evolution is True",* and a blogger – probably the most-read science blogger in the whole world according to *Nature* magazine, P. C. Myers – who have argued that people like me who argue that you can hold a religious faith and be an effective advocate for science are disingenuous at best and frankly dishonest at worst. Needless to say I don't think I am either one of those things. But again what have tried to argue is that there are ways that a religious person can understand and fully embrace science.

Obviously there are ways in which non-religious people can understand and fully embrace science too and I think to me the most striking thing about the day-to-day practice of the scientific profession and the day-to-day work that we all do in the scientific community is that the individual religious faith, or lack of faith, of individual investigators for the most part is irrelevant to the work we do. It just doesn't *matter* and I think that's a key point that we have to get across to the general public, which is that science is the closest thing we have in

this planet to a universal culture that transcends cultural boundaries and also transcends allegiance of faith and that's why science works ultimately.

Denis Alexander: Nicole, do you want to come back on that?

Nicole Maturen: Yes please. Denis and I were recently in Istanbul and we had a public panel session on the hard questions of evolution. One of the things that came up was intelligent design and we had a representative who used to be an advocate of intelligent design who said he had changed his mind. In fact he had been to a Faraday course and was getting information and said he longer subscribed to intelligent design any more.

What I think is that God created the laws that govern biological evolution so my question is really 'is that OK?' Is it fair to say that God created the laws because to me that's getting into science, but there are probably some processes that developed biologically and so I don't think I'm even comfortable scientifically saying that God created the laws.

Keith Miller: Well there was a very provocative column in the New York Times a little less than a year ago by Paul Davies, the physicist and cosmologist. I forget the name of the exact title but it was something like 'Science and Faith' or 'The Faith of Science' and Davies pointed out in the column that one of the ways in which he used to annoy his graduate professors when he was getting his PhD in physics was to ask them where the laws of physics came from. And the response he got from his professors were either 'go away, don't bother me', or 'it doesn't matter where they come from, because our job as physicists is simply to uncover and apply them'. He never found those to be very satisfactory explanations. To him that meant that there was kind of a faith to science and by faith he means that there are undecidable propositions in science, that science is not a closed, logical loop, that there's a certain faith that the laws are real, that they make sense and are universally applicable. As a result he says this is well justified because our experience shows us that this is a reliable way to work in the natural world.

Nonetheless it means that there is an element of faith that is built into physics, in terms of where the laws of physics come from. He then goes on to say that many other people more recently have responded to that annoying question of where do the laws of physics

come from by saying there are multiple universes and in every one of these multiple or parallel universes the laws of physics are somewhat different, and that's the explanation. But as I think he quite rightly points out, that just pushes the question a little further back, because you then have to say where does the mechanism come from that generates multiple universes, each with its own set of fundamental physical concepts.

So in terms of asking if God is up there putting the laws together, I would say the laws of nature exist for some reason or for no reason but they certainly exist and I think it is a fair and perhaps scientifically undecidable question, even in principle, as to where they come from. And to a theist, who thinks that there is a creator behind everything that exists, that is a perfectly reasonable answer. To someone who is not a theist, who thinks that there is no credo behind it, the claim either of multiple universes or that this is the only universe and things are the way they are for no particular reason, I think scientifically can't distinguish between those three alternatives. I find one of them much more satisfying than the others.

Bob White: I think there's a real problem in talking about laws of physics or laws of nature at all, which actually you have just exemplified by talking about uncovering the laws of nature, because they are not laws. They don't control how nature works, they are actually just descriptions which happen often to be mathematical and very concise and beautiful in their manner of explaining them, but they don't control how things happen, they just describe *how* things happen.

We know they are not laws for example by Newton's laws of physics, which work well enough at velocities well below the speed of light – they are a good approximation, good enough to get a man to the moon using them – but they are wrong, and they're founded on a completely incorrect premise, namely that things carry on in a straight line if you don't do anything. Newton's Laws are conceptually wrong, but they happen to be good descriptions which work well within a limited sphere. But you have to go to Einsteinian physics to understand Black Holes. I'm sure Einsteinian physics is not the final answer, we will have to go to something else which we don't yet understand. And don't forget that we have no conception of what 95% of the dark matter and dark energy in the universe does anyway.

There's only a tiny bit of the universe that we can understand at all. So it's all coming back to terminology. You are talking about laws but this may actually be diverting us from how the world actually is. We can describe the world and how it works to some degree, but we are not finding laws or even uncovering laws that force it to happen. Do you see the difference?

Ken Miller: I see the difference but I think it's a semantic difference. What I mean by that is that Newton wasworking within a particular frame of reference and measurement and his laws were able to formulate descriptions [**Bob**: exactly] of how matter behaves.

It turns out that using broader observations, such as the constancy of the speed of light among other things, Einstein was able to formulate laws, which as you know embrace most of the Newtonian physics, certainly at ordinary speeds, velocities, and weights. When you run these through Einsteinian equations the differences from Newtonian mechanics are infinitesimal, certainly too small for Isaac Newton to have noticed or measured and requiring very large energies, very high velocities to actually show up. And actually I think I remember during the moon missions that there were certain calculations which would have been a bit off if purely Newtonian mechanics had been applied so I think relativity actually did come into play during the lunar landings. But what I would argue is that all that you are talking about are empirical imperfections in ultimate descriptions of the regularities of nature. If the regularities of nature are genuine, saying that the laws are imperfect doesn't in any way compromise the notion that those regularities are there. Furthermore, there remains the question of where they come from, because they've got to come from somewhere.

Andrew Brown: So you seem to be approaching the statement that God is a way of describing the fact that these regularities exist, or God is an explanation for the existence of these regularities, or God produces these regularities? I just wanted to get the relationship straight.

Ken Miller: Well, in the Nicene Creed, it says that God is the creator of all things seen and unseen. I would take that as the regularities of existence, the whole thing seen and unseen. So the answer is yes, I would say that.

Bob White: Genesis 1:1 is pretty clear on where the created universe came from.

Ken Miller: In fact it's difficult for me to see how one can take a position of being either a theist or a deist and not answer "Yes" to the question that Andrew just asked me.

Andrew Brown: So it follows from this that it's almost a reversal of the "God of the gaps" explanation in a sense because these regularities make it possible if you can uncover enough of them to remove *all* the gaps.

Ken Miller: Well you know ultimately that's what we want to do in science. Science is predicated on what I would call an operational faith and that operational faith is that the world is understandable and the second element of that operational faith is that knowledge is better than ignorance. Not everyone in this society agrees with that, that knowledge is better than ignorance, but I think that anyone in science certainly must.

Rodney Holder: It seems to me that if I may say so, that you earlier described with your Baptist questioner what was a classic example of "God of the gaps", that there's this bit that science can't explain within the processes of nature, which might be the origin of life.

Now intelligent design commits that over and over again (**KM:** over and over again) – precisely – it seems to me that many intelligent design people seem to say that in fact they are not all totally opposed to evolution *per se* but what they are saying is that there are bits within the processes that can't be explained by evolutionary processes and so on. But when you then moved on to Paul Davis I think you were in a different world there, talking about the laws of nature *per se* because, as you rightly say, science is about uncovering what those laws or regularities or however you describe them, what those *are.* But why they are as they are is a meta scientific question. That is then open to alternatives, such as there might be all kinds of universes that we can't in principle observe and so on, which seems just as metaphysical if not more so than the existence of God.

You are in a different realm when you're talking about design in that grand scheme of things, the overall design and purpose, and the universe and so on and why the laws are as they are rather than individual bits of design, which is what intelligent design is.

Ken Miller: No, I think that's a fair statement and actually in his most recent critique of my most recent book, Jerry Coyne basically said 'what's the difference between somebody like

Miller or Francis Collins and the intelligent design people because they both want to plug God somewhere into nature'. And I wrote a very quick response to Jerry, and asked him how different could it be.

The intelligent design people think that natural processes are *not* sufficient to generate living things and the complexity of life, and I think that they are. I can't imagine a greater contrast than that. I think ultimately his objection is to people like me or Francis Collins, who simply want to retain some respectability for religious thought. I think ultimately the objection is an almost visceral reaction against any person who is in science and seems to be reasonably intelligent, who still retains a modicum of faith in anything spiritual simply because if I had to psychoanalyse Jerry Coyne and his admirers it would be that they have based their own justification for atheism on science and the findings of science, and they cling to that justification. I suppose to say that they have a degree of desperation is almost too pejorative, but they cling to it with a tenacity such that any person who is religious and *also* claims science as their own is a threat to their own internal rationalisation for atheism. I am trying to write something to Jerry now – I consider him a friend – saying that he should be more secure in his atheism than that, and shouldn't be threatened by somebody like me.

Denis Alexander: I think that raises a very important point, that comes into science education. Coming back to the conference in Istanbul last week that is very much what it was about, this trying to deliver science from its packaging and all kinds of ideologies and to free people up to teach it as science and especially evolution, and insist that actually you can absorb this pretty much in any world view that you like.

Ken Miller: Not a religious view that itself makes empirical testable statements which we can show to be false.

Denis Alexander: Yes, but in terms of general world views, be they atheistic, Buddhist, Hindu, you can never co-opt evolution in any of those things. I would say it actually just doesn't matter and I think it's terribly important that we deliver evolution out of the hands of idealogues of any stripe and any colour to just let it be a scientific theory. Evolution is a working theory that we need in the lab so that we can let people get on with that job.

Rupert Beale: Isn't one of the problems of this kind of thing that you can integrate a proper sort of scientific viewpoint into almost any completely silly religious or non-religious persuasion if you just take one step further than that and say 'well let's use the same intellectual tools that we use to do science and apply them to our overall metaphysical viewpoint'. I would very much include a kind of many worlds view of creation, if you want to call it that, in that you run into quite serious problems because if you want to have, for example, Ockham's razor as something which you actually need to be able to do science properly. If you like it's a special case of base theorem: you can't have a 'many worlds' explanation of anything until you have got some justification that these 'many worlds' really exist. It's that kind of philosophical framework that a lot of more sophisticated atheists would point at Christianity and other religious world views, which I think actually reflect back much worse on atheistic view points, certainly atheistic viewpoints which try to be capable of including non-scientific value judgements about things. There are a fairly restrictive set of metaphysical viewpoints which are actually compatible with not in practice doing science because empirically there are people who do science very well who have had very strange ideas – famously Newton as a young-earth creationist – and when you take it one stage further back, there are things which perhaps are not incompatible with specific empirically verifiable scientific statements but maybe are very difficult to reconcile with scientific methodology.

Tom Blundell: I accepted most of what you said today that where it comes back to science, and this is a topic we discussed when I was here last time, if you have faith you may have prayer. These are the sort of things where you begin to reconnect with the real world and so let me ask you, do you pray? (**KM:** Yes) And if you pray is it for your own good or for someone else's good and if it's for someone else's good, could you tell me about the mechanism?

Ken Miller: Sure. I learned early on in my religious training the kind of prayer which said 'give me this, give me that, give me something else', is the lowest one and that prayer properly done is self-examination and reflection. That is actually how I try to pray. (**Tom**

Blundell: So it's for you not for the other). No, it's not for me, it's to reflect upon myself and basically to try to think 'am I living the right sort of life, am I being intellectually honest, am I being compassionate?', and to me that's what prayer is, not 'I want to get this grade annotation, I want to get this job, please cure me of the pain I feel in my right knee as I get older', and that sort of stuff. Is prayer efficacious? This is a question that is commonly asked by sceptics of religious people and it's asked for a purpose and I'm not naïve enough to *not* understand what your purpose is. And the purpose basically is to trap the theist into either saying [**Tom Blundell:** I'm not trying to trap anybody, I'm just trying to ask you a question] and I am answering the question where I perceive a trap and the trap, intended or not, and the trap is basically to say prayer is not efficacious in which event the sceptics say 'well you're not actually a religious person because, Catholics, Protestants, everybody believes in the effect of prayer'. Or to get you to say that you think prayer is effective and then to say 'OK, explain to me how God acts in the natural world – what buttons and levers he pushes ' – and my answer to that is that the workings of God are mysterious in many ways.

I will give you my favourite personal example of what you might call the effective nature of prayer and it's absolutely true. I have a very good friend at Brown medical school, his name is Timothy Flanagan, and he and his wife Lula (she is of Croatian descent although born in America) are both professors of infectious disease at Brown Medical School. They have three children and a few years ago their children were aged 4, 13, 14 and they had a conversation at one point in which they noted that although the 13 and 14 year olds were around the same age the little one had no-one to play with. The Balkan Wars had just been concluded, there were articles in the newspaper about the large number of children in orphanages all throughout the former Yugoslavia and they discussed the possibility of adopting a child of about the age of the youngest and they thought this would not be a bad idea. Lula was actually planning a visit to her existing relatives in Croatia, so they all went along and went to visit an orphanage, and started to engage in one of those awful brutal rituals in orphanages where the leader of the orphanage lines up all the kids and the potential adoptive parents look them over and decide which one they might like to adopt. It's

horrible that this goes on, but it does. They went ahead and did this and found this one little boy and they both came away and said that little boy is the one we would like to adopt and went back to the director of the orphanage and told him this. He said that they didn't want that kid and when they asked why he said that all the children were tested for communicable diseases when they came in and that the boy had Hepatitis C. This meant he was going to be sick his whole life, needing an intense amount of medical care with a danger that he might spread the disease to their other children, so they should adopt somebody else. They went back to the hotel and as they are both religious, they prayed for some sort of guidance. They got up the next morning and said 'we are both professors of infectious disease, we're probably the two best parents in the whole world to care for this kid, it seems like the right thing to do'. 'It might be a tremendous burden but let's do it' and they went back and insisted on adopting the boy because they really thought it was the right thing to do. It took six months but the papers went through and he was adopted and brought back to the United States.

The first thing that Tim did after he settled was to take him to the hospital and do a complete health check. He warned the technician who was drawing blood to be very careful because this little boy had Hepatitis C, so he said double-glove yourself and be extremely careful. So the technician came back that afternoon with a confused look on his face and said 'this kid doesn't have hepatitis C, the test was run three times with negative results'. Tim says that he thinks he knows what happened and that is in the former Yugoslavia budgets were low and the only quick test they had for Hepatitis C was an Eliza test, which is an antibiotic based test, which gives a high number of false positives. In Europe and the UK and the US we use the PCR test which actually tests for the genome of the virus and is much more sensitive, with far fewer false positives. He said he doesn't think for a minute that this young boy had Hepatitis C and was cured by their prayer but he does think that he and his wife were tested, in effect, and after that test they made the right decision based on prayer and self reflection and that's one of the reasons things turned out the way they did. You asked me what did I think was the effectiveness of prayer and I think it would be the kind of

story I've just told you. And I have been asked if I have ever seen a miracle and I say that's as close as I ever came to a miracle. I think it's a miracle that quite obviously has a perfectly natural explanation in scientific terms, but I don't think that makes it a lesser miracle.

Denis Alexander: Well, we've covered a lot of ground this evening. We started with intelligent design and we've ended up with a very interesting story and covered lots of different topics in between. I think we should draw to a close but I do think we ought to thank Ken very much. We've worked him very hard this evening and he's given us some fantastic answers and very thoughtful things to take away with us, so thank you very much.

Ken Miller: And I want to thank all of you – Faraday, Denis, Bob, for the opportunity to be here and have a very pleasant couple of days. I've really enjoyed this visit to Cambridge and the chance to exchange all these ideas. I have enjoyed it very much and I want to thank all of you.

Who's Who

Prof Ken Miller is Professor of Biology at Brown University. He is a cell biologist, and chairs the Education Committee of the American Society for Cell Biology. He serves as an advisor on life sciences to the News Hour, a daily news and public affairs TV programme, and in 2006 was named a Fellow of the American Association for the Advancement of Science. He is the recipient of numerous awards, most recently the 2008 Award for Public Understanding of Science and Technology by the American Association for the Advancement of Science in recognition of "his sustained efforts and excellence in communicating evolutionary science".

Dr Denis Alexander, Director of the Faraday Institute and Fellow of St. Edmund's College, engaged in cancer and immunology research at the Babraham Institute; editor of the journal *Science & Christian Belief*; author of *Rebuilding the Matrix* (2001, Lion), *Creation or Evolution - Do We Have To Choose?* (2008, Monarch) and (with Bob White) of *Beyond Belief - Science, Faith and Ethical Challenges* (2004, Lion).

Dr Rupert Beale, Clinical Lecturer in Renal Medicine and Immunology, University of Cambridge. Research in molecular biology of antiviral immunity. Co-author of 'Somatic Evolution of Antibody Genes' in *The Implicit Genome* (OUP, 2006).

Tom Blundell is Sir William Dunn Professor of Biochemistry and Head of the School of Biological Sciences in Cambridge University. He is a structural biologist interested in the architecture of the living cell at the molecular level. After obtaining his D.Phil at Oxford University in 1967, he has held research and teaching positions in Oxford, Sussex and London Universities before moving to Cambridge in 1996. He is a

member of Academia Europaea, a Fellow of the Royal Society, Fellow of Academy of Medical Sciences. He was a member of the advisory group to the Prime Minister (ACOST), Director General, Agricultural and Food Research Council and founding Chief Executive, Biotechnology and Biological Sciences Research Council. He was Chairman of the Royal Commission on Environmental Pollution, 1998 to 2005. He was President of the UK Biosciences Federation between 2004 and 2008. He co-founded Astex Therapeutics which has oncology drugs in early stage clinical trials in USA and UK.

Andrew Brown, Editor of Belief, Comment is Free, *The Guardian*; columnist, the *Church Times*; author, *The Darwin Wars*, *In the Beginning was the Worm*.

Tim Clutton-Brock is the Prince Philip Professor of Ecology and Evolutionary Biology at the University of Cambridge. His research has investigated the evolution of reproductive strategies, social behaviour and cooperation and the operation of natural and sexual selection and the regulation of animal populations. He has worked primarily with mammals including red deer (on Rum), Soay sheep (on St Kilda) and meerkats (in the Kalahari). His current research focuses on the evolutionary causes and ecological consequences of cooperative breeding in animal societies.

Revd Dr Geoffrey Cook, Life Fellow and former Vice-Master of St Edmund's College and Affiliated Lecturer, Department of Physiology, Development and Neuroscience, where his research is in developmental neurobiology. Ordained as a deacon of the Catholic Church, he chairs the Diocesan Commission for Dialogue & Unity, RC Diocese of East Anglia.

Henry Disney followed a career in the army by studying Zoology at Cambridge. This led to running field study centres in the UK and significant work as a medical entomologist in Belize and Cameroon. Since 'retirement' he has continued his entomological research as a world specialist on scuttle flies (Phoridae). He was awarded a PhD by the University of Cambridge for his 1960's publications (on medical entomology) and a ScD for subsequent publications. In addition to his scientific publications he is also a published poet. He is a churchwarden at his local church.

Dr Frank Flynn, Retired headmaster, earlier research interest Astronomical Optics and Cometary orbital dynamics, present tutor in Astronomy for Madingley Hall (Inst. of Continuing Education), was chief examiner for GCSE Astronomy, current interests in Extrasolar Planets and the search for life in the Universe, and the interface between Professional Astronomy and the layman.

Dr David Girling FRCP. Retired MRC Senior Medical Scientist. Licensed Lay Minister (Reader) at the University Church, Great Saint Mary's.

Dr. Ruth Hogg, Post-Doctoral Research Associate at the Dept of Experimental Psychology and Research Associate at Clare college, visual neuroscience, psychophysics, ageing, epidemiology and genetics.

Timothy Jenkins, Assistant Director of Research in the Faculty of Theology & Religious Studies and Dean & Fellow of Jesus College; author of *Religion in English Everyday Life* (Berghahn, 1999), *An Experiment in Providence* (SPCK, 2006), and *From Le Play to Bourdieu: the Life of Property in Béarn* (Berghahn, forthcoming).

Prof Paul Luzio FMedSci, Master of St Edmund's College; Professor of Molecular Membrane Biology, Department of Clinical Biochemistry and Director of the

Cambridge Institute for Medical Research (CIMR); cell biology, protein localisation and function in cells; molecular mechanisms of disease.

[The Rev'd] George Pitcher - Religion Editor of Telegraph Media (Daily, Sunday and telegraph.co.uk). Co-founder and former chief executive of communications consultancy Luther Pendragon. Author of *The Death of Spin* (Wiley, 2002). Recently completed curacy and now associate priest at St Bride's, Fleet Street, the "journalists' church".

Tom Simpson, PhD student in Philosophy at Corpus Christi College; studying epistemology, testimony and trust; former Royal Marine (NI, Iraq, Afghanistan).

Dr David Summers, Head of the Cambridge Department of Genetics, Fellow and Director of Studies in biology at Gonville and Caius College. Research interests in microbial genetics with a particular focus on bacterial plasmids.

Prof Bob White FRS, Associate Director of the Faraday Institute and Fellow of St. Edmund's College; Dept of Earth Sciences; research focus: volcanoes, earthquakes, climate change and other catastrophes; co-author of *Beyond Belief – Science, Faith and Ethical Challenges* (Lion, 2004) and *Christianity, Climate Change and Sustainable Living* (SPCK, 2007).

Prof Juriy Wladimiroff, FRCOG Emeritus professor of Obstetrics & Gynaecology (Erasmus University, Rotterdam); emeritus professor of Clinical genetics (Erasmus University, Rotterdam); Visiting Specialist Dept of Obstetrics & Gynaecology, Rosie Maternity, Addenbrooke's Hospital, Cambridge.

Prof Andrew Wyllie FRS FMedSci, Head of the Department of Pathology, University of Cambridge; apoptosis in normal and neoplastic cells, and clinical studies on human colorectal cancer