



Science & Religion in the 21st Century

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Eric Albone: We are delighted to welcome Dr John Polkinghorne with us this evening. An old friend of Redcliffe and of Bristol, born and brought up in Somerset, he knows us well. John Polkinghorne is a Fellow of the Royal Society and a KBE, winner of the 2002 Templeton Prize, and was until recently President of Queens' College Cambridge. For many years he was Professor of Mathematical Physics at the University of Cambridge, where he formerly studied under that most distinguished Bristol-born physicist and Nobel Prize Winner, Paul Dirac. In 1979, John resigned his professorship in Cambridge to train for the Anglican priesthood and was for a time curate at St Michael and All Angels' Church in Bedminster; it's good that we have the Reverend David Moss from that church with us this evening.

Among his many involvements, John has been chair of the Science, Medicine and Technology Committee of the Church of England Board of Social Responsibility; he also chaired a joint working party on cloning for the Human Genetics Advisory Commission and the Human Fertilisation & Embryology Authority. He has been a member of the Medical Ethics Committee of the BMA and of the General Synod of the Church of England.

As you well know, John has written widely for the general public on matters relating to science and religion. The title of his first book '*The Way the World is*', or in his words '*What I would have liked to have said to scientific colleagues who couldn't understand why I was being ordained*' might well be a good sub-title for this evening's talk.

Anyway I would like now, without further ado, to hand over to John Polkinghorne for his talk,

'Science & Religion in the 21st Century'.

John Polkinghorne: Thank you very much. I'm very glad to be here. Bristol was the town of my youth where we went shopping and went to the pantomime at the Hippodrome, and I was curate of the parish up the road, a rather sort of different parish from St Mary Redcliffe, but on very friendly terms with our large and dignified neighbour.

Now, if we're going to figure out where we're going, we'll have to know where we start from, so I want to say a little about what's been going on in 'science and religion' towards the end of the 20th century before I get out my crystal ball and try and look a little further into the future.

In fact, there's been a very vigorous exchange going on between science and religion in the last 20-30 years, and that's taken a number of forms. One of the first forms was a sort of revival of something that many people have thought of as dead and gone, which is natural theology.

Now natural theology is the attempt to learn *something* of God from the use of reason and the inspection of the world, by just looking around you at what's going on in the world and trying to figure out whether there might be a divine mind and purpose behind it. It's a limited enquiry, but it's a worthwhile one. It was very popular in the 18th and early 19th centuries in a form that we associate with Archdeacon William Paley, but we've come to see that that form of natural theology got off on the wrong foot, and so the revival has also been a revised form of natural theology.

Now what Paley and his friends got wrong was to think of religious explanation as a rival to scientific explanation. So you took something like the development of the human eye and you said, either science can explain it, but it obviously can't, therefore God has to explain it.

That was a bad mistake. It was a bad mistake theologically because it seemed to imply that either nature did it or God did it. But if God really is the creator of the world, and therefore the ordainer and the sustainer of nature, God is just as liable to work through natural process as God is through any other way that might be at divine disposal. So it was a bad theological mistake, and it turned out to be a bad apologetic mistake too when Darwin came along in 1859 and drew the rug from beneath that sort of argument by showing how the patient sifting and accumulation of small differences could bring about immense complexity and the appearance of design without the direct intervention of a designer.

Now the modern revised natural theology doesn't make that mistake. Instead it has tirelessly used religious theological understanding, not as a rival to science, but as a complement to science, using it to deepen and broaden our understanding of what's going on in the world. We have every reason to believe, I think, that scientifically pose-able questions will receive scientifically state-able answers. But we also have every reason to believe that there are many questions that are both meaningful and necessary to ask about the world if we really want to understand it which are not scientific in their character. And some of those questions interestingly enough arise out of our experience of

doing science, but take us beyond what science itself is competent to speak about, because science has purchased its very great success by the modesty of its ambition. Honest science doesn't pretend to answer every question.

So let me give you a couple of examples, very briefly, just as a warming up exercise of meta questions, that is to say, questions that take us beyond science, questions a revised natural theology can address in a way that is illuminating, and to me, persuasive. I don't go beyond that. We're in an area of inquiry, of human inquiry, where there is no knock down argument available either to the believer or the unbeliever. We are seeking understanding, and well motivated belief, but I'm not going to claim that my atheist friends are stupid. It's obviously not true anyway, many of them are very clever and intelligent, but I am going to claim that theism can explain more than atheism is able to do. So what can it explain?

Well first of all I think it can help us to understand why science is possible. Of course we've got to understand the everyday world just to survive in it. But we can also understand scientifically whole realms of physical experience that are totally different from the everyday world.

I was a quantum physicist. Eric referred to Paul Dirac who was one of the great founding figures of quantum theory. Now the quantum world is totally different from the world of everyday. In the quantum world, if you know where something is, you don't know what it's doing. If you know what it's doing, you don't know where it is. That's Heisenberg's Uncertainty Principle in a nut shell. It's a different world from the world of everyday but nevertheless it turns out that we can understand it. Not only that we can understand it, but

that it is *mathematics*, perhaps the most abstract form of human thinking, which is the key to unlocking the secrets of the physical world.

Dirac was not a conventionally religious man at all, but when Dirac was asked '*what's your fundamental belief?*' - he wasn't a man to say too much - he went to a blackboard and he wrote on the blackboard, '*The laws of physics are expressed in beautiful equations*'. He once said that that was a very profitable religion to have, and so it was. He made his great discoveries through a relentless search for mathematical beauty, not out of a sort of mathematical aestheticism, but because we have found in the history of physics that it's only beautiful equations that will turn out to have that long-term fruitfulness that persuades us that they are really describing what's going on in the physical world. Mathematical beauty is something that those of us who speak that language can recognise and agree upon, and it works in physics.

If you go into Westminster Abbey you can find there in the corner that's devoted to science a memorial slab to Dirac, and on that you will see inscribed, if you have the mathematical eyes to see, a very beautiful equation indeed. It is what the rest of the world calls the Dirac equation. But Dirac, who was a very modest man, never referred to it in those terms.

In other words, when scientists study the world, they study a world that is rationally transparent to them and rationally beautiful to them. Doing scientific research is hard work, and has all the boring routine in it of every other

worthwhile activity, but the reward for that is the sense of wonder, both individually and collectively, we have when some new aspect of the structure of the world is revealed to us, a world in it's rational beauty shot through, you might say, with signs of mind. Is that just our luck, those of us who happen to like mathematics? Or is it the sign that there is indeed a capital "M" mind that lies behind the order of the world. Dirac's brother-in-law, Eugene Wigner, who also won a Nobel Prize for Physics once called it '*the unreasonable effectiveness of mathematics*'. Why does man's abstract thinking fit the world around us? This remarkable fact becomes not a happy accident, but intelligible if there is a divine mind behind it.

Also of course we know the world has had a long history, and that it's taken a long time for interesting things to happen. Ten billion years before any form of life appeared as far as we know. Fourteen million years, only yesterday really, when self-conscious life, like ourselves, appeared on the cosmic scene. If there is a God behind all that, it's a God who is patient and subtle, He's certainly not a God who's in a hurry.

But we've also come to realise that although it took so long for life to develop, there is a very real sense in which the universe was pregnant with the possibility of life almost from the beginning. Just shortly after the Big Bang, the laws of nature that operate in our world took a very specific form, a very finely tuned form, you might say. And we've come to realise, as we've understood the processes of the world, that it's only because the laws of nature have that definite quantitatively specific form that the evolution of carbon based life

has been possible in this universe. It's a very surprising conclusion. I'm sure many of you know about it, it's been called the 'Anthropic Principle'. Not a terribly well chosen word, but that's what it is, and let me just give you one example of it.

The chemistry of life is the chemistry of carbon, but the early universe was very simple and it only made very simple things. In fact after three minutes when the whole universe cooled down enough not to be a sort of cosmic hydrogen bomb anymore, the nuclear structure of the universe got fixed at $\frac{3}{4}$ hydrogen and $\frac{1}{4}$ helium. These are the two simplest elements and together they have a very boring chemistry. Just by themselves you can't really do anything very interesting with hydrogen and helium. For the chemistry of life you need carbon. Where does carbon come from?

There's only one place in the whole universe where carbon is made. It's in the interior nuclear furnaces of the stars. Every atom of carbon in our bodies was once inside a star. We are people of stardust, made of the ashes of dead stars. And one of my senior colleagues in Cambridge, Fred Hoyle, figured out the very beautiful process by which carbon is made inside the stars. It turns out the first element to make is carbon and it turns out to be very difficult to see how to make carbon out of helium. It's only possible because there is a very strong enhancing effect (in the trade we call it a resonance) which occurs at exactly the right energy to make the production of carbon possible. In fact Fred figured out that there must be this resonance because otherwise there wouldn't be any carbon and he wouldn't be here to worry about it. He looked it up in the nuclear data tables and couldn't find the resonance there. He was so confident that he told some of friends of his who were good experimenters, '*Go and look! I can*

tell you exactly where to look, it's got to be at this energy. You look and you'll see. You missed it.' They had a look and they found it! Extraordinarily stunning. A scientific triumph to have predicted that on that basis.

But you see the laws of nuclear physics, which are the things that control where these resonances are, if they had been different there wouldn't be any carbon and there wouldn't be any you or me. Now again, is that just a happy accident? Or is it a sign that there is something more going on in the world than science is directly aware of.

Some people think maybe there are just trillions and trillions of different universes, with different laws of nature and in just one of them, by chance, things will be right to make carbon and that's the one we live in, because we're partly made of carbon. Well it's possible, but it's a pretty uneconomic, prodigal sort of assumption, the sort of thing that would make William of Ockham turn his grave. Maybe, on the contrary, there's just one universe, which is the way it is, because it isn't any old world, but is a creation that has been endowed by its creator with precisely those finely tuned laws and circumstances that alone have enabled it to have a fruitful history and has eventually produced you and me.

I don't present that as a knock down argument, but I do present it as a serious argument that is worthy of consideration.

So that's the basis of the revival of natural theology. It is not claiming *to prove* the existence of God. Most things that are interesting are beyond proof. I believe passionately in quarks and gluons that are constituents of matter but I don't

think I can absolutely logically, beyond peradventure, prove their existence. Yet it's a well motivated belief and one that I embrace wholeheartedly. So I think proof is not a very interesting category, but insightful belief, well motivated belief, is, and I think the new natural theology claims to present arguments that point to a divine mind and purpose in precisely that sort of way.

So that's one of the things that got things going and I suppose that was at it's height about 10-15 years ago. In the last 10 years, the thing that really exercised people was the question of 'can we take absolutely seriously (as we certainly should) what science can tell us about the processes of the world and it's regularity and reliability, and still believe that there is a God who not only holds the world in being, but also in some sense providentially interacts with it's unfolding history?'

You see, when I was talking about natural theology, suppose you are totally convinced with everything I said, it would not get you to a picture of God beyond that of the Great Mathematician or the Cosmic Architect. God could be no more than the deistic spectator of the world, who just set it all going and just watches it happen. But Christians – and a lot of other religious believers – believe in a God who is *more* concerned than that. Not the God of deism but the God of theism, a God who interacts with the unfolding history of the world. Is that believable today? Those of us who pray, when we pray petitionary prayers are presumably believing in a God who has some influence on what happens in the world. Is that credible?

Up to about 1900, physics seemed to describe a world that was pretty clockwork and mechanical in its appearance, but 20th century science saw the death of a merely mechanical view of the world, meaning by that a world that is clear and determinate and predictable. Certainly the physical world, whatever it is, is something more interesting than that, more subtle than that. We've realised that through two big discoveries. One of course is quantum theory. Everybody knows that quantum events, decays of nuclei and so on, are probabilistic. We can say there is a certain probability it will happen over the next hour, but we can't say for definite when it's going to happen. Quantum theory is intrinsically unpredictable in detail.

We've learnt also, most surprisingly, that even everyday processes, described apparently by the sort of physics that Newton would have been familiar with, are also, many of them, intrinsically unpredictable. There are clocks in the world for sure, but there are lots of clouds, meaning by that systems that are so exquisitely sensitive that the slightest disturbance totally changes their future behaviour. These are of course the celebrated 'chaotic systems', and there is one over there in the transept if you want to look at it.

There are lots of intrinsic unpredictabilities in the world, but then the question comes, what do we make of that? Unpredictability is what the learned like to call an epistemological property; it says we don't *know* what the future behaviour is going to be. But if we're thinking about openness of process, then we are concerned not with epistemology, but with ontology, with what is actually the case. Is the future truly open? What I mean is, is unpredictability simply due to ignorance - ignorance that maybe we can't penetrate - but

nevertheless everything is really running on tramlines all the same? That's the big question.

Now, how do you move from what you know, to what's the case? That's a celebrated problem in philosophy and like all celebrated problems in philosophy, it has no generally accepted solution. In fact, it's a metaphysical decision what connection you believe there to be between 'what you know' and 'what's the case'. Emmanuel Kant, the great founder in a sense of modern philosophy, notoriously thought there was really no connection between the two. You saw the shows of phenomena but you didn't know what lay behind them, the realities of noumina. You were lost in a sort of Kantian fog.

Well I don't think that's right, and most scientists don't think that's right. If we didn't think that, in our work in science, we were learning what the physical world is actually like, frankly we wouldn't bother to do it, or so it seems to me. So we believe that what we know is a reliable guide to what is the case, that there is some close connection between what we know – epistemology – and what's the case – ontology. That's a stance which is called 'realism'.

A few years ago my wife gave me a sweatshirt which has on it the splendid, rousing slogan '*Epistemology models ontology*'. You get some very funny looks when you go down the street but if somebody stops me, I say, what it's saying is that 'what you know tells you what things are like'. It's a metaphysical decision: you can refuse it or accept it at your choice. Science itself will not determine the issue for you. It goes beyond science. That's why I call it metaphysical - going beyond science.

If you believe in realism, then you will believe that unpredictabilities are themselves signals of openness, not meaning by openness that the future is some sort of random lottery, but that there are further causal principles bringing about the future, which science - a reductionist 'bits and pieces' science - will not be able to describe.

We have very good reason, I think, to believe that there are such causal principles in the world. I'll demonstrate one. When I raise my arm, there is of course a 'bits and pieces' account of what's going on. Currents flow in the nerves, muscles contract but I raise my arm. We have, it seems to me, a direct experience of human agency, an agency exercised by us as totalities, as whole persons. And we have a role (limited of course in a great many ways) in bringing about the future by our determinate choices. And if we can bring about the future in that sort of way, it seems to me rather strange to think that the creator of the world cannot also reserve to the divine initiative means to bring about the future as well.

It's a big argument, and it's another lecture to go into it properly, but I think the decay of mere mechanism in that predictable sense opens up the possibility of taking science absolutely seriously, but also of believing that there are agencies that work in the world, both human and divine providential, which play their role in bringing about the future. God is not condemned to a spectatorial role.

Theology has to find a path between two unacceptable extremes. One is the extreme of the deistic spectator God who just watches it all happen and doesn't do anything after starting

it off. The other is the cosmic tyrant God, the God whose creation is a puppet theatre, who does everything and never lets creatures do anything at all for themselves. That can't be the God of love. Somewhere between, there is a picture in which God interacts with history but does not overrule it and that is perfectly consistent with what we know scientifically about the processes of the world.

So far I've been talking about physics, which is my own science, but you might say, what about biology? Aren't things a little bit more difficult and different down that end? And they certainly seem to be. It's anecdotally clear to me that there's more opposition to religious belief among the biological scientists than there is among physical scientists. Why should that be? I think there are a number of reasons for that. One of them is simply that the biological world is a much more messy world. I've talked about the rational order of the world, the sense of wonder in physics and all that, which is perfectly genuine, but the biological world is much more puzzling and ambiguous in its character... parasitisms, extinctions... you know the story, I don't need to elaborate. That's something that religious believers have to take absolutely seriously, and I'll come back to that in a minute. But I think there's also a second reason. I'm going to give you now a physicist's view about biology.

Biology has had stunning successes in the last 50 years. DNA, the molecular basis of genetics, has been a tremendous discovery and I think the biologists at the beginning of the 21st century are in a very similar position to that in which physicists were in the middle of the 18th century, immediately following Newton's great discoveries... another big, stunning, foundational success.

Though Newton himself was a deeply religious man, many of his successors were not. They were full of confidence. They felt that if we can explain the solar system, we can explain everything. The solar system is mechanical, therefore everything is mechanical. You get people like De la Mettrie writing a book called *Man the Machine*, and so on. Well physicists have come through that and out the other side. They've come through the triumphalist phase and into something I think a little bit more humble and a little bit more realistic. Biologists I think are still in the triumphalist mechanical phase. DNA is a great discovery, but, as with all initiating discoveries, it's a mechanical discovery. Crick and Watson made a mechanical model of DNA, and you can't get much more mechanical than that.

So I think that biology will come out of that rather triumphalist phase, like the state of physics 2½ centuries ago. This time lag is not because physicists are that much cleverer than biologists. It's that biology is that much harder than physics. That's the way it seems to me.

But then, isn't there this question of evolution? People like to portray 1859 and the publication of *The Origin of Species* as head on collision... scientific light, religious darkness and the defeat of the armies of obscurantism. Well, of course, that's just historically ignorant.

When Darwin published his great work, there were divisions of opinion on both sides of the science/religion divide. There were a lot of scientists who had difficulty with Darwin's ideas... mostly we can see retrospectively mistaken difficulties... but they certainly

were there and not everybody welcomed it. Sir Richard Owen, who was a rival of Darwin in some ways, certainly didn't like it. And by no means all religious people who rejected evolution. Charles Kingsley, an Anglican clergyman, very soon after the publication of *The Origin* saw the theological way to think about an evolving world. He said no doubt God could have bought into being a world ready-made, at a snap of the divine fingers, but God had chosen to do something cleverer than that in bringing into being a world that explored and brought to birth its potentiality through evolutionary process. God had made a creation in which creatures could *make themselves*.

And that's a very profound observation. The world is not God's puppet theatre. God has endowed the world with great potentiality, with great fertility, but God allows creatures to be themselves and to make themselves. God holds back, if you like, from being simply the tyrant of creation. It seems to me that a world making itself in that sort of way is a much greater good than a ready-made world, produced in a magical flash.

But it's a world that has a necessary cost. If you're going to explore and bring to birth potentiality, there will necessarily be ragged edges and blind alleys. The engine that has driven the evolution of life has, of course, been genetic mutation. If some cells are to mutate and form new forms of life, then necessarily other cells will mutate and become malignant. You can't have one without the other. So the fact that there is cancer in the world, which is certainly an anguishing aspect of the world, is not however a gratuitous aspect. It's the cost, and you can argue whether it's a

cost worth paying, but it's a necessary cost of a creation allowed to make itself. There is a necessary shadow side to things.

I find that mildly helpful. I don't suggest for a minute it removes all the problems we feel about suffering, but I think it's helpful. We all tend to feel that if we'd been in charge of creation we would have done it better. We'd have kept all the nice things, and got rid of all the nasty things. Have the sunset and the flowers, get rid of the disease and disaster. Yet the more we scientifically understand the process of the world, the more we see it's interlaced... that there is a shadow side as well as a bright side to things and they can't be torn apart in that sort of way.

So I think things will happen in biology in the 21st century, and particularly when biologists get interested in organisms again. They've learnt an enormous amount by thinking about molecules but there must be some time when they have to think about organisms again in a serious way, and that will change the tone of the conversation.

Even more, there are prospects for the future that will be positive and extremely helpful, I venture to predict, through interaction between the human sciences and religious thinking. It's clear that is a most important interface, since psychology, neuroscience and anthropology are really most central to theological understanding.

At the moment, there's not enough going on in that sort of area. Partly that's because subjects like neuroscience are really at a very early stage. The neuroscientists are making very interesting discoveries about, say, the neural pathways which process visual information. These are very important things to learn, but that's miles away from really understanding what's going on in an integrated way in brain and mind. However sophisticated your

talk about neural networks, it seems to me there is an absolutely yawning gap of immense proportions between that sort of talk... important and significant as it is at its own level... and the simplest conscious experience of seeing red or feeling hungry. We really don't know how to solve the problem of qualia, as people say, of feelings. How is the firing of neurons related to these fundamental feelings and experiences that we have? They are clearly related, but the form of that relationship is something we don't know how to deal with.

So what's going to lie ahead? Well I want to make two suggestions about what might lie ahead. First is just a sort of guess in a way about what may be a very important scientific development in the course of the 21st century.

We are just beginning to learn, in a small way one has to say, how to think about the behaviour of complex systems.

Scientists' techniques, have been basically methodologically reductionist. The idea has been to split things into bits and pieces. 'Divide and rule' has been the moral of scientific strategy. I worked as a particle physicist, so I really am at the nitty gritty constituent end of that sort of spectrum. It's been immensely successful as a technique, principally because it's easier to think about bits and pieces than to think about complex totalities. But we realise, and we're realising this increasingly, that there are many things about totality that you just cannot learn by simply thinking about the bits and pieces. Scientists are just beginning, in a small way, to be able to come to grips with some of the ways of thinking about complexity and

complex systems. Quite a lot of their thinking at the moment is not so much scientific as 'natural history'. It's taking place at a kind of observational level. People run models on computers and see what happens. It's like sitting in a bird hide and seeing what's going to land on the lake. The systems they study are very restricted in their complexity compared, to say, a living cell but nevertheless they're sufficiently complex for quite unexpected and unanticipated things to happen. At the moment, we don't really understand what's going on, but we know that something interesting is going on.

Let me give you just one example. I'll describe to you a model that was devised by somebody called Stuart Kauffman and it's described by him in a very interesting book called *At Home in the Universe*. It's a logical model that he sets up on a computer and he runs it on the computer many times and sees what happens. In logical terms, it's a Boolean net of connectivity 2, but that may not be the language we want to speak this evening, so I'll describe instead in terms of what would be a hardware system.

So consider the following system. Suppose you have a large array of electric light bulbs. Every bulb in the array is either on or off, and the system develops in steps. The way that it's set up is something like this. Each bulb in the array is correlated with two other bulbs somewhere else in the array. They don't have to be physically near it, but it's correlated with two other bulbs somewhere else. Whether those two bulbs are on or off now will determine in a specified way (that I won't try and go into), what state the bulb with which they're correlated

will be in at the next step of the development of the array.

So you set up this system. It has these rules - quite simple looking rules really - and you just start it off in some sort of random configuration with some of the bulbs on and some of the bulbs off. You then let it develop according to these rules and you stand back and see what happens. I don't know what you'd expect, but I'd expect that if you started off with some random configuration, nothing very interesting would happen. It would just flicker away haphazardly for about as long as you let it do so. But it turns out that isn't the case. It turns out that very soon the system settles down into cycling through a very limited number of patterns of illumination. In some way, it so-to-speak spontaneously generates a very, very high degree of order in a way that you couldn't have guessed from thinking about the specification of the system. A very surprising result... the degree of it is amazing.

Suppose there are 10,000 light bulbs in the array, then the number of possible states of an illumination of the array are $2^{10,000}$, which in rough terms is $10^{3,000}$. That's a 1 followed by 3,000 zeros, and all of you can see that's a pretty big number in anybody's book... vastly in excess of the number of particles in the observable universe. Nevertheless, that system will very soon settle down to cycling through about 100 different patterns of illumination. So somehow or other, $10^{3,000}$ possibilities gets processed down onto 10^2 possibilities, an absolutely staggering phenomenon, it seems to me.

Now clearly there's a theory behind all this, but that theory isn't known, yet I take it that the science of the 21st century... and let's hope sooner rather than later ... will penetrate to that theory, connected also with a deeper understanding of

behaviour of chaotic systems and so on. There's a whole area of complex behaviour that we know is full of really quite staggering and significant phenomena, but we don't know yet how to think about it properly.

Now what we're talking about here is not the exchange of energy between 'bits and pieces' but the generation of dynamically ordered patterns of behaviour in a whole totality. So we're looking at the other end of the spectrum from the 'bits and pieces' end, looking at the holistic, total end. We're moving, it seems to me, from a conceptual field in which energy is the fundamental concept into a conceptual field in which something that specified dynamical pattern and order, something you might call 'information' in some suitably generalised sense, is the fundamental concept. I'm willing to bet that by the end of the 21st century (although I shan't be here to collect the winnings) information will have taken its place alongside energy as a fundamental concept in thinking about the nature of the world in which we live.

That seems to me a very interesting development. I'm not trying to say information equals spirituality, but at least it looks more spiritual in character than energetic exchange, so I think our concept of the world, from a scientific point of view, is getting richer, and in my view more realistic, and I think that that will be helpful to the dialogue between scientific thinking and religious thinking.

So that's one hope I have for the future, but there's another hope I have and that's concerned with a problem that really puzzles me and worries me/troubles me quite a lot. It is

perhaps, apart from the problem of evil and suffering, which is *always* on the theological agenda, going to be the most important theological issue, not just for the 21st century, but probably for the third millennium and it's this.

Science began (roughly speaking) in 17th century Western Europe, but of course it has spread all over the world. If you stop people in the street today, in Bristol or in Kyoto or in Delhi and you ask them what matter is made of, provided you chose the right person, you'll get the same answer in those three cities, 'quark and gluons and electrons'. If you stop people in those three cities and ask them a religious question, 'what is the nature of ultimate reality?' or something like that, the chances are you'll get three very different answers in those three cities. So science, though it started localised, has become global. But the world's faith traditions are still extremely stable, remain different from each other, and are largely regional. There are of course changes, but by and large they remain very stable, so there is a problem of how are we to understand how the world's faith traditions relate to each other.

We can no longer indulge ourselves in what was perhaps always a questionable belief, namely that we're all right and they're all wrong! People in other faith traditions are no longer strange people in far away countries who believe odd things. They're people living down the street, and we can see the spiritual authenticity of their lives. So we cannot say, 'We'll tell you, we'll put you right'. The problem is really there.

In many ways, the different faith religions are talking about at least the same sphere of

human experience, which you might characterise as encounter with the sacred, a dimension of reality that is extremely important for the wholeness of human life and which is not to be subsumed under any other sort of rubric.

So they are concerned with the sacred. I remember being absolutely convinced of that years ago. Some of you may remember there was a series of television programmes called *The Long Search*, in which a presenter spoke in successive programmes to people from different religious traditions and explored their beliefs and their ways of life. The presenter was somebody called Ronald Ayre, whom I knew a little bit. The programme that really impressed me most of all was an encounter with a Buddhist Zen Master. Now I have to say, Zen Buddhism, set out on paper, is a religious faith tradition that I have the greatest difficulty in getting either my head or my heart around. But there was a spiritual authenticity about that person that was just overwhelming and humbling and absolutely undeniable. So the faith traditions have meeting with the sacred in common, but they say such different things about the encounter. That's where the puzzle begins.

Some people think they're all really saying the same thing... different paths up the mountain... but I don't think that's right. It's not as simple as that. Let's take the question of the human person. The Abrahamic faith traditions, Judaism, Christianity, Islam, all see the human person as of unique and abiding significance in the sight of God. Our Hindu friends see the human person as something that is recycled through reincarnation, a belief that seems absolutely natural to people in the Eastern faith tradition, and totally baffling, I have to say, to my Western way of thinking. Our Buddhist friends, if I understand the doctrine of Anatta

aright, believe that the person, the self, is an illusion from which we must eventually seek release. Now those aren't three sets of people saying the same thing in different language. They're three sets of people saying three different things, it seems to me. So I don't think that we can just dismiss the problem in that sort of way.

Take the question of the nature of time. Is time a sort of linear pilgrim path, to be trodden, which is what the Abrahamic faiths all believe, or is it some sort of samsaric wheel or a cycle from which eventually we seek release, which seems a more Eastern way of thinking about the nature of time?

That's all very unnerving, I have to say. I'm very opposed to the idea that science is truth and religion is opinion, but on the other hand here's a sphere where it's not so easy to rebut that argument, and I'm greatly troubled by that, and don't entirely know what to think about it.

I am sure that an important part of the third millennium is to be a true ecumenical dialogue between the world faith traditions, in which they'll have to explore what they have in common and where they really do differ. That's going to be a very long and a very painful business because it can only be conducted, I think, with integrity and authenticity, in the acknowledgement of disagreement.

I don't think that the way for the world faith traditions to meet is to apply some bland lowest common dominator religion that nobody really cares too much about. We have to meet in our differences. When I talk to my friends in other faith traditions, I have to talk to them as a

Christian, with all my beliefs about the unique significance of Jesus Christ. I don't think I help them or myself at all by somehow trying to soft peddle there. We've got to meet in our differences if it's going to be an honest meeting.

But how are we to have such a meeting? We can't have such a meeting head on, it seems to me. If we set up a conference in which the first day we're going to discuss the significance of Jesus, the second day, what's the significance of the Qu'ran, and so on... if we try and engage 'head on' with core beliefs then defences will go up all round and there will be no meeting between the faith traditions.

So if faith traditions are to talk to each other, they must first of all talk about something that's worth talking about, but is not too threatening in it's character. They need a serious meeting ground. One possibility for that, and it's only one possibility, is for the world faith traditions to talk together about what they make of science's account of what the world is like, and what it's history has been like. There are serious perplexities there for all the faith traditions, but it seems to me that there is not that threat to the core of a tradition that will be represented by a more head on engagement.

The Templeton Foundation has backed over the last five or six years something called 'Science and the Spiritual Quest', in which they set up groups of people who had the science in common., but who came from different faith traditions, exactly to conduct that sort of conversation. I was in the physics group of about 15 or so. It was a very interesting experience. I was in the first phase of it and our phase

culminated with a conference in Berkeley, California. Progress was slow I have to say. We didn't make enormous progress but we made some progress. We got to know each other and establish some friendships and some conversations that continue. I think that's going to be an important contribution. I think the science and religion area first of all has to become truly ecumenical. A lot of the work in it has come out of the Christian community - we've been more concerned than any other faith tradition. It's just a fact, but we can't stick there. We've got to both draw on the insights of our friends in other faith traditions and also use that as a source of contact with them.

So that's one of my real hopes for the 21st century, that the science and religion conversation will become truly worldwide, truly interfaith and truly creative and helpful in that way.

Certainly the conversation will continue. It will continue because there is, despite all the differences of their approach and their subject matter and so on, there is a common concern in both science and religion. Both forms of human activity and search for understanding believe that there is a truth to be sought and to be found. Never of course to be totally grasped, but to be sought and to be found. The question of truth is as important to religion as it is to science and that gives them a cousin-ly relationship and both of them are motivated by that deep human longing to understand the world, to understand what life is about.

I think of myself of being sort of two-eyed. I want to look with the eye of science on things and I want to look with the eye of religious understanding on things. And I do believe that I shall see more with binocular vision than I would with either eye on its own. But it would be nice to know what

you think about things, and perhaps now we can have some sort of conversation.

Over to you.

Eric Albone: Thank you very much indeed John. It's a very thought provoking and very wide ranging presentation. Over to you, as was said.

Gordon Stirrat: I'm an Obstetrician and also I teach Ethics and Medicine in the University of Bristol. You ended by saying science is a search for truth and religion is a search for truth, but I'm now living in a world amongst my students who say there is no such thing as truth. They are post-modernists and although many of them don't understand the meaning of the word, actually they do live in that world in which there are no absolutes. They're absolutely certain there are no absolutes, which I find rather interesting. So how do you deal with this issue of truth, when our post-modern world does not believe that absolute truth is there to be found?

John Polkinghorne: Well, I view it this way. What you might call the Modernist Programme from Descartes onwards was based on the idea that there are clear and certain ideas and there are foundational truths that no person could question, and on which you can build a sound structure of knowledge. That was a heroic programme but I think it has proved to be a failure. It has proved to be a failure because seeking knowledge is more subtle than that. We see it in science for example. There is an inevitable circularity in the search for knowledge. We have to believe in order to understand; we have to understand in order to believe, as Augustine said. In science we have to have theory to interpret the experiments, and

experiments to nudge and correct the theory, and that means that there is no sort of independent place from which you can look at the world without there being a perspective. So we have to be aware of the existence of perspectives, and I'm sufficiently post-modern to agree to that. But I don't think that there are no ways of finding truth. The philosopher I've found most helpful is Michael Polanyi, who was a very distinguished scientist, and who wrote a wonderful book called *Personal Knowledge* which is about the philosophy of science. He says that science is an activity of persons. It can't be specified by following a protocol; you can't write a computer programme that will win the Nobel Prize. It involves tacit skills of judgement, but we have every reason to believe that those tacit skills of judgement can be exercised in a way that is reliable. Of course, you never have full truth. You have verisimilitude, an accurate map on some scale but not on every scale. In the introduction to his book, Polanyi says this... and remember he's talking about science... *'I have written this book to explain how I may commit myself to what I believe to be true* (he's very keen on the commitment involved in science) *knowing that it might be false'*. I think that is the human situation. But that doesn't lead me to a sort of relativistic slough of despond. It doesn't lead me to say, any old story is as good as any other old story.

It's a big, big question and a very important one, but that's the lines along which I try and address it.

Anthony Shillingford: I'm a Fellow of the RSA and also a Lay Assistant in my diocese. You mentioned about this

common gathering of faiths to speak to each and the need for it, and compared that with science and the excitement of what's happening in science at the moment. Talking to scientists I think a lot of this is due to the preparation work that is being in getting a common database. I know there are people at Cambridge working on the biochemistry database so that there is a basis of talking to each other across them.

How do you start and do that within the faiths when there's such a long way to make up? I know if you go back over my lifetime and your lifetime, we'd maybe come together ecumenically within the different Christian faiths and have a common language to talk, how can we do it in the way that science has done it so successfully by having these sort of advanced databases, going backwards and forwards.

John Polkinghorne: Well I think faith traditions have their sort of databases. Their databases are in fact their foundational scriptures, which usually record foundational events or foundational insights, and then they have the developing tradition, which is a commentary on those for developing understanding. There is some sort of similarity there between the resources of a tradition, including its scriptural resources, and scientific databases. What is different is that science is really cumulative, essentially because we transcend the material and we can put the physical world to the test. That's the great secret weapon on science, Experiment. We can't put God to the test or indeed put each other to the test. Personal relationships have a different character to them. By always trying to set little traps to see if you're my friend, I'll destroy the possibility of friendship between us. Equally 'you shall not put the Lord your God to the test'. That means that the character of science is different. The character of science is cumulative. I know much more about the physical

world than Isaac Newton ever did, not because I'm cleverer than Isaac Newton, because obviously I'm not, but because I live 300 years later than Isaac Newton. But in religious and spiritual experience, and indeed in pretty well all other forms of human activity, there's no presumptive superiority of the present over the past. Augustine and Calvin and all these people remain conversation partners, just as there's no presumptive superiority of 21st century art and music over the art and music of preceding centuries. Their character is different.

John Nolan: I'm a Fellow of the RSA and an inventor. When you talked about interfaith discussions I suddenly had a connection with your 10,000 light bulbs and I wondered if via the Internet, we could substitute a person for a light bulb and get an exchange in some way. This is a seed thought if you like. On or off of the light bulb is equivalent to belief or disbelief, but you'd have to limit it to certain precise thoughts in some way. I wondered if you started off with a few people, shall we say 100 or something like that, whether a pattern would come out of it. It's just a seed thought.

John Polkinghorne: Well that's a very interesting thought. I think that again we're faced with the complexity of human personality and the complexity of the kinds of interactions that we have both between ourselves and also I would want to say with the reality of God. So it's much more difficult in that way but I do think there's an important point there which is this. You know Alfred North Whitehead once said that religion is what you do with your solitariness... an extraordinarily dangerous half truth. Religion is something that also has to be

pursued within a community, just as science has to be pursued within a community and therefore those communal interactions are certainly very important. At the moment we have these within faith traditions, and within the sub-sections of faith traditions, but we don't have them much between the different faith traditions. I think that the problem is, you know, many powers of ten more difficult.

Alec Ewens: Two backgrounds, one is with advanced composites business, much concerned with mathematical physics, and the other the Ecumenical Bristol Council of Churches Social Industrial Responsibility Project, or ISR for short. ISR is much concerned through the clergy that work in industry with the people industry. Do you think we should be more engaged with the management and the direction that industry has taken, particularly in some cases with the morality of them?

John Polkinghorne: I'm sure we should. The trouble is that in some sense, in theology every intellectual activity is grist to the theological mill. If theology seeks to speak of God who is the ground of everything, then theology has to take into account every form of human enquiry into the nature of everything. So similarly in the living of our lives, in a religious tradition, then it must be concerned with the whole of life and not with a 'holy huddle'.

In an extremely amateur way, I've been involved with medical ethics issues over the last ten or twelve years, and when you move in that area you find that you need two things. First you need the experts, you need the experienced people, those who

know how things work, what the prospects are, what will be the consequences of doing this and that. But you can't leave them to be judges in their own cause, because in science they get carried away with the excitement of it. In industry maybe there are other motivations that carry them away. There has to be a dialogue between the experts and society. There comes a time when society says, 'now wait a minute, maybe you can do that, but is that the right thing to do? - not everything that can be done should be done'. I have to say, it very much saddens me that much of the ethical discussion in our society is framed in the terms of the clash of single issue pressure groups.

We need the creation of meeting places in which there can be temperate discussion, a genuine collaborative attempt to sort out what we should do. I think the Churches have a role in facilitating that sort of thing. No doubt people like RSA also have a role in facilitating that.

Andrew Judge: I'm a vicar at Keynsham. In your review of the 20th century, you didn't mention cosmology. I was just wondering whether you felt the issues of the Big Bang and their compatibility with the Christian faith, whether those have largely been resolved or are there still issues that remain to be teased out this century?

John Polkinghorne: Well, I think by and large that we can see what's happening there. We have every reason to take the broad sweep of Big Bang cosmology seriously. We realise, if we are theologically aware, that creation is not about what/who lit the blue touch paper of the big bang, but why anything exists at all. Creation is the answer to the question 'why is there something rather than nothing?', rather than how things began. That is why my former colleague in

Cambridge, Stephen Hawking, is more than a little naïve when he says that if these speculative cosmologists are right and there's no really dateable beginning for the universe, what role is there for a creator? Well there's every role, as the ordainer and sustainer of the laws of nature Stephen was exploring in his work.

I think that's an area in which we've reached quite a lot of agreed conclusions, which are important, but I don't see them as carrying on into the future probably very much.

Philip Down: Priest and formerly applied biologist. I just want to check, going back to what the gentleman here said a little while ago, I'm sorry to go back in the discussion. This was referring back to the light bulbs. I don't know whether you intended it, but did you hear yourself speaking, saying the need for science to look at complexity theory and to understand complex systems and perhaps organisms. I think it speaks to the problem of the oekumene, to the ecumenical dialogue question, and I just wonder if you can envisage that science, in doing much more work on its complexity theory, might actually eventually use ecumenism as a case study?

John Polkinghorne: Well that's a very ambitious project that will take us beyond the third millennium! I would be very happy if these sorts of investigations into complexity gave us a really deep understanding of the workings of a biological cell, which is already an immensely complex thing.

Tony Whatmough: Vicar of St. Mary Redcliffe. Speaking on a metaphysical level, do you

think there is other intelligent life in the universe?

John Polkinghorne: That's a very interesting question, to which we just don't know the answer scientifically. There seem to be lots of planets around. No doubt for life to be possible you need a rather special planet. Not only one that's not too hot or too cold, but has the right chemicals, and maybe you need lots of other things. For example many people think that the development of life here on the Earth was helped by the fact that we have an unusually large satellite in the Moon. That big satellite stabilises the Earth's rotation and gives stability to the Earth's climate, which is very helpful for the development of life. But there are so many stars, and so many planets presumably, there must be lots of potential seats of life in the universe. What we don't know is how easy it is for life to develop. There are some people, like Manfred Eigen who won a Nobel Prize who says 'sure, if you've got the right conditions, wait for a billion years, it's bound to happen'. Perhaps the greatest biologist of the 20th century, Francis Crick, who certainly has no hidden religious agenda, says he can't figure out how it happened once, so he can't believe it would happen twice. So when the experts disagree, I think you and I will conclude they don't know the answers.

Scientifically it would be extremely interesting of course to detect signs of life somewhere else and to know it was independent of life on Earth. Mars will be tricky because of the possibility of exchange. It's very interesting to know for example what the genetic code would be for such life.

Theologically people have thought about that for about 300 years. As soon as Galileo made it clear that the planets were made of the same sort of stuff as the Earth, people said 'What about the Venusians? What about the Martians? Did Christ die for the Venusians?' and so on.

I personally believe that if there is life out there, if there are little green men out there, and that they are in need of redemption, then the Word would have taken little green flesh for their redemption as I believe the Word took our flesh for our redemption. That's what I believe theologically. Other people would not agree with that. They say the Word can only be a creature once and it's just good luck it happened to be on earth. That seems to me open to question. But it's a very intriguing question. I mean both scientifically and theologically we don't know what the answers are.

Ruth Bamber: I'm an English teacher. You mentioned your binocular vision... science and religion... does either side see or explain evil? You mentioned shadow. Shadows in the case of disease and so on. Is there a straightforward Christian answer or is it more complex?

John Polkinghorne: Well there are at least two sorts of evil. There's moral evil, which is the chosen inhumanities of humankind, the abuse of the gift of free will and that seems to be something that implies that something has gone wrong with humankind. The Christian diagnosis is that we've become alienated from the God who is the ground of our being, and when we're alienated from God then we do not lead the kind of lives that God intends us to lead. That's the source of moral evil.

The other evil in the world is physical evil, which is the disease and disaster of the world. Now I'm suggesting that that's part of

allowing of creation to be itself and to make itself.

To give another example, Austin Farrer, a great Oxford theologian, once asked himself what was God's will in the Lisbon earthquake of 1755... All Saints Day, 1st November, everybody's in church, there's a big earthquake, the churches collapse, 50,000 people were killed in one day... a great disaster that reverberates down the rest of the 18th century. What was God's will in the Lisbon earthquake? Farrer's answer, and it's a hard one but I think it's a true one, is that the elements of the Earth's crust should behave in accordance with their nature. They are allowed to be. The world is not God's puppet theatre. They are allowed to be, and that means that sometimes they will slip and there will be earthquakes. So I believe that God neither wills the act of a murderer nor the incidence of a cancer but allows both to be in a creation that has been given a certain degree of independence to be itself and that is the gift of the God of Love, because a God of Love cannot be an all controlling tyrant. I don't say that removes all the difficulties; it certainly doesn't, but it's the line I would take. And of course the Christian insight is special because Christians believe in the cross of Christ, that man nailed to the tree in the darkness and dereliction of Calvary, we see God living a human life, caught up and impaled upon the contradictions of creation. So the Christian God is not just a compassionate spectator looking down on it. The Christian God has been truly a fellow sufferer who understands, knows suffering from the inside and not just on the outside. That seems to me to be the most profound answer to the problem of

suffering, but again it doesn't smooth every difficulty.

Michael Moore. My speciality was aviation medicine, and I'm also a Lay Reader. Calvin said science is measurement and measurement involves experimentation. I suggest that if we put our ideas to the test, we find out by experience, and if you put God's Word to the test you also find out, you find God by experience, you experience God and He keeps his promises. Rather like the Monk Elmer in the year 1010 AD put his belief in flight to the test by leaping a suicidal leap from the top of Malmesbury Abbey, but he didn't die because he'd made himself a pair of wings and he flew, and that's recorded. And we can put God to the test in a similar manner by an act of faith.

John Polkinghorne: I think I want to say yes and no to that. I certainly believe that there is an experiential aspect in religious experience that's important, but I think that there is also, so-to-speak, an ambiguity in that experience that can only be resolved from the inside.

I had a friend who was diagnosed, quite out of the blue, as having terminal cancer and was given six months to live. He and his wife prayed together everyday under advice from wise Christian friends, seeking God's healing. My friend died almost exactly six months to the day from the time that he received the diagnosis from his physician. And after it was all over, his wife asked herself what had been going on, if or how the prayers had been answered. She was generous enough to share that with us and she felt this. My friend had a condition that could have led to a very painful death, and in fact he died a very peaceful death. He also had lived

in a community where there was a good deal of opposition to him, but the courage and fortitude with which he met his death had a very healing effect on that community and people were reconciled to him in an unexpected way. She felt that that was the healing that had been given, though I don't doubt for a minute that they both hoped at the beginning that the healing would be in terms of some physical remission. So I certainly believe there is an important experiential aspect in religious faith but it's not simple, it's not a simple testing and it's a test that only those who are intimately involved can actually assess, I think.

Charlton Pitts-Crick: Doctor, no special religious training. I'm afraid. My question is about the scientific approach to understanding faith and beliefs and also how the ecumenical process might be served, in some ways better, by getting or by investigating what people believe who don't have a very specified religion. You were talking about the problems of getting a combined view of faith and saying that there are some totally incompatible beliefs such as reincarnation and in fact this is rather a specific view of very committed Christian. At least a majority of people I know who call themselves Christians do actually believe in reincarnation and though they say that it doesn't quite fit in with their religion 'but I just get a feeling that that's true'. There's a lot of people who are already ecumenical in a sense that they have beliefs which have not necessarily borrowed from other religions, but overlap with other religions. If you wanted to investigate the whole process in a scientific way it would be interesting to find out what people actually believe and see if you could then devise a religious framework which would incorporate the beliefs in a coherent way rather than taking the most dyed in the wool Christians

and Muslims and Hindus and ask how can we get together. They're probably the worst people to do it compared with the people who haven't yet crystallised out quite so fully.

John Polkinghorne: I take that point up to a point. I don't think those of us who are engaged in this are all dyed in the wool people. I think if we were that dyed in the wool, we probably wouldn't be conducting the conversations. I also don't think these matters can be settled simply by counting heads.

A lot of interesting work is being done about religious experience. Alistair Hardy, who was Professor of Zoology in Oxford, got very interested in religious experience and conducted various surveys and there's a Hardy Institute which continues this work which revealed that a lot of people... a surprising percentage of people, I think it's something like 30% of people... will say that they've had what you would recognise as being a religious type of experience, very often a feeling of joy or of unity or something of that character. Very often they don't want to describe it in a religious language. Very often these people are people of not any sort of conventional religious faith, so they don't want to use that sort of language to describe it. So there is a lot of so-to-speak spiritual experience around and it's quite interesting to know that and to explore that and quite a lot of work is being done on that basis. I think that's an important component, but I think it's only a component and you need reflection, and I do think you need a certain intellectual sifting of these things.

I think that God is not to be grasped solely with the mind.

All forms of belief, and particularly religious belief, are always sliding down a knife edge with error on either side. One error is to think that you can grasp God with your mind and have God totally tied up in some sort of theory. That clearly isn't true of infinite reality. Equally to think of God as simply mystery and simply unknown is, I think, also a mistake. God may, and indeed I believe, *has* acted to make God's nature known in all sorts of ways and one needs to explore that and one needs to explore a rational understanding of that and that's what interests me very much. So both in religion and science I'm keen on 'motivated belief'. And the motivations will be different for the two sorts of belief, but they have to be there, and amongst other things, they have to be sifted for their credibility and reliability.

Mike Dilley: I'm on the clergy team of the West Swindon Ecumenical Partnership. I also heard you several decades ago and you enabled me to make the ongoing context of science and religion, but I really wanted to ask in the current climate of quantum mechanics, your own speciality, is there in the 21st century going to be a tying up of experience on the personal and spiritual level to describe, explore and maybe explain at the quantum level?

John Polkinghorne: Well not directly. First of all, one of the paradoxes of quantum physics is that although it was discovered 75 years ago, more or less, and has been used enormously successfully, we still don't fully understand it.

We don't know how to interpret the theory and there are a number of very contrasting types of interpretation on offer,

not all of which can be correct. So there's an ecumenical problem in the quantum world too, to sort out the different traditions in that respect. For example it's perfectly possible to interpret quantum theory deterministically and to say that the probabilities are simply due to ignorance. Most of us don't like that theory for various reasons but it's not empirically inadequate. So there are lots of unresolved issues in quantum physics.

Even if they're resolved I'm very wary of quantum hype. I'm very wary of jumping from the quantum world to something much more complex and different from it. We really don't understand the world very well... we understand patches of it... and we don't know how those patches relate to each other.

A certain intrinsic randomness in these processes is one thing, but that's totally different from human free will. So even if quantum processes in the brain are important - and that is in itself a contentious issue - that doesn't in itself establish free will. It's a very complex area in which we have feel our way. We don't know how to string it all together into a single unified account, so I'm not too hopeful. People send me letters from time to time about quantum theology and so on and I'm not terribly enthusiastic about it, I have to say.

Eric Albone: I think we've had a really wonderful evening of very stimulating thoughts. The thing which strikes me is this talk of dialogue, of actually having discussions on these issues... and we've a very wide range of different people here this evening... which aren't polarised but with people listening and understanding each other. I think particularly interesting is the notion which John mentioned about science as being perhaps a common point for discussion between different faith communities.

It's been immensely stimulating. I would like to thank John Polkinghorne for coming over and leading such a valuable and inspirational evening. Thank you very much indeed.