The Friendship of Science and Religion

A PRESENTATION AT ANDREWS UNIVERSITY, MARCH 2, 2003

By John Polkinghorne

Sir John Polkinghorne specialized in elementary particles as a physics professor at the University of Cambridge when he responded to the call of God to study for the pastoral ministry. In 1979, he resigned his professorship and studied for the Anglican priesthood. After serving in the pastoral ministry for five hears, he returned to Trinity Hall at Cambridge, where he was appointed fellow, dean, and chaplain in 1986. In 1989, he was unexpectedly appointed president of Queens' College at Cambridge. He retired in 1996, and has since devoted himself to a speaking and writing ministry in the academic community.

Having accepted an invitation to give the Friday vespers talk at Andrews University on March 28, 2003, Polkinghorne also agreed to make other presentations on campus. On Friday morning, he lectured to the general physics class on elementary particles. After lunch, he gave a presentation entitled "The Faith of a Physicist," in which he emphasized to a scientifically aware audience the need to take religion seriously. The transcript of his vespers talk, "The Friendship of Science and Religion," which he presented later in the day, is published here with his permission.

Polkinghorne's visit to Andrews University continued into Sabbath. In the morning, Pastor Dwight Nelson interviewed him during both morning services. At another Sabbath presentation, in the Faculty Lounge Sabbath School, Polkinghorne focused on Revelation 21:1-8. There he spoke about God choosing to shield himself from his creation in this present universe. According to Polkinghorne, such shielding was required to avoid the charge that God had in some way forced the obedience of his creation. As a consequence, Polkinghorne pointed out, this present universe will end and all living things die. In the promised new creation, he asserted, there will be new physics so that the new universe will never end and there will be no death.

Polkinghorne expressed appreciation for Andrews University students who were respectful even when they disagreed with him. His use of the "fine tuning" argument to support belief in God as creator and sustainer of the universe is compelling. Polkinghorne gave the Andrews University community much to think about regarding the relationship between faith and science.

The friendship of science and religion is, indeed, one that must be fostered. Hopefully, we can remember that both dimensions must be taken seriously. This is the mark of real friendship.

S. Clark Roland
Research Professor of Physics
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There are quite a lot of people out there, and there may be even some in here, who think that I've got the title wrong and it should be the enmity of science and religion that I should be speaking about. They seem to think science and religion are at each other's throats, and if you think that, you tend to think that science will have the stronger grip in that unedifying contest.

However, I truly believe in the friendship of science and religion and I think that friendship stands on the fact that, in their different ways, both science and religion are concerned with questions of truth. They know there is a truth to be sought, a truth to be found.

Of course there are different sorts of truth. Science is telling us truth about the structure of the world in which we live, and about its history. Religion is telling us a much deeper truth of the One who is the Creator of the world in which we live. They are both looking for truth, and they're looking for truth through motivated belief. They have reasons for the understandings that they gain. So that in itself means that they will be friends with each other.

There's another reason I think science and religion ought to be friendly with each other, and that is that many people believe that it was in fact religion, speaking more specifically, the Christian understanding of the doctrine of creation, that helped to bring modern science to birth. In other words, that in a real sense, religion was the midwife that produced the offspring of science.

Science in a form that is recognizably connected with science today began in Europe in the seventeenth century. Have you ever thought about why it began there and then? Why didn't the ancient Greeks get onto what is recognizably a form of modern science?

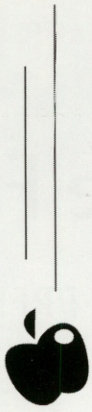
They were very clever, the Greeks, and they were very curious people. They liked asking questions about the world, but in terms of investigating the physical world and the biological world they never fully got onto what we recognize as the beginnings of modern science.

Why didn't the medieval Chinese make that discovery? The culture of China in the Middle Ages was in many respects greatly in advance of the culture of Europe; nevertheless, the Chinese never developed science.

So why did it happen in Western Europe in the seventeenth century? Well, of course, you can't have a certain answer to a historical question like that, but many people believe that it was the presence of the doctrine of creation in people's minds that helped to get science going.

The way the argument runs is this: You see, if you believe that there is a God who is the Creator of the world, the first thing you believe is that there is an order to the world, there is a structure to it. God is rational, God is the ground of order, so there is a pattern to the world you can seek to try to discover and understand.

The Greeks believed that, but in their version of the Creator, that being they called the demiurge, they thought their Creator didn't have a choice about what sort of world to make. There was a sort of eternal plan existing that the Creator of the world just had to follow. And that plan was based on deep rational ideas. You could find out what that plan was simply by sitting and thinking. If you thought long and hard enough, you would know the rules for what the demiurge had to follow to make the world.



Christians didn't think that anybody told the Creator what to do. God's creative act is a perfectly free act. God does what God wills. So if you want to find what God's plan was for creation, you have to go and look and see what God had actually chosen to do. And that brought into the question the role of observation and experiments, something the Greeks didn't get onto.

Well, what about the Chinese? If you believe the world is God's creation, then it becomes worthwhile to study that world to learn about it, because you are learning something about the Creator. And that is something the Chinese didn't really understand. They didn't really value the natural world. They thought of it simply as a sort of backdrop for the human story.

Anyway it is certainly true that the people who got modern science going were also the people for whom religion was very important. They may have had their troubles with the religious authorities, as in fact Galileo notoriously did; they may have also had their difficulties about Christian orthodoxy, as Isaac Newton did. But they were people with whom religion mattered. If religion helped to bring science into being in that way, it would be really very surprising if they were enemies and not friends.

If they are friends, then they will have things to say to each other. There will be conversation going on

between them. That is the conversation that I want to try to help us overhear. I want to start off first of all with what science has to tell religion, the gifts science has to give to religious people.

There are two gifts really. One is simply to tell us what the world is like in which we live and what its history has been like. I think we need to take that extremely seriously. If we are people seeking to serve the God of truth, we need to value and honor truth from whatever source it comes. Some of the truth, even if by no means all of it, comes from science. So we need to listen to what science has to tell us about the world in which we live.

What it tells us, briefly, is that the world in which we live has had a very long history. The universe itself appeared about fourteen billion years ago in the fiery explosion of the Big Bang. The world started extremely simple. The very early universe was a simple ball of energy, which is about as simple a system as you could possibly get. And the world that started very simple has now become very rich and complex in its character. The ball of energy has turned into the home of saints and mathematicians (closely allied groups of people). And that's a very striking thing.

A friend of mine, Holmes Rolston, says in one of his books that when an astronomer peers through a telescope at some distant galaxy, he or she should remember that the most complex and interesting thing we've ever found in our exploration of the universe is six inches this side of the eyepiece of the telescope, sitting inside the skull of the astronomer. The human brain is far and away the most complicated system we've ever encountered in our exploration of the world.

So the world started very simple and became very rich and complex. That in itself is a very striking fact about the world. It might suggest that something has been going on in that long cosmic history. But we also have learned from science that unfolding fruitful history is what we may call an evolving history. Life as we know here on earth started about three and one-half billion years ago. It also started very simple and became complex.

Many people think that the theory of evolution is absolutely the collision point, the battlefield where the warfare between religion and science has been taking place. But I think that is a mistaken view. Darwin published the *Origin of Species* in 1859. If you believe some of the things you see in television shows and read in certain books, you will believe that when he published that book, all of the scientists shouted yes, yes, yes! And all of the religious people shouted no, no, no! Well that actually is just historically ignorant.

There were some scientists who had a lot of difficulty with Darwin's ideas, including Sir Richard Owen, who was the greatest comparative anatomist of the day, and there were a number of religious people who, from the start, welcomed the insights that Darwin had to convey, because they recognized that it told us how God had actually chosen to bring creation about and to allow creation to develop.

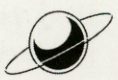
If we are people seeking to serve the God of truth, we need to value and honor truth from whatever source it comes.

An English clergyman, Charles Kingsley, within a year or two after the publication of Darwin's book, coined the phrase that I think expresses perfectly how religious people should think about an evolving world.

What Kingsley said was this. No doubt, God could have snapped the divine fingers and brought into being a ready-made world, but it turned out that God in fact chose to do something cleverer than that. For bringing into being an evolving creation God had made creatures that could make themselves.

I think that is absolutely the way to think about an evolving world. It is creation allowed to be itself and to make itself. It is the gift of the God of Love to creatures that they can explore and bring to birth the very deep, rich fruitfulness with which the Creator has endowed the world.

You see, the God of Love could never be a sort of cosmic tyrant, could never be the God whose creation was simply a divine puppet theater in which God pulled every string. The gift of love is always the gift of some degree of independence to the object of love.



Parents know that about their children. As our children grow up, we have to allow them to be themselves, indeed by their choices in life to make themselves. It is the gift of love always to allow the room for realization and freedom. And that was God's gift of creation in bringing into being an evolving world.

That insight actually helps religious believers with what is the greatest difficulty facing religious belief. I don't know what you think that difficulty is, but I feel certain I know what it is for me. The greatest difficulty is the problem of evil and suffering in this world. If this world really is the creation of a good and powerful God, why is there so much disease and disaster in the world?

It's a very serious question. I think it's a question that holds more people back from religious belief than anything else, and in my view troubles those of us who are religious believers more than anything else.

The idea of an evolving world as a creation in which creatures are making themselves does give one a little bit of help with that problem. I don't think it solves the problem, but it does give us a little bit of help. You see, I've just been arguing that a creation making itself is a very great good, that is, a greater good than a ready-made world would have been. Yet it's a good that has a necessary cost; it has an inescapable dark side to what is going on.

If creation is exploring and bringing to birth the fruitfulness with which the Creator has endowed it, there will inevitably be blind alleys and ragged edges in that process. The engine that has driven the evolutionary process here on earth has been genetic mutation. As what we call germ cells mutate and change their nature, new forms of life become possible. That is a process by which the world, which for the first two billion years of life only had bacteria in it, has now become the home of such rich and developed forms of animal life.

Now if germ cells are going to be able to mutate and produce new forms of life in that fruitful way, it is just inevitable that other cells, somatic cells as we call them, elsewhere in the body will also be able to mutate and become malignant. You cannot have one without the other. The fact that there is cancer in the world, which is an anguishing aspect of the world, is the dark side and the necessary cost of a creation making itself.

I don't think that removes all of the difficulty or the anguish we feel when we see a young mother die prematurely and leave orphaned children (due to cancer), or the anger we might feel in that situation. I don't think it removes that, but it does at least show us that the existence of these strange sources of suffering in the world is not gratuitous. It's not something that a Creator who had been a little more compassionate or a little more competent could easily have got rid of and put right.

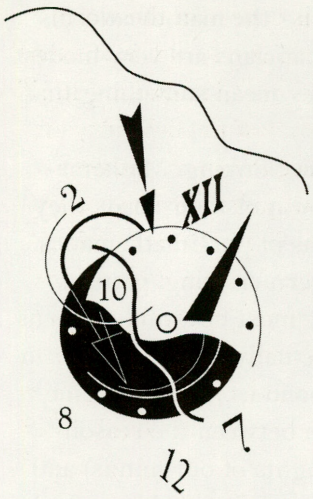
We tend to feel if we had been in charge of creation, frankly, we would have done it better. We would have kept all the good things, sunsets, flowers, and got rid of all the nasty things, the disease and disaster. But the more we understand the world, and by that I mean the more we understand the actual nature of God's creation, the more it seems a sort of package deal, the more it seems things are inextricably interlaced with each other.

Science's picture of physical process loosened up in the twentieth century in a way that is congenial to religious belief.

You can't pull them apart. You can't keep the good over here and the bad over there and throw it away; they are necessarily interlaced with each other. I don't know what you think about that, but I find that helpful in thinking about the religious problem of disease and disaster that we see in the world.

The second thing I think science gives to religion is that twentieth-century science saw the death of a merely mechanical view of the world. In the eighteenth and nineteenth centuries, it looked, particularly as physics got going, as though there was developing a picture of the universe as being a piece of gigantic cosmic clockwork, just ticking away. If that were the case, then God might be the cosmic clock maker, but that was about all the role it seemed left for God to play.

Now there was something fishy about that idea, because human beings have known, as surely as they have known anything, that we ourselves are not an automata; we are not clockwork. But we are a part of that world, so the world could never have been just clockwork.



In the twentieth century, through the discoveries of quantum theory and the discoveries of chaos theory, the intrinsic unpredicitabilities present in the world first of all at the atomic and subatomic level of quantum theory and then at the everyday level of things like the weather with chaos theory, we come to see whatever the world is, it is not merely mechanical, it is not a piece of clockwork.

It is something more subtle, and I believe more supple, than that. If that's the case, and that's the way you and I are to act in the world, to act our intentions to execute as agents, it is by no means unbelievable that God also is able to interact providentially with the unfolding history of creation. Science's picture of physical process loosened up in the twentieth century in a way that is congenial to religious belief.

So there are a couple of gifts that science gives to religion. In my view, religious people should welcome those gifts, accept them gratefully and be glad they are there. So what can religion give to science? Well, certainly not to tell science how to answer its own questions. I think we have every reason to believe that scientifically stateable questions will receive scientifically stateable answers. And God intends us to find those answers by doing science.

I spent twenty-five years doing theoretical physics, and I regarded that as being a Christian vocation, to use such talents as I had. So we have every reason to believe science will answer its own questions, but we also have every reason to believe that there are many questions that are important, necessary, and meaningful to ask that are not scientific in nature.

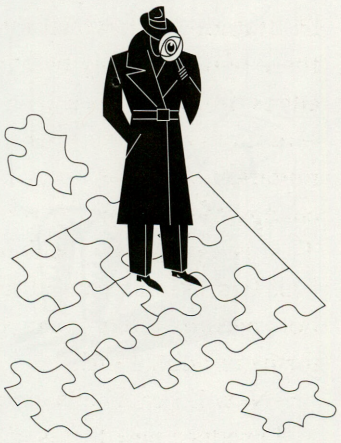
Those are the questions that scientists are not going to be able to answer, but we, as people who want to understand the world through and through, most certainly will be wanting to seek to answer in some satisfactory way. Interestingly, some of those questions come out of our experience of doing science, but take us beyond science itself. They're not scientific themselves. They're what philosophers sometimes call "metaquestions," questions that take you beyond where you started.

I want to spend a little time discussing two of those metaquestions, which come out of our experience of doing science and which I'm going to suggest receive deeply intellectually satisfying answers from religious belief. The first is a simple question indeed, so simple we hardly ever take time to think about it. Why is science possible at all? Why is it we can understand the world in which we live so profoundly?

Well you might say it's pretty obvious; if we couldn't understand the world we wouldn't survive in it very long. If we couldn't figure out it's a bad idea to step off a high cliff, we wouldn't stay around too long. And of course that's obviously true in terms of everyday experience and everyday understanding of that experience.

Yet we know vastly more about the world in which we live than anything that is necessary for everyday survival. For example, somebody like Isaac Newton could come along and, in an astonishing creative leap of human imagination, could see that the same force that made the high cliff dangerous is also the force that holds the Moon in its orbit around the Earth, the Earth in its orbit around the Sun, and could discover the beautiful law of universal inverse square law gravity in terms that could explain the behavior of the whole solar system.

That is by far more than we ever would need in everyday survival, or in my view anything that could be thought of as a happy accidental spin-off from the need for everyday survival. We are able to understand the world to really quite an astonishing extent, so why is science possible in that way?



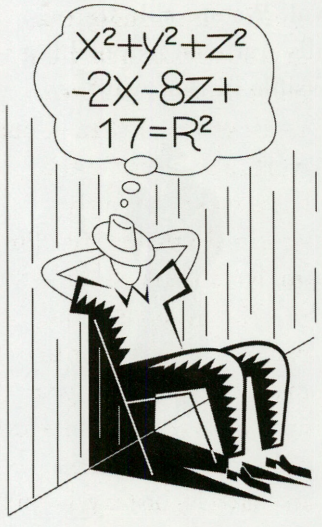
I don't know if you're a Sherlock Holmes fan. I rather hope you might be. When Holmes and Watson first meet each other in the "Study in Scarlet," they meet over conversation at breakfast in a London hotel. Holmes is pulling Watson's leg from the start. He says, "Watson, I don't know. Does the Earth go around

the Sun or does the Sun go around the Earth?" The good doctor is horrified at this deplorable ignorance on the part of the great investigator. Holmes simply says to him, "what does it matter in my daily life as a detective?"

And indeed what does it matter? We know many things that we don't need for our everyday life. The universe is astonishingly rationally transparent to us. Science is possible in a very big way. We can understand the vast curved spaces of the universe itself. We can understand the counterintuitive behavior, the strange behavior, of the smallest bits of matter. Our power in understanding the world is very great. We should ask why it is our good fortune that the physical world proves to be so intelligible, that science proves a possibility for us in such a deeply intellectually satisfying way.

The mystery is even stronger than that, because it turns out that it is mathematics that is the key that unlocks the secrets of the physical universe. It's a technique in fundamental physics to look for theories whose expression in mathematical terms is in the form of beautiful equations. We've found time and time again that it is only the equations having that character of economy and elegance that turn out to be the ones whose long-term fruitfulness persuades us that they really do describe what's going on in the world around us.

Not all of you will know what mathematical beauty is like. It's a rather austere form of aesthetic pleasure, but it's something we really can recognize and agree upon. One of the greatest theoretical physicists I knew personally was Paul Dirac, one of the founding figures of quantum theory. He was once asked, "What's your fundamental belief?"



He wrote on the blackboard "The laws of physics are expressed in beautiful equations." And that's how he made his great discoveries, by relentless and successful searches for beautiful equations.

Now when we use math in that way to unlock the secrets of the physical universe, something really strange is happening, something the mathematicians would call nontrivial. Mathematicians are very modest speakers, and by nontrivial they mean something that is highly significant.

What is math? It's abstract thinking. Mathematicians sit in their studies and out of their heads they dream up the beautiful patterns of pure mathematics. Just think of it as being a pattern creating, pattern analyzing subject. Some of the most beautiful patterns mathematicians think of are actually found to occur in the structure of the world around us. There is some sort of deep-seated connection between the reason within (the mathematical thoughts of our minds) and the reason without (the pattern of the world in which we live).

That's a very striking fact about the world. Not only is the universe rationally transparent, it's rationally beautiful. A word that scientists use very frequently (not when they write formal papers for the *Physical Review*, but when they talk to one another) is the word "wonder." The world is beautiful and the scientific discoveries induce in their discoverers a sense of wonder.

So why does math work in that way; why is math the key to unlocking the wonders of the physical universe? I don't think it's good enough to just shrug our shoulders and say, well, that's just the way it happens to be and a bit of good luck to you chaps who are good at math. That to me seems to be pretty lazy.

So what ties together the reason within and the reason without? Well, for me, my belief in God the Creator, the rational God, the God who is the Creator of this universe, is the ground both of my mental experience and the physical world of which I am a part. You can summarize what I'm trying to say by saying that as scientists study the world, they find it shot through with signs of mind. And I think it's a very worthwhile thesis to consider that it is indeed the capital "M" Mind of the Creator that lies within the wonderful fundamental order of the universe.

I believe that science is possible precisely because the world is a creation and because we are creatures made in the image of our Creator. So that's one example of how something that seems to be a happy accident from a purely scientific point of view becomes deeply intelligible from a religious point of view. And indeed speaks to us something of the glory of God the Creator.

I want to ask another metaquestion, rising out of scientific experience, a little more specific than, why is science possible? My second question is this: why is the universe so special?

Now scientists don't like things to be special, we like things to be general. Our instinct would be to think that we live in a universe that's just a pretty typical universe, just the sort of thing you could get at the average universe shop so to speak. Just any old world really.

But the more we study the universe, the more we understand its history, and the more we understand the processes by which that ball of energy has turned into the home of saints and mathematicians, we've come to see that it's only been possible at all because the universe is of a very special kind.

The laws of nature are "finely tuned" in a way that precisely allows the possibility for such a deeply strikingly fruitful history. It couldn't happen in "any old world." That's a very surprising discovery, and it was a very upsetting discovery for a lot of scientific people because of our instinct to think there is nothing terribly special about the world in which we live.

It took a long time for life to develop. It took about ten billion years for life to develop and it took about fourteen billion years for self-conscious life like you and me to develop. But there is a very real sense with which the universe was pregnant with the possibility of life from the very beginning. By the physical fabric of the world, I mean the given laws of nature, the things that science itself doesn't explain but that science takes as the basis for its explanation for what is going on.

Those very laws of nature, those fundamental forces that control the structure and character of our world, had to be very finely tuned to very precise specifications for the possibility of the development of life to be there for our particular universe. It's sort of a surprising conclusion and I'll try to explain to you why we think along those lines.

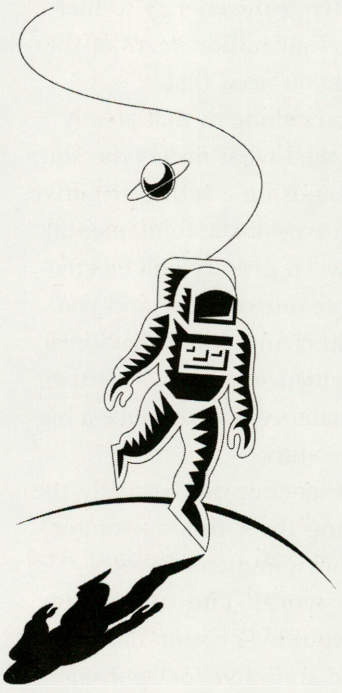
First thing you might say is, how do you know that, as you only have one universe to look at? So how do you know what other universes are looking like? A pretty fair question. But we scientific people in our modest way are quite imaginative, and though we only directly can observe one universe, we can observe with our imagination universes that are like ours but different from it in some quite well-specified ways.

Let's have an exercise of that sort. I'm going to think of a world that is almost exactly the same as the world in which we live, has the same laws of nature, but has one difference. In our world we have certain fundamental forces of nature, gravity being one. In our world gravity has a particular form (an inverse square law) and strength.

If you aren't a physicist you might be surprised to learn that gravity is far and away the weakest of all the forces of nature. That might seem a strange thought on the way down from a high cliff, but the reason the cliff is dangerous is that nothing cancels gravity out. Gravity comes in one kind, and though all the bits are small they all add up to a big effect. That sort of makes the cliff dangerous.

There's another force of nature: electromagnetism. That's the force that holds things together. The pews on which you are sitting are held together by electromagnetism; actually you are held together by electromagnetism. That's a much stronger force than gravity, but as everyone knows it comes in two kinds, plus and minus, and over a distance they tend to cancel each other out. So we are less directly aware of electromagnetism than we are of gravity.

Anyway, you've got these fundamental forces. In our little universe we are thinking of in our imaginary trip we're going to have all of the same forces that we have in this world except for gravity. Gravity is going to be a little bit different. I'm going to think of a world in which gravity is a little bit stronger than in our world. In fact I'm going to make it three times stronger than in our world just to make the sums come out fairly simple. So that's what I'm going to think about.



Now suppose you persuade the Creator to make that world for you and suppose you have a few billion years to spare to watch its history. I don't know what you expected but I would expect that

world so very little different from our world would have produced eventually its own form of life.

I don't think it would have produced Homo sapiens, for example, but it would have produced something different. Little green men maybe. And I actually think they would be "little" green men because actually if gravity is stronger it would be harder to grow tall. So I would expect the inhabitants of that world to be rather squat.

In actual fact, there would be no inhabitants of that world whatsoever; its history would be boring and sterile. So what would have gone wrong? If you are designing a universe that would be able to produce life, you have to be very careful to get the stars right. The stars have a very important role to play in relation to the development of life.

That's just not long enough to fuel the development of life. It takes time, it's a slow process. So that world would have been boring and sterile because its stars would have been burned out before anything interesting had time to happen. So you see you have to get things right and you have to give the laws of nature the strength of the force of nature finely tuned to the right limits for life to be possible.

Let me give you one more example. There's a second extremely important role the stars have to play and that is to produce the chemical raw materials of life. The very early universe is only very simple and it only does very simple things. It only makes in fact the two simplest elements, hydrogen and helium. And they have a very boring sort of chemistry; you can't do anything very interesting with hydrogen and helium.

If you are designing a universe that would be able to produce life, you have to be very careful to get the stars right.

One of the simplest but most important roles they have to play is simply to provide the energy that will fuel the development of life. Life has been able to develop here on planet Earth because our local star, the Sun, has been burning more or less steadily for about five billion years supplying the energy to fuel the say three and one-half to four billion years of the history of life on Earth. And you need that.

We know what makes stars shine in that steady sort of way, we know pretty well what makes the stars shine, and it turns out it depends on a rather sensitive and delicate balance between two of the fundamental forces of nature. In fact, between gravity and electromagnetism. And if you change one of those and you change that balance, then you change the behavior of the stars. Because their dependence is fairly sensitive, quite a small change in the balance will produce a big change in the behavior of the stars.

So in that world where everything is basically the same other than gravity (being three times stronger), the stars in that world will burn immensely more furiously than they do in our world. They will simply pour out energy. And they would very soon burn themselves out. In this world stars live for approximately ten billion years. In that world the stars would live only a few million years, at which point they would burn out to cinders.

The chemistry of life requires all sorts of elements, but the central element is carbon. The chemistry of carbon is the chemistry of life. So where does the carbon come from? Well there's only one place in the whole universe where carbon is made, and that is 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. That in itself is quite a moving thought.

One of the great triumphs of astrophysics in the second half of the twentieth century was to figure out the processes by which carbon and lots of other elements were made inside the stars. One of the people who played a very significant role in that was a senior colleague of mine in Cambridge, Fred Hoyle.

They were trying to figure out how to make these elements and the first one they tried to understand was carbon. They were absolutely stuck; they couldn't see how to get it going. They had helium nuclei, and to make carbon you have to take three helium nuclei and make them stick together.

That's a very hard thing to do directly. The natural way of doing it is to first of all make two stick together, that makes beryllium, then let the beryllium stay around for a bit and hope another helium nucleus

gets stuck onto it, turning the beryllium into carbon. Well that's a great idea but it doesn't work because beryllium is unstable and it doesn't stay around. So they just couldn't figure out how to make the carbon.

And then Fred had a good idea. He saw it would be just possible if there was an enhancement effect (in the trade we call it a "resonance") occurring at a very precise energy. It had to be at this energy to make carbon possible. If it was anywhere else, it wouldn't have the effect. So Fred felt absolutely certain that since there is carbon around there must be this resonance, and that's how carbon can be made inside the stars.

So he went off to the nuclear data tables to look up and see if this resonance was known. And it wasn't, it wasn't there. But he was so certain that it must be there that he got in touch with some of his friends in California who are very good experimentalists and he said, look, you've missed something. There's this resonance in carbon, I can tell you exactly where to look for it, exactly what its energy is going to be. You've got to have a look.

And they had a look and there it was. It was an astonishing achievement, a very great scientific achievement to predict that effect in that sort of roundabout way of arguing.

Now the point is, the fact is if the resonance weren't there at that precise energy, we wouldn't be here at all. Carbon-based life would have been absolutely impossible. In fact exactly where that resonance is depends upon precisely the details of the forces that control nuclear reactions. In any world in which the nuclear forces were different than they are in this world, there would be no carbon and there would be no carbon-based life.

Now Fred always had a strong indication toward atheism, but when he saw that this effect in carbon was there, in exactly the finely tuned right place to make life possible, he said in a Yorkshire accent that is beyond my powers to imitate, "the universe is a put-up job." In other words, this can't be an accident; there must be some Intelligence behind all that fine tuning of the laws of nature.

And I think that's right. We live in a universe that is very special in its character. And that doesn't surprise those of us who are religious believers because we don't think the universe is any old world. We think it is a creation and it is believable and encouraging to our belief that it's been endowed by our Creator with precisely those finely tuned laws and circumstances that enable it to have so fruitful a history.

So there we are, I've tried to give you those two examples, why science is possible, why the universe is so special, questions that come out of science that science itself can't answer, questions that nevertheless we ought to try to answer. I suggest that religious faith in God the Creator provides deeply intellectually satisfying answers to those questions. There is truly a friendship between science and religion. They truly can help each other.

I stand before you as somebody who is both a physicist and an Anglican priest. I like to think of myself as being two-eyed, to look with the eye of science and to look with the eye of religion. I believe we can look with those two eyes, and I believe that binocular vision is better than monocular vision.

I believe that with those two eyes, I can see more and understand more than I would if I had only one eye or the other to use. So I truly believe there is a friendship between science and religion, and I believe there is a fruitful conversation taking place between the two, which I'm sure will continue for a very long time yet.