THE FAITHANGLEFORUM

TRANSCRIPT

Current Controversies in the Religion and Science Debates

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MICHAEL CROMARTIE: We're delighted that Dr. Ard Louis has come all the way from Oxford to be with us, where he's a reader in theoretical physics at the University of Oxford. Ard grew up in Africa, but he did his Ph.D. in theoretical physics at Cornell, and I gave him the broad topic "Current Controversies in the Religion and Science Debates" because there are, as you all know, a lot of controversies in the religion and science debates. I'm eager to hear which ones he thinks we should highlight.

So, Ard, thank you so much for being here.

DR. ARD LOUIS: So thank you very much. It's a great honor for me to be here with all of you.

To start, I thought I'd give you a few quick websites of organizations that I've been involved with. This is for you if you want some background reading.

One that I highly recommend is the Faraday Institute for Science and Religion, based at St. Edmund's College in Cambridge. They have a huge amount of information on its website, and so it's probably a first place to go if you're interested in these topics or writing on them.

Another one I'm involved with is called BioLogos, which was founded by Francis Collins, and I chair the advisory board. So I've gained a fair understanding of some of the controversies in the Evangelical world surrounding evolution.

And lastly, for the past six years or so I've been on the advisory board of the Templeton Foundation, which doesn't mean I'm responsible for anything they do, but it is actually quite a fun group to work with because they tackle all kinds of crazy big questions, and I

actually got into some of these issues we're discussing today because they tapped me up. So I'm thankful for them for that, and I think they're an incredibly stimulating organization to work with.

The Faraday Institute would be my first port of call if I was any of you and you're trying to get anything on science and religion. They're probably the best organization in the world on these things.

So what I'm going to do today is not so much focus on controversies, but rather give you a brief overview of some fun things in science, and my guess is that this will elicit a bunch of questions, and of course the question section is actually the most interesting part of the talk.

Then I'll talk a bit about the creation evolution debate and if I have time I'll go into the God, atheism and science debate.

But first a little bit about myself. As Michael said, I grew up in Gabon in Central Africa, and this is actually a picture of myself and my sister and our pet chimpanzee. My parents are biologists. So we had a chimpanzee who had been rescued from some local hunters.

Just to be clear, this is me. That's the chimpanzee.

(Laughter)

My mother says that although we look different, we behave remarkably similarly.

(Laughter)

And in fact, growing up with the chimpanzee has always made me wonder what makes us different from chimpanzees. So, for example, you may not realize this, but we share something like 98 percent of our genes with chimpanzees, and so the question is—why are we different? Why are we so different from the chimpanzee?

We share 70 percent of our genes with frogs. We share a large fraction of our genes with bananas, for that matter, and one of the questions I work on as a physicist in my lab is the question of how these gene networks work.

If you can see this little thing in the corner here, it's basically a bunch of dots that are connected up with lines, and what that represents is a gene network. So you may have been told or thought a long time ago that genes are something like blueprints. You know, genes, you can read them like an architectural drawing.

But that's probably not the best way of thinking about them. A lot of genes are, in fact, switches. They turn things on, they turn things off, and so a better way of thinking about genes is like a whole bunch of transistors that you connect up, and by turning and changing the way they're connected, you change the way that they do things.

And so that's really fun for physicists because all those connections can be modeled with (differential) equations. So you have this really complex system of many interacting things, and it's actually through their interactions that the complexity emerges.

If you look at all of these different organisms here, I've got mycoplasma genitalia here, the world's simplest organism, which has a few hundred genes; E. coli; yeast. Basically we as humans, homo sapiens, we have about 23,000 genes, and these two little worms, C. elegans and P. Pacificus, one has 19,000 genes. One has also about 23,000 genes, not too different the number of genes than we do, but this little thing only has about 1000 cells, it's an unbelievably simple organism.

So why are we so different from this little tiny worm? Well, it has to do not with the number of genes, but the way that these genes are connected. So that's the first take-home for you: there is something really beautiful happening here in the way these genes connect up and make our complexity, and that's one of the things that, as a physicist, is really fun to study. I think one of the big revolutions going on in biology is precisely how we understand the way these things connect up.

Does that make sense? So that's kind of a fun thing.

The other thing I want to show you is a little movie that inspired me to move from physics into more biological questions, and this is a movie of a bacterium. So bacteria swim. They have little tiny flagella that they swim with, and the flagella are driven by a little motor. I'm showing you this motor right here. It's an animation by Keichi Namba's group in Osaka.

Now, this little thing can spin at 100,000 rpm. It can stop in a quarter of a turn. One of my colleagues, Richard Berry in Oxford, can measure the torque of these machines. I mean, they're absolutely spectacular little pieces of nano-machinery, and this is what a bacterium uses to swim.

Now, there are many amazing things about this machine, but what I find the most amazing is what you see in this little video. This thing makes itself. If you were to find a machine like this, say, the size that you could see it with your eyes, you'd assume that it was made in a factory. Somebody put it together, right? But this thing makes itself. There's no big machine inside there that makes these flagella. Instead, these little proteins float around and somehow stick into exactly the right shape, which we call self-assembly. These things make themselves.

About six years ago I saw this video for the first time, and I thought to myself, "Wait. How does that work? How do they know where to go? That's really crazy."

I'll tell you another little fun thing. You have about ten times as many bacteria in your body as you have cells in your body. Before you all rush off to the hospital, that's because bacteria are smaller than the cells in your body. A lot of them live in your gut. So in fact, if you got rid of all of them, you'd become ill. So as a human, we're not just human. We're also partially bacterium. That's why we now speak of the microbiome, which is the genome of not only the human genome but the microbes that make us up. It's a fascinating thing.

And also, while I'm speaking to you, this process of making that little motor is probably happening millions of times in your body, as it takes roughly the time of my talk for one of these little motors to be assembled.

In my lab one of the things we work on is viruses, which are a simpler version of these self-assemblies. That movie shows a really complicated thing with lots of different components. And, there's lots of different kinds of flagella. We don't understand necessarily that much about how they self-assemble, except that they do.

But viruses are simpler. So these are two viruses I'm showing you. They're almost spherical. About half the viruses in nature have that kind of spherical form, and what makes these ones easier to understand is that they're made of one component.

So this one over here is made of 12 pentagons of five proteins each, and this one is 12 pentagons and 20 hexagons, which if you look at an old football, or soccer ball, you'll see that is also the way they're stitched. So nature got there a long time before we did.

What you can do is take this one, for example, which is made of 12 pentagons, and let's say you put 100 viruses in a test tube. You can change something like the pH and it will break up into 100 times 12, 1200 separate units.

If you then change, say, the pH back, it will spontaneously jump right back into 100 little balls, pretty amazing!

This is some work we've done in my lab recently on these computer viruses we call them—but I tell my computer officer that they're good, not the bad kind of viruses—and what we've been able to do is design these interactions such that if you move them around randomly, they always spontaneously form these beautifully shaped objects.

So I like to say that what I'm doing is a little bit analogous to having Lego blocks, putting them in a box, shaking the box, and out comes a preformed train.

Science is fun, and one of the great things about science is that I'm paid money to think about these things, which always amazes me. If I lived in the U.S., it would be your tax money, for which I thank you very much.

Not too long ago I would have had to be independently wealthy to do something like this. So it's only quite recent that there's a guild of people who are paid to think about these kinds of things. So science is really fun, and I think it's a great privilege to be part of it.

When I saw something like that video I thought, "Wait. How does that work?" So I'm actually paid to think about what I think is interesting. Since I decided that was interesting, and that's one of the things that I'm working on in my lab.

The other thing that I worked on in my lab is evolution. I'm interested in how things evolve, and one of the things I'm interested in is how does evolution make things that self-assemble, and that's a really fun and interesting question to think about.

Scientists have other advantages too. I probably don't fly nearly as much as you do, but I fly fair amounts, and my guess is that you're sitting next to somebody and what you really want to do is just have a little kip, a little sleep and they want to talk to you. I'm sure if they ask you if you're a journalist that's the beginning of a long conversation. The great thing about being a scientist is that if someone turns to you and says, "What do you do?" Well, if I want to stop the conversation. I say, "I'm a theoretical physicist." That usually kills the conversation right there.

(Laughter)

And if that doesn't work, if they kept going on, I'd say, "I really like equations. What's your favorite equation?"

(Laughter)

And that's as far as I've ever gotten.

There are lots of funny stereotypes about scientists. This one says, "I finally figured out why we never had girlfriends." … But I solved that problem.

I'll start by just telling you about my favorite equation because I think this is something that is so beautiful that I really want everybody, including you journalists, to know about this. The story goes back to 1928 in Cambridge with a man called Paul Dirac, and so I've got all these equations on the sides, but don't tune out. Just stay with me. I'm going to talk you through this.

How many of you have heard of quantum mechanics? Oh, very good. So how many have you heard the Schrodinger equation? Very impressive.

The Schrodinger equation basically describes very small things. Quantum mechanics deals with small things. The Schrodinger equation describes small things like an electron, and it's an incredibly powerful and beautiful and non-intuitive theory, but it works unbelievably well, and explains all of chemistry, et cetera, et cetera.

So that was worked out in 1926. Now, you probably all are familiar with Einstein's theory of special relativity, the theory of very fast things, which was worked out in 1905. So Paul Dirac, the great mathematical physicist at Cambridge, was thinking, well, if I have something very small, obeying this equation and I have something very fast, obeying special relativity, how do I bring those two things together? Does that make sense? That's kind of an obvious question.

I have an electron that's governed by the Schrodinger equation. What happens when it moves very fast? Well, this first equation here is an energy equation for the Schrodinger equation. And this is just $E=mc^2$. You see the square root of mc squared, squared, is $E=mc^2$. That's pretty easy.

And then there's a little additional term there which is for momentun and so you say, well, I'm also going to do this for the electron. The electron has spin-up and spin-down. It's a two component equation. Dirac tried and tried and tried, and no matter how hard he tried the only way that mathematically you can make the Schrodinger equation transform according to the laws of special relativity is if you have not just a spin-up and spin-down electron, but something else, a second component.

I remember when as a student of physics in the University of Utrecht we were taught this derivation. I thought, well, Dirac must have made some kind of mistake. You know, something's wrong, and I actually spent the whole night doing this calculation, trying to figure out where he had gone wrong—the hubris of youth—before finally bowing to the great master who showed it is the only way that you can make this thing relativistically covariant.

Now, it turns out that that other component that you got in the equation was discovered in 1932 by Carl Anderson at CalTech, and it's the positron. You probably know PET scans, positron emission tomography. That's the opposite of electron, and what is that? It's basically antimatter. So every electron, every piece of matter has an antimatter counterpart. Electron has a positron, and the proton has an antiproton. The neutron has an antineutron.

And so it turns out that mathematics seems to impose on the world antimatter, and Dirac basically predicted something completely and utterly non-intuitive about the world just from the laws of mathematics. This is what famously was called by Eugene Wigner the unreasonable effectiveness of mathematics, a wonderful gift which we neither understand nor deserve.

I think that's truly beautiful. It's just amazing. How could it be that you have something about very fast particles which you can derive without too much difficulty, something like the Schrodinger equation, which you can derive with a little bit more difficulty, but it's pretty straightforward; you put them together and out comes something completely crazy like antimatter, and it's the only way that it works?

I think that's incredibly beautiful and incredibly amazing.

And so if you're thinking how do physicists think about the world, this is what a great mathematical physicist, Henri Poincaré, said: "A scientist does not study nature because it is useful. He studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing life would not be worth living."

You can see that Poincaré was a Frenchman.

(Laughter)

And Dirac was once asked, "What's your fundamental belief?"

He thought about it for a while, and then he said, "My fundamental belief is that the laws of nature should be expressed in beautiful equations."

That brings me to the first big question or controversy, and you'll probably see it discussed in the newspapers a lot, which is how can we look at things like other universes. Why do physicists make claims that there might be a multiverse?

Well, that is actually a very interesting extension of this idea that mathematics imposes itself on world. You probably know that there are four fundamental forces in nature, the strong, the weak force, electromagnetic force, and gravity, and those first three can be unified in one theory, and the only little bit that's missing in that is the Higgs boson that they're trying to find in Cern in Geneva, but that's really the last little thing.

If all we find is the Higgs boson, in honesty it's going to be really, really boring because all that does is just confirm what we think we already know, which is that these three forces can be unified.

What's a really interesting question is "can we also unify the weakest force, gravity, into some mathematical framework that makes all these forces come under one basic principle?" One of the ways of trying to do that is string theory. These theories are based on some special mathematics, and these mathematical principles turn out, in certain cases, to have for example 10^{500}false vacuums, and so this is where the idea that there are 10^{500} different possible universes comes out.

And one of the really interesting questions is: is that still science or has this become philosophy? Because it's unlikely we're ever going to be able to observe or falsify the prediction that there are many universes. It's kind of a wild and crazy idea, and it makes antimatter look very tame.

And the fact is, I think we probably won't ever be able to falsify it. So this is one of the really interesting questions or controversies that's happening now, and I think there's going to be a discussion for the next millennium maybe, this question of what about other universes. This may be something more like philosophy than like science, but it is a fun thing to think about.

So that's one little quick thing that we can get back to in the question session.

A related topic, in fact, and one of the drivers behind trying to come up with multi-verses is the following question: Why is the universe the way it is? One of the amazing things about the universe and about physics is that it's very fine tuned for life. In other words, if the laws of physics were just slightly different we'd have a biologically sterile universe.

Now, my favorite story on this topic, which I want to share with you, is about Sir Fred Hoyle. Hoyle is the man who coined the words "Big Bang," and that was a pejorative term because he had an alternative theory, the steady state theory which had the universe existing forever. He was a very committed atheist, and so he didn't like the idea of Big Bang because the Big Bang suggested a beginning, which suggested a beginner. But like many pejorative terms, it kind of stuck. So that's where the word "Big Bang" comes from.

One of the really interesting issues is that the early universe only makes hydrogen and helium and a few other things, whereas to be chemically interesting you need things like carbon, oxygen and heavier elements, and so the question is where did those heavier elements come from?

Well, what scientists have worked out, what Hoyle worked out, is that these come from a nuclear reaction. So the sun, our own sun, is a giant nuclear reactor. The hydrogens in the sun fuse together to make helium, and that generates energy. The sun is a giant thermonuclear reactor. A hydrogen bomb uses exactly the same physical principle.

So what's going to happen is at some point, if the sun keeps burning, it will use up all of its hydrogen, and so all of the hydrogen will have been turned into helium. At that point the heliums will start to fuse into something heavier, et cetera, et cetera. That's how you get the heavier elements, and at some point a star like the sun will burn up all of its elements that can go through that process of fusion. These elements get spread if then the star then turns into a super nova that spews this dust throughout the universe.

So you and I, all of our heavy elements, are, in fact, made in the giant nuclear furnaces of the stars. They're then spewed around the universe. Every element in your body that's not hydrogen or helium was once created inside a giant star. So we're made of stardust. A romantic notion, I think.

But here's an interesting point. So Hoyle was thinking about how does hydrogen make something like carbon. Some of you may remember that hydrogen weighs one, and helium weighs four. Carbon is 12. So you need three times four, three heliums, to make one carbon, and what Hoyle worked out is that that reaction from three heliums to one carbon is going to be very unlikely, and so he did the calculations, and it looked like it wasn't going to be able to make nearly the amount of carbon and together with some side reactions for oxygen, that we need for life.

Now, Hoyle was a very clever man, and so he said, "Well, let me turn that question around. I know that I'm here. So I know that this reaction must have happened." So he back-calculated it, and he said, okay, the only way it's going to work is if what we call a resonance, which is unstable energy level, in the nucleus of carbon is at just the right energy so that it enhances the probability of the heliums making carbon.

And so he made the calculation. He said, well, there's a resonance at just the right energy, and he went to look at the nuclear data tables to find it, and it wasn't there. Okay? So he was a bit puzzled. But he was a very stubborn chap, and so he phoned up Willie Fowler at CalTech and said, "You know, you missed something. There's a resonance at this energy level. I know exactly where it is. You've got to go look for it."

And so eventually he convinced them to go back. They looked, and lo and behold, there it was at exactly the energy that Hoyle predicted. And it turns out that if this energy is up or down by just a few percent then this reaction doesn't work. The universe would be chemically sterile and, therefore, biologically sterile.

Hoyle famously said, "a common sense interpretation of the facts suggests that a super intellect has monkeyed with physics and biology," and he said his atheism was deeply shaken.

So, this is kind of a fun thing to think about.

I should just point out for people who are Christians like myself, fine tuning is not a full proof for God, but it does seem more consistent with theism than atheism. Sir Martin Rees, the Astronomer Royal, famously said we seem to have three choices. We can

dismiss it as happenstance. We can claim it as the workings of providence or, his own preference, we may conjecture that our universe is an especially favored domain in a still vaster multiverse.

And so that's a kind of a fun thing to think about, something to speculate about. It's a very interesting question, don't you think?

On balance, I think it's going to be hard to know which way it goes, but there is something really beautiful about the way the world is; something very striking and spectacular.

Next we're going to go to this question, creation or evolution: do we have to choose? So I'm a Christian, probably something close to what you might call an Evangelical Christian, although I realize that's a word whose definition has become complex, but I work on evolution in my lab. I think it's a really beautiful thing to work on. But for some people that's a little bit like saying that I am a vegetarian butcher.

(Laughter)

An oxymoron of all kinds, but that's the way it goes.

I'm interested in evolution, and I think it's a very beautiful theory. Unfortunately, the creation or evolution debate is really where a lot of the controversy lies in the questions of science and religion, and so we could talk about "evolution and its discontents," with Charles Darwin, this bearded man—with this picture looking over us with great wisdom or maybe with something very sinister, depending on your background.

He wrote his famous book in 1859, *The Origin of Species*, and George Bernard Shaw famously said, "Darwin had the luck to please everybody who had an ax to grind," and that ax to grind is often the idea that where we come from determines who we are and how we should live. So in Herbert Spencer's famous words, the survival of the fittest got taken up by some quite aggressive versions of capitalism or had an influence on eugenics.

So there are all kinds of ways in which ideology has gotten attached to these scientific questions that Darwin was trying to answer, which were: how do we get the diversity of life that we see? Where do we get the endless forms most beautiful all around us from?

And so as you probably know better than I do, in the United States something between 42 to 47 percent of the U.S. population agrees that God created human beings pretty much in their present form at one time within the last 10,000 years or so, and it's much higher among Evangelicals.

But it's interesting that sometimes people think this is an American issue, an American problem, and I'll go back in a minute as to why I think these percentages are so high, but in 2009, the Darwin year, there were a lot of polls that went around, and somebody did one at the University of Wageningen in the Netherlands. He polled 415 staff and 215 academics. So academic staff of all kinds, and 30 percent did not think that variation and natural selection is sufficient to explain life on earth.

There was a very fascinating poll in the U.K. as well, which had one question whether evolution alone is not enough to explain the complex structures of some living things—it suggests that the intervention of a designer is needed at key stages. Fourteen percent of the population thinks that is definitely true. Thirty-seven percent thinks it's probably true, which means that 51 percent believe in some version of what we might call intelligent design. Again, these are strikingly high percentages.

The makers of this poll, actually people linked to the Faraday Institute, said either way, it appears that in the country of Darwin's birth, a century and a half after the publication of his master work, only about one in four people would qualify as confirmed Darwinians, with at least as many being actively hostile towards Darwinian evolution, and an even larger portion being inclined towards Darwinism, but distinctly unsure about its merits.

And their argument was that the reason it is that way is related to the way that evolution is often portrayed in the media, the way it's often sold by its best known popularizes, not just as a scientific theory, but as an ideology, as a story that tells us where we come from and how we should live.

And that brings me to the question of what I mean by the word "evolution," and I think almost all of the controversy hinges on what you mean by the word "evolution." So you can think of evolution as natural history, the idea that the world is old, that more complex forms follow from simpler forms. That's natural history.

And for people that are Christians, it's actually the natural history question that they most need to link up with a book like Genesis and say, "Well, how did these things line up together?" So that's where the controversy really should be in the Christian public.

The second question, which is to say how did this complexity come about, you know, why did we, the mammals, eventually rule the roost? And where did mammals come from, et cetera, et cetera? Those are the kinds of questions that Darwin really answered, not natural history, but the question of how did this happen, and his argument was that this evolution came as a mechanism which is basically mutations that generate variation and a natural selection that selects those various things.

Now, it's interesting that your immune system, for example, uses exactly this methodology. It generates a large number of random variations that are then selected upon, and that's how your immune system, with a limited number of genes, can recognize a very large number of different pathogens. That's a way of generating a very rich complexity.

So most Christians would agree. They will credit this mechanism. They just disagree that this is the mechanism by which complexity came about.

But the real difficulty is that the word is often also used as a kind of big picture world view. So George Gaylord Simpson, the famous Harvard paleontologist, said, "Man is the result of a purposeless and material-less process that did not have him in mind. He was not planned. He's a state of matter, a form of life, a sort of animal and a species of the order of primates, akin nearly or remotely to all of life, and, indeed, to all that is material."

Richard Dawkins said, "Darwin made it possible to be an intellectually fulfilled atheist." I think the real difficulty with this question of evolution and creation has to do with the way that the science of evolution has gotten all of these other things added onto it. It has thus become a kind of ideology.

And so I think that the average person in the pews in the United States or, in fact, even just the average person on the street clearly in Britain, is uncomfortable with this. They're uncomfortable with this idea that it's all purposeless. So when you ask them the kind of

question that you saw in the poll, they think you're asking them: do you believe that life is somehow purposeless?, and so their natural inclination is to say no.

And I think this is very problematic for those of us who are scientists because in the end it's very important that the public understands what we do and supports what we do.

So basically if you're interested in the debate among Christians, then really there are four different approaches that Christians have taken.

One is some kind of creation science that says that science is incorrect. The earth is 10,000 years old or something like that. It's interesting that this movement has really only become popular in the last 50 years. It's really a very modernist movement in many ways. For example, when a series of books called *The Fundamentals* were written from 1910 to 1915, which is one of the origins of the word "fundamentalists," a number of the writers were actually quite happy with something like evolution. B.B. Warfield, who is the father of the doctrine of Inerrancy, so a very conservative Presbyterian, was also an evolutionist, who called himself a Darwinian of the purest water, and James Orr and other writers explicitly made the point that Genesis was not meant to be a scientific text.

So you see that even at the origins of the Fundamentalist Christian movement in the United States, there was a lot more variation in views that was allowed in the earlier part of the 20th Century than might be the case now.

Young Earth Christian Science is no longer just an American phenomenon. The biggest Young Earth organization in the world is based in Turkey. It's led by a very charismatic Turkish man who goes by the pen name Harun Yahya, who has an enormous amount of funding and a made famous book called *Atlas of Creation* that he sent to everybody who was in this field, at an estimated cost of about $100 each to print, and I think he printed thousands and thousands of these things.

So Creation Science has become something popular. I think we're going to see this spread throughout the world. This is a controversy that's not going to go away any time soon.

Interestingly, we see that some of the writers of *The Fundamentals,* a number of them held to some kind of progressive creationism or perhaps even some kind of what we might

now call theistic evolution or what Francis Collins calls "Biologos" which would be an argument that God, in fact, did create through evolutionary forces.

And of course, another very controversial topic in the United States, particularly, has been the Intelligent Design movement, where, in fact, proponents hold any of these three different theistic views, but they essentially argue against evolution number two, my second definition, the idea that natural selection and variation can explain the complexity we observe They argue that that's not correct.

So this is my little typology of the different arguments that are out there, and almost any time you read a commentator talking about this, they will be speaking either from one of these three perspectives if they're a Christian or perhaps these four perspectives, or they'll be talking about evolution itself and often mixing up these different meanings of the word.

Somebody will say, "We know evolution is true because we have the bones of dinosaurs. Therefore, man is the result of a purposeless and materialistic process." And, in fact, it's that mixing of these definitions that is at the origin of a lot of the confusion.

Now, I just want to get into one thing which irritates me a little bit about the public debate, and I'll be curious to see whether I can communicate this to you in a helpful way. One of the reasons why people have difficulty, laypeople have difficulty with evolution has to do with the language. So we speak about random mutations and natural selection, and the problem is that random suggests something like purposeless, not having a purpose. It's random, just random, whereas, in fact, in physics, or in engineering, if you want to solve a complex problem or particularly a high dimensional complex optimization problem, we almost always use methods that in some sense or other use what we call random number generators, the technical term for these are stochastic methods. That's a fancy way of saying random. It's just a more technical term without the metaphysical overtones.

So, for example, in the picture I showed you of the viruses I designed, we designed them with the random method, but if you put those viruses down and we let them move around randomly, they'll always form this particular outcome, this particular shape. So even

though I'm randomly generating the moves of these particles, they always have the same outcome.

And in fact, the price of your stock portfolio is set by a bunch of quants running these various kinds of stochastic Monte Carlo algorithms. Okay? Even the way people design bridges uses these kind of stochastic algorithms.

So if God wanted to create something like the complexity we see around us, it would seem that the most efficient way of doing that would be to use some kind of random or stochastic optimizer. But the problem is that that word, that methaphor, causes all kinds of problems.

I'll give you another fun little example of difficulties of metaphors. This is Richard Dawkins in a famous passage from *The Blind Watchmaker*, where he says, "Genes swarm in huge colonies safe inside gigantic lumber and robots sealed off from the outside world, communicating with them by torturous indirect routes, manipulating it by remote control. They are in you and me. They created us body and mind, and their preservation is the ultimate rationale for our existence."

What a beautiful way with words.

Now, it's interesting that another Oxford academic Dennis Noble, who was, in fact, Richard's examiner for his Ph.D. thesis, another great thinker, wrote a lovely book, called *The Music of Life,* where he turned this around just for fun and said, "Genes are trapped in huge colonies, locked inside highly intelligent beings, molded by the outside world, communicating with it by complex processes through which blindly as if by magic function emerges. They are in you and me. We are the system that allows their code to be read, and their preservation is ultimately dependent on the joy that we experience reproducing ourselves. We are the ultimate rationale for their existence."

(Laughter)

Dennis says that he asked, "Richard, do you have an experiment that could show which of these two interpretations is correct?"

And there isn't an experiment because both of these are philosophical interpretations—actually both of the last parts of the statements, are really theological statements. In fact, Dawkins' book *The Blind Watchmaker* was a famous play on the a passage from an 1805 book by archdeacon William Paley, who used an analogy of God as the watchmaker. You walk along and find a watch on the heath; it is so complex that it must be made by God. The same analogy holds in nature. Whereas Dawkins says no, for nature it is not God but rather the Blind Watchmaker.

Both Paley and Dawkins are engaging in something that we might call natural theology, actually a very particular kind of natural theology. They are trying to extract meaning from the science. What you see here is that how you extract meaning from the science is a lot harder than it looks because two people might describe the same set of phenomena in two different ways.

What's also interesting about this is another bigger discussion that's going on in the scientific community and the philosophical community at the moment, which is a question of emergence. So what causes what? Dawkins is very much of a reductionist. He starts down at the very bottom level and tries to work up, whereas Dennis Noble is one of the founders of systems biology, which is saying look at the top down. What's happening at a higher level and what is causing what? Is something emerging from the bottom up or is something supervening from the top coming down?

Those are really interesting questions. They're interesting scientific questions; practical questions, like what's the best angle from which to understand the phenomenon. They're also interesting questions when we think about something like consciousness or how does our mind work. These are the types of questions that I think are going to be in the fore for a long time.

So here are two great men of science. The first is Stephen Jay Gould; the second is Simon Conway Morris. Gould was a very famous popularizer of biology and a great biologist at Harvard. He wrote a book called *Wonderful Life*, in which he says basically if you would restart evolution again and let it run again, nothing remotely like human beings would grace the replay. The fact that we're here is just an accident of history and, thus, says

Gould, humanity is dethroned from its exalted view of its own importance; Of course these are really theological statements.

The irony of this is that the book, *Wonderful Life*, has three heroes: Simon Conway Morris and his two colleagues, Whittington and Briggs, and Gould says in the book that there is no Nobel prize in paleontology, but if there was one, the first would go to Simon Conway Morris, Harry Whittington, and Derek Briggs. So they are the heroes of the book.

But interestingly, one of the heroes, Simon Conway Morris, has a completely different interpretation of the same piece of paleontological evidence. Conway Morris basically says that if you were to rerun evolution again, something not too dissimilar from humans might grace the replay. He talks about convergenct evolution.

So what do I mean by that? I'll give you just one example. I think it's a kind of fun example. It's the camera eye. So here I show you a bunch of different eyes. There are basically two major eye types in the animal world. One is the compound eye, which a fly has, which you see on your left. Whereas on your right you see the camera eye. In fact, if you do the physics, and if humans had a compound eye, it would look something like this, which is not very practical.

(Laughter)

But what is amazing is that we have a camera eye, but so does an octopus, and the camera eye that we have and the octopus camera eye is very similar in its design. We have a lens, we have a retina, but if you look at the origin, for example, of where the cells come from, then the origins are very different, and if you look at other things like: we have a blind spot because our optic nerve is on the front of the retina, whereas in the octopus it's on the back.

And so what you actually see is that this camera eye has independently evolved a bunch of different times, and that's really fascinating because it is a really complex thing, and how on earth did that thing evolve multiple times? I think that's a fascinating scientific question.

And so Simon points out that nature is full of this kind of convergence, where the same thing evolves again and again and again, and thus he suggests if you were to rerun the tape of evolution, you are very likely to see something like humans or human intelligence grace the replay.

Now, these are the fun things about which to speculate, a little bit like multiverses because it is very unlikely that we are going to be able to rerun the tape of evolution again unless we find life on another planet.

Okay. The last thing I want to do about evolution as I'm jumping through all of these topics is to talk about what I think is going to be and is already the big controversial topic for the next the ten years at least, and that's this question of evolution and morality or evolution and ethics.

One of the really interesting questions is where does our moral sense come from? We all have a strong moral sense, and there are certain moral sensibilities that you find almost universally throughout history, like the taboo on incest, for example, and the question is why do we have this moral sense?

And one of the arguments would be, well, this is because in evolution and evolutionary times, somehow we evolved certain types of moral sensibilities. So, for example, altruism of some kind might, in fact, make us more likely to survive.

You have to be a bit careful with this argument because when biologists talk about altruism, they use the word "altruism," but it has quite a technical meaning, namely that you as an organism do something that doesn't necessarily propagate your own genes. For example, it is like a bird that's in a flock that cries out when it sees a hawk. That doesn't propagate his own genes, but it does help everyone else to survive.

And you can show that this works in the animal kingdom with direct relatives, so in other words, if you die but your brothers and sisters survive, then your genes are more likely to be passed on for I think two brothers and eight cousins, I think it is. You can give up your life for eight cousins and then it works mathematically, and that explains some of this kind of behavior in the animal world.

That's a far cry from the altruism that we see in life, but it's an interesting question to study.

I have no problems that that this is possibly where some aspects of our moral sensibilities come from, but the really interesting question that might be fun to discuss is why would this actually be truth tracking in any way. It would be a tremendous accident. Evolution, in the words of Patricia Churchland evolution is only interested in the four Fs, "feeding, fleeing, fighting, and reproducing."

(Laughter)

And truth takes the hindmost. Why would evolution be truth tracking? Probably the real question is if you believe in some kind of moral realism, if you think there really are moral facts about the world, like killing innocent people is wrong and that's not something that we just socially constructed, it is very unclear that you could derive that, and I think a lot of philosophers agree you can't derive that, in any straightforward way from naturalism. In fact, evolution makes it less likely for that to be true.

I think that's potentially deeply problematic because a lot of people have a very strong intuitive sense that morals really are true, and that belief is particularly important in difficult situations. It's one thing if you're living in a nice, comfortable academic environment. You can say, well, you know, it's all just socially constructed.

But you really want morality to work in difficult situations, in situations of famine and war, et cetera. I worry that by generating an alternative where we come from how we should live story about the origins of morality, then, given that we already live in a society with a a cut flower morality—morality's flower is cut from its origins and will eventually wilt, then the worry is that if you promote an alternative story, that could be tremendously destabilizing.

And I think the last thing I'll talk about very, very briefly because I realize I'm now already on 50 minutes, and I think I was going to stop around that time, is science and the ultimate questions.

I think a lot of the controversy that we see about science and faith is really a question about how do I obtain reliable knowledge about the world. And what we mean by that is this. We're all philosophers and theologians in some way or the other. As Professor Berger pointed out yesterday, we're mainly inconsistent philosophers and theologians. And so the science and faith debate is not going to go away because fundamentally it's a debate about how do I obtain reliable knowledge about the world. How do I know that something is true? How do I know that something is false? How do I know that something is reliable or unreliable?

Science is a very reliable way of obtaining knowledge about the world, but is science the only way to obtain reliable knowledge about the world, or are there other ways of obtaining reliable knowledge about the world?

And a moment's thought suggests that science, certainly natural science, is very unlikely to be the only way of obtaining reliable knowledge about the world. Think about things like relational knowledge. So, for example, you want to get married. A truly irrational thing to do would be to grab the first, the best girl on the street and say, "Please marry me," and if she says yes, that's even more irrational.

Instead what we do is we get to know the person. We spend time with them. We ask the community around us what they think. You might even do compatibility tests, which my wife and I did, and which were quite revealing and interesting, but in the end of the day you don't marry someone because you both score 90% on the compatibility test. Also, one can't wait, and I didn't wait, for scientific certainty that Mary was the person that I wanted to marry or I would have waited forever. The reason I would have had to wait forever is not because she's not amazingly wonderful. It's because there are aspects of being married that are unavailable to me until I'm married. So there's knowledge that is based on commitment, and that knowledge is not available to me beforehand.

If I insist on an attitude or assumption of doubt, that I don't really know if she loves me until she proves that she loves me, the fact is that there will be evidence that will never be accessible to me precisely because I take that kind of, quote, unquote, scientific perspective. And so it seems pretty obvious if you think about it a little bit longer that

something like the scientific method can't be the only way of obtaining reliable knowledge about the world, and instead there's lots of ways.

We all agree that there are good and bad ways of making choices for partners, and that the scientific method, repeated experiments in marriage, et cetera, are not necessarily the right way of going forward with that. We've learned as a society and instead we've got lots of ways of understanding how to make these kinds of decisions in life.

So I actually think that the argument that science is the only way of obtaining reliable knowledge about the world is an odd one.

I'll say maybe one last thing.

The last thing is just a comment on the kind of new atheist arguments which I see repeated quite often, as illustrated in this famous quote from Richard Dawkins, who has a great way of summarizing things. If you want to believe, he says, in teapots, unicorns or tooth fairies, Thor or Yahweh, the onus is on you to say why you believe in it. The onus is not on the rest of us to say why we do not. We who are atheists are also a-fairyists, a-teapotists and a-unicornists. But we don't have to bother saying so.

And so Dawkins says, if you have an imaginary friend like God, it's up to you to prove this imaginary friend exists.

Now, what he's really saying here is something about on whom the onus is. He says that the natural assumption is atheism. That's where we should start, and you have to provide evidence for God before I have to try to even bother thinking about something like whether God exists.

Now, if I were to make a claim today that I discovered this new virus in my lab, you would be justified to be an "a-new virusist" until I gave you evidence of that. But the real question is what if this is a question about something like God, if for God you take the source of all being, sustainer of the world—you know classic theological ways of thinking about God—then it would seem very odd to think that I could think about God and discover knowledge about God in the same way I discover knowledge about a new virus in my lab. It's just a completely different category.

And so what I think is happening in this argument and is happening again and again is that someone like Dawkins presupposes that there is no God and then uses that as a starting point to move on. And I don't think that's very helpful and I also don't think that's actually where the professional debate is.

So here's a slightly bold statement by Quentin Smith, who is a famous naturalist philosopher in Michigan who wrote in an article about ten years ago, or rather he complained that "Naturalists passively watched as realist versions of theism, most influenced by Plantinga's writings, began to sweep through the philosophical community, until today perhaps one-quarter or one-third of philosophy professors are theists, with most being orthodox Christians." And he basically argues in his paper that naturalist need to up their game and get back into the fray.

To first order, the professional argument is one that says: the problem isn't the evidence, but the problem is how we should weigh the evidence.

And my argument is that the way the evidence should be weighed is that at the start you have a choice. You can either start with something like the brute fact of the physical world or you can start with the brute fact of a divine will and purpose behind the physical world.

And the argument that someone like Plantinga makes about Dawkins and that style of language is that Dawkins' version of evidentialism presupposes no God before it makes its arguments and then asks whether there is or isn't a God.

I think that there is a much more fruitful way of engaging in this argument. I think it's a very interesting argument. But it is not an argument that one side obviously wins over the other side. It's a very fascinating and incredibly important argument for us as people and for society as a whole.

Ask yourselves: if I start from the assumption that there's nothing but materiality, where does that get me? How well does that explain things like fine tuning? How does that explain things like a whole set of what we might call signs of transcendence? How would it explain something like suffering ?

I can do that from both different starting points and the question then is, which of these two makes the most coherent sense of the world? That's really where the argument should be at.

And with that I have run over my time.

MR. CROMARTIE: Yes, well, thank you. Thank you very much.

DR. LOUIS: Thank you very much.

(Applause)

MR. CROMARTIE: Okay. Let me start with Kirsten Powers and then Frank Foer and Sally and Dave Campbell.

KIRSTEN POWERS, FOX News: This was really fascinating, so thanks a lot for this.

I'm curious as a Christian what you think about the Christians who do believe in the things like the Young Earth. I know some Christians who say, "Well, some people can believe in evolution and some people can not, and that's okay."

And I know Francis Collins says, "No, that's not okay actually. You need to believe in evolution. It's actually kind of ignorant to not, even as a Christian."

I'm just wondering what your take on that is.

DR. LOUIS: Yes. So I have a lot of sympathy for Christians who are skeptical about evolution because I think what they're skeptical about is evolution as a world view, and they find it hard to disentangle that from evolution as a mechanism, and so that's where I think the key difficulty lies.

I think the average person in the pew is right in saying, "We should do something about this," but what they should have done is say, "You know what? Whether evolution as a mechanism is correct or true doesn't tell me whether theism is correct or God is there or not." What they did instead is that they tried to attack the science, thinking that if they

could only undermine the science, then somehow the metaphysical problems would go away.

That trend has been unhelpful for Christians, and it's unhelpful for the way people perceive Christians. Certainly in the academy one of the big reasons why academics are skeptical about Christianity has to do with the fact that there are all these people that do not believe things that seem to them so obvious, like the fact that the earth is old. They think: How could any reasonable person not believe that? On the one hand I agree with the scientists. But I still have sympathy for the reasons Christians hold to views like a young earth.

The second thing is that—I wanted to make another point about this—which is that there's another reason as well why Young Earth creation science is very popular among Evangelicals, and I think that has to do with the structure of protestant Evangelicalism which doesn't have a centralized body of any kind. Everybody reads the Bible on their own and makes up their own minds, in the words of Nathan Hatch, you have "the democratization of American Christianity."

And that makes it difficult for Evangelical Christians to engage well with certain kinds of complex issues, like the relationship between evolution and science and faith. And the fact is that there aren't a lot of places where Evangelicals can spend their working lives thinking about these issues, which is what you need to do to properly assess them.

By contrast, if you look at the Catholic traditions, they've had a lot less difficulty with this, and been a lot more sophisticated on science and faith, and that's partially because there is something like a magisterium where these things get argued out among specialists for a long, long time before finally something like an encyclical comes out. There is no Evangelical magisterium on these kinds of issues. This leads to the "scandal of Evangelical mind."

MR. CROMARTIE: A follow-up and then Frank Foer.

MS. POWERS: Well, there's also this distrust, I think, of science by the Evangelicals I think for a good reason in a lot of ways. They feel that, for example, with abortion, you know,

they were told that it's not a real life, and they feel like when sonograms come out and it shows that it is a real life, and so they have this distrust of scientists.

And I'm just wondering, is there a way to bridge that?

DR. LOUIS: Yeah, so I think one of the ways of bridging it, I think, is by example. So somebody like Francis Collins is incredibly important because he is clearly a real scientist and also a real Christian.

Why was his book so popular? I think because it has that kind of classic evangelical conversion story with C.S. Lewis, et cetera, in it that everybody recognizes, but then also he's a bona fide great scientist.

For the average person who's not going to sit down and try to work through all the philosophical issues, what they really need is somebody they trust. I think it's also true that, you know, science often gets used to support all kinds of different views, and if it supports a view that you don't agree with, then it's natural to think something is wrong with the science. But a better approach might be to ask yourself whether the science does, in fact, tell you something about it.

So on the question of abortion, obviously science plays in on that, but the question about when we think life begins is a theological question. It's not really a scientific question in and of itself, at least if you look at the ways that different faith traditions have said, when does life begin, this has been not based on something scientific, but rather on other considerations.

MR. CROMARTIE: Okay. Frank Foer is up next.

FRANK FOER, *The New Republic*: What is God?

DR. LOUIS: What is God?

MR. FOER: No, I mean, I think you did a really elegant job of framing the two conflicting arguments in a way that make them both plausible and you reduced it to kind of clash of

philosophies, but I'm just curious, given—in your thinking about evolution and natural processes, how do you think about God?

What is God's role? What is God?

DR. LOUIS: All right. So I'm just—

MR. CROMARTIE: That's an easy one, right?

DR. LOUIS: What is God? Yeah, exactly. No, I want to just see.

MR. FOER: You have a slide on God?

(Laughter)

DR. LOUIS: No, actually there's a really good definition of God. I'm just looking for it, if I had it. I thought I had it on the side, it is from *The God Illusion*, which basically says God is a supernatural, super powerful intelligence.

MR. FOER: This is a question I turn over in my mind constantly. I'm Jewish, and in the Jewish literature the classic of this debate is Maimonides, which is kind of an impossible text to get through, and it doesn't necessarily—and there's a lot of code in it, but I'm just curious.

DR. LOUIS: Yes. So some people would say God is something like a transcendent being who contains within himself the reason for his own existence or something like that. I think you're right in pointing out that the question of what is God is a really important question that lots of people have disagreed with each other about. We think of gods, in plural. We think that maybe there's a high God and there's multiple gods.

I think traditionally Christians would say, and I think the Abrahamic faith—

MR. FOER: Yes.

DR. LOUIS:—would say that God is a transcendent being who—

MR. CROMARTIE: Personal.

DR. LOUIS:—would be personal or would be a person in some way. Something like—or a better way of saying it would be God is at least a person, in as far as we can think about that.

I personally feel like the idea of God as a person is the most helpful way of thinking about the Abrahamic tradition of God.

MR. CROMARTIE: Okay.

MR. FOER: Yes.

DR. LOUIS: So here's another way of thinking about it. So why is there something rather than nothing? Right? So you could say, well, maybe the world has always been in existence, forever and ever and ever. The more you start thinking about it, the weirder that becomes because that means you have an infinite sequence of causes , and how can something be truly infinite?

So maybe then the world just popped into existence out of nothing. Well, that's weird. I mean, there's nothing that we have in our ordinary experience that has something pop in out of nothing. So maybe the word came into being by something, a mind, that somehow transcends our materiality.

And the fact is that each of those three options is very, very different and not intuitive no matter how you unpack it—it's not like one of them is the scientific one and the other ones are nonscientific. None of them are scientific, but you've got to choose one of those three.

MR. FOER: Right.

DR. LOUIS: And so when you think about God, God is must somehow be a necessary being who contains within himself the reason to be, right?

MR. CROMARTIE: On this point, Shelby? Is it on this point?

SHELBY COFFEY, Newseum: Yes. I just was very interested in your unpacking a little bit what you mean in this instance by "person" and "transcendent." If you could just—

DR. LOUIS: Yes, so—

MR. COFFEY: It's such an interesting area.

DR. LOUIS: So transcendent, I really am feeling a little bit out of my depth here because I'm not a philosopher and I always get my—

MR. COFFEY: There are not too many philosophers here right now—

DR. LOUIS: Okay.

MR. COFFEY:—with a major exception.

(Laughter)

DR. LOUIS: So transcendent is really, I think, a complex word, but it really means something more, I think, something more than just the material world of physics.

MR. COFFEY: Right.

DR. LOUIS: And so you could call that supernatural, I think that would be a way of thinking about it, and I think something like God must be supernatural. Otherwise—having said that, there are theologians who try to blur those categories, but I think, you know, saying the traditional God of our own faith is supernatural and transcendent means in some sense something outside of the ordinary cause and effect of physics.

MR. COFFEY: As we perceive it.

DR. LOUIS: As we perceive it. Yes, that would be—

MR. COFFEY: And "person"?

DR. LOUIS: So "person" again is a traditional theological concept, that God is somehow personal or that God is at least a person, and so you could think of God as a force, right,

a yin and yang force, but I think God is something like a person, somebody who willed the creation into being.

Christians would traditionally say that God also wants the good of creation.

MR. CROMARTIE: We could stay on the whole theological questions of the attributes of God and existence, but I think we should move it now back to religion and science if possible, although it's the Faith Angle Forum. So if you've got theological questions, you might as well ask the physicist from Oxford.

(Laughter)

You're up, Sally Quinn.

SALLY QUINN, *The Washington Post*:Well, first of all, I want to know what you and your wife talk about when you're alone together.

(Laughter)

DR. LOUIS: Well, Sally, I'm quite lucky that my wife works on the development business interface. So that's a much easier thing to talk about. We actually spend a lot more time actually talking about her work than mine. It's more easily popularizable. If she's on an airplane it's harder for her to shut people up. It usually has the opposite effect. So we talk about that, but we also talk about some of these topics. I think she's been very helpful for me in trying to sharpen my thinking about this.

MS. QUINN: Is she also Christian?

DR. LOUIS: Yes, she is. She's sitting right there.

MS. QUINN: Oh. I'm interested in—I have a question about science, but first I want to know what kind of a Christian you are.

DR. LOUIS: So I'm an Anglican.

MS. QUINN: Oh, one of the few left.

DR. LOUIS: Well, one of the few—

MR. CROMARTIE: Oh, no, no, no. Professor Berger can answer that for you. It's growing and booming all over Africa.

MS. QUINN: No, no, I thought that was Pentecostal.

MR. CROMARTIE: Just not in England though.

MS. QUINN: Yeah, yeah.

DR. LOUIS: So I'm an Evangelical Anglican.

MS. QUINN: Okay.

DR. LOUIS: So I go to a pretty run of the mill church. It's interesting. In the U.K., for example, among Evangelical Anglicans, evolution hasn't been that controversial. In fact, when Darwin first came up with his theory of evolution even among Evangelicals, there was a widespread acceptance that this could be the way that God created the world.

Just imagine this, right? So I come to you and I bring you this fully formed train from Legos. That would be cool, but it would be even cooler if I could put a bunch of Lego blocks in a box, shake it, and out comes a train. Even if the train has a few scratches on it when it came through the process, you could imagine that someone might think that it is even more glorious for God to create in that way than it would be if he created it all at once, at one time.

And if you look back at theological history, one of the questions that people like Aquinas and Augustine did worry about was this question: did God create it all in six days or was it all created at once or was it created with potentiality. So the questions about could God have done this in different ways, and the idea that the Genesis text wasn't meant to be a journalistic account of the order in which God made things is something that you see throughout history all the way back to Origen, the great church father in the Third Century who said, "what man of intelligence would say that this text is meant to be taken literally if the sun and the moon were not created until the fourth day. So how can you have a day

and a night without a sun and the moon?" Now that's not a modern science. That's something that everybody would have noticed throughout history.

So there has always been some diversity in thinking about these things, and so British Anglicans and Evangelical Anglicans, have traditionally been aware of that and not seen evolution as such a huge controversy.

MS. QUINN: Frank actually stole my question, and it's something I'd love to get back to, but what I'm really interested in, I know Francis Collins and I've talked to him a great deal, and interestingly he has been the closest advisor to Christopher Hitchens during Christopher's illness, and I asked Christopher who had given him the most comfort and solace, and he said Francis, which I thought was particularly interesting.

But what I'd like to know is as a scientist, being a scientist has that strengthened your faith or weakened your faith or is it the same?

DR. LOUIS: So it's interesting. For me it strengthened my faith.

MS. QUINN: Why?

DR. LOUIS: For the following reasons. I think that when I look at the way the world has been put together, something like this story I told you about from Dirac's special relativity and quantum mechanics. I think it's amazing that something like the unreasonable effectiveness of mathematics would hold for the world, that we could peer so deeply into the structure of the universe, and to me that resonates. That's a sign of transcendence. That points to something outside of us.

So it's those kinds of things that I think strengthen my faith rather than weakened it, and I say that partially because we do live in a world where people question these things all the time, and so I think it's important if you're interested in these things, if you're intellectually driven as I am, or somebody that's typically motivated by intellectual things, then it is important that as you dig deeper into your subject. And it is gratifying if something about it shows you something about God, and certainly science has done that for me.

And I mean, I've got quite a few colleagues in Oxford. I think at least 15 of my physics academic colleagues are active members of their churches, mainly Anglicans, and every single one of them, if you asked them has science strengthened your faith, they'd say, oh, yeah, they think it has, and sometimes for the reasons that I've given you.

MR. CROMARTIE: On that point, Ard, I once had a conversation with Christopher Hitchens, and he said he was in a meeting, a conference with fellow atheists, and he and Dawkins were on the panel together and someone asked, "Mr. Hitchens, are there any arguments in all the debates you've been a part of, is there any argument that's given you the slightest pause?"

And Christopher, much to the consternation of Richard Dawkins, said, "Dawkins is a friend of mine and he got angry with me." Christopher said, "Yeah, well, there is one, and that's the anthropic principle and the design of the universe."

And Dawkins got mad at him for even saying that much, which tells you a little bit about Dawkins, but explain then, Ard, if you can summarize the anthropic principle, and if it didn't hold, what would happen to the universe.

DR. LOUIS: Well, yes. The anthropic principle is, well, I prefer to use the fine tuning rather than anthropic principle for technical reasons, but it's basically a generalization of that example I gave you with Sir Fred Hoyle, which was the idea that the universe is very finely tuned to allow life to exist as a whole.

So you could imagine that the constants of nature could be such that they could show quite a range of values. Think about the external temperature that humans can live in. I can range quite a bit, you know. You can find humans up in Antarctica. You find them in the Sahara Desert. They can range over quite a few degrees, but our own internal body temperatures really can only go up and down by a little bit, and we either die of fever or we die of hypothermia.

And so what actually happens is that the universe, rather than having this broad range of possibilities, seems to have a very, very narrow range of possibilities. So it looks like it has been fine tuned; in fact it looks a lot like it has been highly fine tuned for life.

Now, one way that you could explain this would be to say, well, you know, if it wasn't that way, we wouldn't be around, which is true. But then the counterargument would be to say the analogy is a little bit more like this. This is a famous argument from John Leslie, a Canadian philosopher, who said, well, imagine that you are put in front of a firing squad and there are 50 trained marksmen, and they all point and they shoot and everybody misses. Now, that's a little bit what it's like, the fact that the universe seems to be fertile for life because so many things seem to be just right. It's almost like every single one of them didn't quite hit you.

And in that firing squad argument you could say, well, you know, the fact is that they do executions all the time, and occasionally one sharpshooter misses. So occasionally all 50 of could them miss, and that's why I'm free. So I'm not going to worry about it.

But I think most of us would think, well, you know, why did that happen? Was there some kind of collusion going on? Was this a put up job? I think that's about as far as you can get with this interesting argument. I like to use the fine-tuning argument because in general there is a popular assumption that the scientific arguments somehow mitigate against faith, whereas, I think on balance they seem to be more suggestive of something like a divine purpose behind the world, but I don't think that by itself it is conclusive one way or the other.

But I think it is very interesting. I personally find the unreasonable effectiveness of mathematics a stronger argument, a more fascinating one.

MR. CROMARTIE: The what again?

DR. LOUIS: The unreasonable effectiveness of mathematics. I find that a stronger argument in favor of God, but that's partially on aesthetic grounds.

MR. CROMARTIE: Define that again.

DR. LOUIS: So that's something like the example I gave you where you take quantum mechanics, a theory of very small things. You combine it with special relativity, a theory of very fast things, and the only way that it works is that it predicts something like antimatter. We call that the unreasonable effectiveness because it seems unreasonable

that abstract mathematics, in this case a particular form of algebra, would describe the way the world works in ways. It is something very extraordinary, I think.

MR. CROMARTIE: Okay. Andy Ferguson and Peter Berger, and I have others.

ANDREW FERGUSON, *The Weekly Standard*: I had a question about ID, which you had sort of lumped in there with Young Earth creationism and so on. Is it another one of these surface theories that Christians hold that is sort of unnecessary, you know, like Young Earth creationism? You really don't have to believe in that to reconcile it with the history of the universe. I mean, is it just a very high class version of that or is there actually something to it?

DR. LOUIS: Well, so the difficulty with it is partially in the word "intelligent design." Because almost all theists would believe that God intelligently designed the universe. So I talk about capital ID. I say this is Intelligent Design of the type that comes out of Discovery Institute.

I've been rather fascinated by why it has been so popular because it doesn't actually solve many theological problems like questions of what about Adam and Eve. It doesn't actually solve any of them, and it makes some questions like theodicy questions, I think, worse. So questions about why is there suffering in the world; you know, if God designed the bacterial flagellum, if God specially intervened in nature to design and make the bacterium flagella motor work, which is what makes E. coli more virulent and makes you more sick, then that just seems odd.

Although they would disagree with this assesment, I still think that fundamentally intelligent design is a kind, or at least certain versions of it are like a God of the gaps argument, which says that there's this gap, this thing we don't understand, and therefore we put God into it. On theological grounds I'm unhappy with that because I think that the traditional way of theistic way of thinking about what is science is that science is studying the ordinary ways that God sustains the world, and what ID is really saying is these ordinary ways that God sustains the world are not sufficient to generate something like biological complexity. So therefore, God had to do some kind of miracles in history, in natural history.

There is a famous arguments between Newton and Leibniz about the planets. So when Newton when he came up with the law of gravity, you had the Earth going around the sun, it explained the elliptical orbits of Kepler. Jupiter also goes around the sun, and Newton could explain its elliptical orbit because of gravity. It's a great advance.

But then you start thinking about it a little bit more. Actually Jupiter also pulls on the Earth, right, because of gravity, and Mars pulls on the Earth and Venus pulls on the Earth, and so when Newton did his calculations it appeared as if the solar system was unstable. Thus, said Newton, God must occasionally reform the plants. He must do something like send a comet through or something to fix the planet.

And his great adversary Leibniz in a series of letters contested this because Leibniz said this would demean God's craftsmanship if God didn't make it right in the first place, and Leibniz said, "I also hold that God doesn't do miracles for wants of nature but for wants of grace." In other words, theologically the reason why God would do miracles is for reasons related to redemption history. So Christians would say, for example, that when Jesus rose from the dead that would be a miracle in the sense that was not something that has God sustaining the world in the ordinary way. That's something extraordinary.

But Leibniz said God doesn't do that for the wants of nature, but for wants of grace. That same argument applies to intelligent design, and given that it doesn't solve any theological problems or difficulties with interpretation of scripture and given that it has these other problems, these theological problems, I don't quite see why it's so interesting for Christian apologists.

Having said that, I do understand why it's popular, and I think it's popular because it makes it seem like somehow evolution less purposeless, right? If you think about evolution as being a purposeless process, then this is a way of injecting theology or purpose back in. I just don't think it's the right way of doing it.

MR. CROMARTIE: Okay. Professor Berger.

PETER BERGER, Boston University: Well, unlikely though this may seem, I want to introduce a sociological note into this.

DR. LOUIS: Okay.

(Laughter)

DR. BERGER: And I found this fascinating and something I knew very little about, the science of it, but when you were talking one name occurred to me, which I hope doesn't offend you, Mary Baker Eddy.

DR. LOUIS: Yes, okay.

DR. BERGER: And I'll tell you what's sociological about what I have to say. I was thinking about if you compare Darwinists not in the sense of people who think Darwin was correct as a biologist, but as a philosophy of life. What they have in common with much of what happens in the Christian side, including intelligent design, is a belief in science, and a belief that science can be the ultimate arbiter of world views, which Mary Baker Eddy believes. So she had to write the book claiming that Jesus was a scientist.

And I think one thing you said which I totally resonate with because I have the same thing when it comes to social sciences. There are different ways of getting to the truth, and I thought I'd give you just one example. I think—and it's purely personal—the most beautiful place on earth is Lake Como in the north of Italy, and I was there for a conference a couple of years ago. I was there with a friend and I said to him, "Look. I think just looking at Lake Como is proof of the existence of God." Okay? If you like an intelligent design sort of argument, but how on earth could I call this science? And just looking at Lake Como I imagine different types of people looking at this.

A Christian, in my case I was not there as a sociologist when I said this. As a Christian this is so beautiful God must have created it. If I were a geologist, I would look at this in terms of—I don't know—rock constellations, volcanoes, Ice Ages produced this lake. If we look at it as an engineer, I might ask couldn't I build a bridge across it which would facilitate traffic.

And there are many others. I mean, there are at least ten different—let me use again a term I used yesterday—relevant structures within which I could look at Lake Como, and science is certainly not the only one.

So I think not understanding three-quarters of what you were talking about, I understood you, but I mean the science behind it; I totally agree with what seems to be your basic thrust. There are different ways of looking at the world, and the idea that from a Christian point of view one has to have a unified view of the views I think is a complete mistake, and that's sociological because science has achieved a status of privileged knowledge in the modern world for good reason, because science has been so successful in creating, making possible technology that has made all of our lives easier.

So science has become a kind of magic key to everything, and it's a misunderstanding, and I think whether one is a Christian or atheist, one can say science is a very useful way of looking at the world. It's not the only one.

DR. LOUIS: Thanks, I think there's not a lot to add, except that this is a quote that I think you might agree with.

This is from Sir Peter Medawar who is a famous Nobel Prize winner at Oxford, an atheist, who said "that there is indeed a limit upon science is made very likely by the existence of questions that science cannot answer and that no conceivable advance of science would empower to answer. These are the questions that children ask, the ultimate questions of Karl Popper. I ask the question how did everything begin, what are we all here for, and what is the point of living. It is not just science there, but the metaphysics, imaginative literature originally that was turned for answers to questions having to do with first and last things."

I think that's fascinating. Thank you.

MR. CROMARTIE: Okay. David Campbell.

DAVID CAMPBELL, University of Notre Dame: My question, I think, picks up on the core of what Peter is getting at, I think. I was curious, Ard, and thank you very much also for the presentation. I found it fascinating, and it got me thinking about this question of evolution versus creation, which you know is this endless debate here at least in the States, and I was actually interested in your perspective on how evolution or the theory of organic evolution should be taught to, you know, think high school kids, adolescents

who might be learning this for the first time in a biology classroom who themselves have a religious background.

I mean, it seems to me that in the States that's the big question, and most of the kids sitting in the classroom have some sort of religious background. Now, that's going to vary. In some cases they'll be from faiths that are perfectly fine with evolution, and in other cases they're going to be from faiths that are not necessarily fine with it.

And I'm just curious from your experience whether you have any thoughts on how biology teachers should approach that question. Should they just ignore the theological implications and just teach organic evolution and pretend like there is no debate? Should they acknowledge it? How should they handle it?

DR. LOUIS: That's a really excellent question. First of all I should say that we should not underestimate how smart young people are. I occasionally give talks like this to secondary school students, and often their questions are the toughest and the sharpest.

I think that science more generally needs to be taught—not only science needs to be taught, but also something like a sociology or a philosophy of science or basic versions of it need to be taught to secondary school students at the same time, because the default option is that it often gets taught as if science is this privileged way of knowing and everything else is somehow irrational. That's the first step.

So it's really a broader question, i.e what Professor Berger was pointing out, how do we get to the truth. This is just one way. There are multiple ways, and once you realize that, then it kind of deflates the antagonism that people might feel toward any kind of new science that they're learning because it no longer is so obvious that the science is telling them who they are or how they should live.

So let's say somebody from an Evangelical Christian tradition, I'm sure from a Mormon tradition it must be the same, is that you say, it is God who tells us who we are and how we should live, and I think that's true of any theistic tradition. It's not science that tells us who we are and how we should live.

DR. BERGER: So may I add something?

DR. LOUIS: Yes, please.

DR. BERGER: Of course I haven't had the problem that you raise, but I had the problem in other situations. Teaching sociology of religion. Okay?

DR. LOUIS: Yes.

DR. BERGER: To people who are very religious, and I teach it in a very objective way. In fact, when I first taught to undergraduates, the rumor was I must be an atheist.

Well, what I do is simply say—you like to ask embarrassing questions like what's your faith—students will ask that, and I will say at Boston University, I would say, "I'm not being paid to teach you about my faith. If you're interested"—and I would say, "I'm a Lutheran. I'm a Christian, but if you're interested I'll be happy to talk to you about it outside. Now, let's get back to the sociology of religion."

That's what I do, somewhat similar to your issue.

DR. LOUIS: Somewhat similar, except I only have one caveat to that, which is to say that students often don't hear anything religious mentioned at all in the course assume, therefore, that you're an atheist, and they may often assume that you you're actually saying a lot of things that you're not really saying.

So I think actually for secondary school students, to teach them about evolution you want to first of all try to rid your textbooks of potentially ideological statements, and actually sometimes there are ideological statements in secondary school textbooks, as much as possible.

I think the other thing that helps students tremendously is to see that there are examples of people who have thought differently. You could say: Well, if you want to think Christianity about this, read a little bit by Francis Collins. That's his view. Here's somebody else. That's their view. Here's somebody else. That's their view."

And by showing that there are multiple views, I think it hugely deflates the kind of existential questions that students attach to the science. Then you can just teach them the science.

My guess is that teaching sociology of religion is even harder sometimes for people that have religious backgrounds because they're not used to thinking about or looking at their own faith tradition in this kind of sociological way.

That's not a very satisfactory answer, but—

MR. CROMARTIE: No, that was very helpful.

Okay. Tim Dalrymple is up.

TIMOTHY DALRYMPLE, Patheos.com: Yeah, thanks very much, Ard. Theoretical physics was actually my first love, and then I went into some—my doctorate is in philosophy of religion. It amazed me how much we ended up asking the same questions.

DR. LOUIS: You didn't lapse at all.

MR. DALRYMPLE: I didn't, and I was reading books that were largely philosophical interpretations of 20th century physics that were asking a lot of these questions, and they end up being the same questions that you're asking, certainly philosophy of science, but also philosophy of religion courses.

So I have two questions. One is methodological, and it has to do with the question of whether you feel—this is an issue in the natural sciences, social sciences, and study of history, whether you feel qua physicist that you have to bracket potential inferences to the supernatural.

And this comes up in arguments over intelligent design, even the more sophisticated forms where people say, well, believe whatever you want to believe as a Christian but qua scientist you really can't infer to non-naturalistic explanations.

So how do you feel about that?

Number two has to do with as you'll know, there have been attempts to have a non-infinite universe and yet one that doesn't have a beginning, right? And Stephen Hawking did work on this, and the multiverse theory is another way of trying to account for the universe without it exactly having a beginning.

And I was curious what you think or what's the current state of thinking in the field on whether that's been successful? There's been a desire to avoid a beginning since it seems to require something like divine explanation, and if we can do away with the beginning and have time emerging at the same time as space is emerging and everything, then maybe we don't have to. It seems trying to avoid the obvious theological implications, but what's the state of thinking on that?

DR. LOUIS: Great. So those are two really excellent questions. The first is really a question about what some people call methodological naturalism, which Peter Berger also advocates for in his book, and also he just did it now, and that's the argument that when you do science, you shouldn't assume that there aren't going to be miracles in the lab essentially. That's one way of thinking about that—that's one way of parsing that out.

So as a Christian, and I think this is going back to, in a simple way perhaps, the history of science, which is the development of the idea that the world would be regular, the idea that the world would be intelligible, and that the world would be uniform, by which I mean if I do an experiment in Oxford, somebody in Cambridge if they're smart can get the same results.

(Laughter)

Those are things which we are—

PARTICIPANT: Which is never a given with a person at Cambridge.

DR. LOUIS: You know, there's a famous saying that in Oxford people know everything about nothing, whereas in Cambridge they know nothing about everything. So it's all in fun.

To us it seems obvious that those things must be true because we're brought up with that with our mother's milk, but it's not obvious to most people in most of history. In Gabon where I grew up a village, it wasn't at all obvious that the world should be rational or uniform because nature appeared to be capricious, and who knows what the spirits are going to do?

So you can trace back some of these principles to deep theological principles of a God who sustains the world and sustains in a regular way. As a theist I believe God sustains the world, which means that if God were to stop sustaining the world it would not slowly grind to a halt, it would actually stop existing. That is, I think, the classic theological position.

In other words, when I study science, I study the ordinary ways that God sustains the universe, and I wouldn't expect there to be miracles. So I would say that on theistic grounds I expect something like methodological naturalism to work. I don't like that word because it actually has a lot of other connotations to it, but I expect, in fact, no miracles in the lab because, following Leibniz, I don't think God does miracles for wants of nature.

So for that reason the way I do science as a Christian is virtually identical to the way I would do science if I didn't believe in God.

On the other hand, I think it's quite an interesting and daunting task for an atheist or a naturalist to derive from some kind of first principles why something like science would work. It's actually not that easy to do.

It is easier to do if you start from a theistic point of view. So for all those reasons I don't expect to find miracles in my lab. You know, my students, I've got about ten research Masters and Ph.D. students working for me. This is why I can be here. They're back doing all the work while I float around talking about things, and I don't ever ask them, you know, what they believe—you know, one of my students is quite a serious Muslim. A few of them are quite convinced atheists, but when we sit around talking about science, none of this ever matters.

This is one of the great things about science. Obviously when we start thinking about something like fine tuning where actually scientists by and large agree that that's there, the question what does that mean is a very different question, and there we disagree, but the reason we disagree is because of a series of other metaphysical presuppositions, not because we disagree on the science.

So the difficulty I have a little bit, which is behind your question, was the rhetoric around methodological naturalism that has been used a lot by the ID community, and the difficulty I have with that is that it does in the end sound a little bit like wanting to smuggle some kind of miracles—well, one difficulty is that the inference, the philosophical inference, that they're trying to extract are from scientific arguments that people disagree on. So I'd rather do my philosophical inferences on things that we at least scientifically all agree on. That's a much cleaner thing to start from. Maybe that's a better way of saying it.

And so this is why something like the Intelligent Design movement, the Seattle based, Discovery Institute based movement, I don't think it's been that fruitful yet. I actually think fundamentally biology is far too young of a science to try to extract these kinds of philosophical inferences from. So let's say something like the fine tuning that I showed you in cosmology. The reason we can do that is because physics is simple. In physics I can calculate what happens if I change the constant. I can tell you what's going to happen.

In biology I just can't do it. If I change it a little bit, who knows what's going to happen? And so to do those kinds of arguments you have to often do counterfactuals, which you can do in physics. You can say, well, what if the universe was different. What would it be like? I can do that in physics.

But in biology if I ask what if biology was different. I have no idea. I don't even understand biology. So I think it's just too premature to make those kinds of arguments. That was your first question.

Your second question was a no beginning question. So I think I can be shorter on that. I don't think that the no beginning universe theories have had a huge amount of traction,

and this is partially because they end up getting huge problems with causality, and the multiverse theory doesn't actually solve the beginning problem either.

So one way of thinking about this is to say even the vacuum, the physical vacuum is full of things happening all the time. So think of the electrons and positrons I told you about before. They can spontaneously appear out of the vacuum and then disappear again. They appear and disappear all the time, and so when Hawking famously said, you know, "I have this theory that the universe can appear out of nothing," what he meant by nothing was actually the physical vacuum, which is a hugely structured, complicated thing.

And so the problem isn't can the universe pop out of the vacuum. Maybe it could; maybe it couldn't. That's a different question. The question is where did that vacuum come from and why is it so incredibly structured and who breathed the fire into the equations in the first place?

It's just simply a question that science I think by definition can't answer.

MR. DALRYMPLE: Quick follow-up question. Do the laws of science themselves need explanation? I remember coming to the end of one book by Paul Davies, that was saying we might be able with these laws to explain the universe in the whole, but we can't explain where the laws themselves came from.

And I just thought it was an interesting—and maybe that's what you're getting at.

DR. LOUIS: Maybe that's what I'm trying to say. So I think what's really interesting is that there are these laws. They're incredibly beautiful, and even something that we call the vacuum is hugely structured. So electrons and positrons which are matter, m, can appear out of E, energy. There's basically energy in the background of the universe, and matter can pop out of it and then pop back in.

And that's something you might call nothing in ordinary language, but not really nothing. It's a hugely structured nothing, and the question is: where did those laws come from?

So all the questions about like what's the origin of the universe, they actually boil down to where do those laws come from, and the fact is those laws are incredibly structured and beautiful and intricate, and it would be very odd if they had always exist

MR. CROMARTIE: Okay. Paul Edwards, you're next and then Peter David. And, by the way, after Peter David, Michael Flaherty and Karen and Fred Barnes and Shelby. I just want you all to know I've got you.

Go ahead, Paul.

PAUL EDWARDS, *Deseret News*: You've addressed this a little bit, but I'd like you to speak directly to the issue of miracles. So so much of sacred history as recorded has these miraculous events. The sun stands still for Joshua. The Red Sea is parted for Moses, and so on. How does that fit into a scientist's thinking to talk directly about miracles?

DR. LOUIS: Sure. I've actually—if you're interested in this, if you just type my name in and miracles afterwards in Google, you'll find an essay I wrote on the topic for the BioLogos Forum, which will give you a lot more background.

One of the ways of thinking about this is that if God sustains the world, then the ordinary ways he changes the world are the laws of nature that we study. The extraordinary ways would be what we call miracles.

And so one analogical way of thinking about this would be in terms of music. When you listen to a great piece of music, what makes it pleasant is the fact that it has a lot of regularities, a lot of laws. It's in a particular key. But a great composer occasionally puts an accidental in, something which is out of the key, and that's what makes the music really great. If it is just accidentals, okay, it would be something quite dissonant, but putting a few of them in is what makes something really great.

So that would be an idea of why God normally sustains the world in ordinary ways, but sometimes does it in extraordinary ways. Now, theologians have thought about this for a long time. Why does God do miracles? And this is again the Leibniz quote, which is God does miracles for want of grace. So God does miracles for redemptive purposes.

So we believe that God does miracles in the biblical history, which once you assume that there's something like God—it is not surprising that God could do miracles. Science has nothing to say about miracles really because by definition it studies regular things. It's something outside of science.

So that's maybe a short way of answering the question, but we need to look in the New Testament. The Greek words, that we translate as miracle include "dunams," which means a manifestation of power, "semeion" which means a sign and "teras" which you might call wonder. That word "teras" or miracle or wonder is always used together with one of the other words, a sign or a manifestation of power.

In the popular culture, we only think of a miracle as a wonder. It's an amazing thing, like a magic thing. But in the Bible the word is always connected up to either a work of power or to a sign. There's always a purpose to these things, and that's an old theological concept that you see right through Scriptures, and I think that generates a pretty coherent story about why God does limited miracles.

And obviously if somebody were to come and to say, you know, "I was sick. I had cancer and God healed me and now I'm better," science can adjudicate that to some extent. They can do a scan before and a scan after, and if there's no difference, then probably there wasn't a miracle, but if there is a difference, then it makes it more likely that there was a miracle. But it's always going to be difficult.

And even like to push on something you probably are already thinking about, what about scientific studies of miracles? And so I was talking to Kimon about this because the Templeton Foundation has sponsored a few of these where they do a double blind test praying for people that are ill in the hospital and seeing which ones get better quicker.

Well, first of all, it's odd because it treats it prayer like an antiseptic. The second, it's odd because if there is a God, then why would that God open himself to this kind of scientific test, as if he was a giant slot machine in the sky?

So by very definition if you assume that there is a God, it would be very highly unlikely that you're going to measure something. If you say there is no God, it's highly unlikely

you're going to measure something. So why do the experiments? It's probably a poorly posed question.

MR. CROMARTIE: Okay. Well, Peter David has a very nicely posed question I'm sure.

PETER DAVID, *The Economist*: Thank you very much for your talk.

I was listening to it as a very nonmilitant, nonaggressive atheist, you know, without the, I hope, the charmlessness of the aforementioned scientists you discussed.

(Laughter)

MR. DAVID: And I was really troubled by it in a way, and I think my trouble was encapsulated by Peter Berger's observation when he said he looks at Lake Como and thinks it's astonishingly beautiful and then sort of infers from that the existence of God.

And a lot of your talk seemed to boil down essentially to the same thing, which is that you look at the beautiful phenomena of nature and physics and the loveliness of the equations and you make a sort of similar inference.

But you're talking to us in a different way because you're wearing the mantle of physics and the rigor that implies, and the sort of nugget of what you gave us that was not just admiring the beauty and inferring God was the fine tuning.

DR. LOUIS: Yes.

MR. DAVID: The fine tuning sounded almost as if it's a bit like, you know, the way one can look at equations and physics and impute the existence of some missing force or impute the existence of antimatter or, you know, that there must be a Higgs boson, but then when physicists have done that, they've gone away and devised an experiment to locate and weigh the antimatter and find the Higgs boson.

So my question to you is presumably unanswerable, but maybe not. Can you imagine looking at, you know, the fine tuning and then going away and devising an experiment to

prove the existence of the God that you infer from the sort of improbability of what you observe if there is no God?

DR. LOUIS: Well, that's a very interesting question. I think one of the reasons why I like the fine tuning argument is because it is not too dissimilar, I think, to what Professor Berger was saying, which is that a lot of our evidence for God has to do with the way things are, and they're often hard things experiment on in that sense.

So let me think about the fine-tuning. How would you do an experiment? So one possibility would be that somehow once we get the fundamental theory that combines gravity with the other three forces, then that will fix some of these constants that are free to move. That's the direction that physics is now going.

And so we'd have to perform experiments as well as to see that we made the right choice for doing that, but let's say that somehow we were able to do so. That would still not take away our wonder that once those forces, the constants were all fixed, they allowed something like life to occur. The only experiment I can think of would be to observe a whole bunch of universes and see that either there are many universes, first of all; so observe that there are many universes, and then by chance one of them might have life, one might be fine tuned for life, that would be one kind of experiment that you would do.

It still wouldn't disprove God. It would make the fine tuning argument less strong. But it's a hard thing. I don't really see how you—it's a little bit like saying the unreasonable factors of mathematics, could I device an experiment to show why that is the case? And the answer is I don't think I can.

And so I think what Peter Berger and I were saying is that there are certain types of truth or knowledge that are not necessarily accessible to the scientific method as we're used to using it, no matter how hard we try, but—

MR. DAVID: But you see my problem in a way is that, you know, if you enter this debate as a physicist, you're sort of laying claim to the rigor of mathematics and physics as part of your explication for the existence of God, but in effect what you're saying it seems to me is not that different from just, you know, what millions of people have done for

millennia, which is just look at the world around us and admire its complexity and its beauty and infer the existence of God.

There's nothing kind of in the mathematics that I understand that you've shown us that sort of, you know, drives you to a different conclusion. So why should we privilege—and maybe you're not asking us to do this—but why should we privilege your observation because you're a physicist?

You may be not asking us to do that, but—

DR. LOUIS: No, I think that's helpful. I understand that. I think you're right in saying that I should not be privileged with essentially a philosophical topic as a physicist. Neither should an atheist be privileged because they're a scientist. In practice the reason why people like listening to me is because there's a kind of an indirect sense out there that the atheists are allowed to privilege science. Science and atheism come together.

And my argument would be, no, that's not true. Neither is it true that the fact that I'm a scientist makes me necessarily better at adjudicating this, just like the fact that I'm a scientist doesn't make me necessarily a better lover. Maybe it has the opposite effect.

(Laughter)

Because they're different categories in many ways. So I think that's helpful.

I think maybe one of the points I am trying to get at is to say that science itself, I think, doesn't tell us that there is no God; and it doesn't tell us that there is a God. It doesn't mean it's completely neutral.

Anyway, that's a very complex and interesting argument. It's interesting if you read Francis Collins' autobiography. He talks about his own turn to faith, and he says he's walking in the Virginia mountains one winter, and he sees a frozen waterfall, and he falls on his knees, and he has a conversion experience.

Now, I very much doubt that Francis thought that this was a miracle. He understands how water freezes, but what he's looking at is something of the beauty of the way the world is made, and that seems to point towards God.

So really this is a philosophical question, and maybe I'll make a little segue just for fun. So I very briefly mentioned this argument among of philosophers about whether God does not exist, and one of the most prominent philosophers of religion who argues in favor of theism is a man called Alvin Plantinga, whom Quentin Smith is complaining about. Plantinga says, well, if there is a God, it would not be surprising that that God would put in us and in everybody a "sensus divinitatus," a sense of the divine.

And so if you start from the assumption that there is a God, it would be strange if that—and if you assume then, which is not too strange an assumption, that God would somehow want to have some interaction with us, it would be strange if our ability to access God would be completely dependent on our education and our intelligence.

So if we posit God, something like a "sensus divinitatus" must be around. Plantinga furthermore develops a very sophisticated theory of warrant. He argues that you could be warranted to believe in God even if you don't have evidence for it.

And the way he started this out was with very famous book in 1967 called *God and other Minds*. Let me try this on you journalists and see what you make of this. Plantinga linked to a well known problem in philosophy: I look around at you and I think that you all have minds that are independent. You're not robots that are somehow controlled from somewhere else. That's a very strong sense that I instinctively, intuitively have.

But it's very hard to prove that based on evidence, okay, because no matter what you do, somebody who thinks that you all are all robots would say: hat's exactly what a clever robot would do. Yet we all think it's rational to think other people have other minds. So by analogy Plantinga says it may be that this "sensus divinitatus" in the same way generates in us an instinctive sense that there is something outside of us, and it would therefore be rational to believe in God, even though we can't ourselves assess the evidence for fine tuning, for example.

And I think that if I start from the assumption of brute fact of a divine will and purpose behind the world, then it would not at all be surprising that that's the way the world is. In fact if you look around, even though there are many different kinds of religions, almost all of them do have a sense of a high God who makes moral demands on us of some kind or the other. Even in polytheism this is often the case.

So given that this is so common, so widespread, it suggests almost empirically that there is something like the "sensus divinitatus" in us. It actually suggests that something in atheism is very unnatural and you have to work really hard to keep it up because it is not where we naturally go.

That's a very fascinating piece of argument, but maybe that's getting off the topic.

MR. CROMARTIE: No, no. The book is *God and Other Minds*, published by Oxford University Press. Alvin Plantinga just retired from Notre Dame as chair in philosophy there.

Michael Flaherty is next.

MICHEAL FLAHERTY, Walden Media: Again, fantastic presentation, Ard. Thanks so much.

This follows up a bit on David's question about how you teach kids about all of this. One of my favorite scenes from the Simpsons is when Homer becomes famous and someone asks him, "Well, what's so great about being famous?"

And he goes, "It's not the money. It's not all the articles, but it's the ability to write a really crappy children's book."

(Laughter)

Anyone who's famous can do that, and Richard Dawkins has just done that using his celebrity to write a really crappy children's book called, I think it's the—what's it?—*The Magic of Reality* or something like that.

And Deepak Chopra wrote a great review on it in the *Huffington Post*, and he called him a one man society for the suppression of curiosity.

(Laughter)

And which I think when you get back to your whole philosophical idea—and that's what I like about it—is you know, ultimately there is that iron bound approach that Dawkins has which is, "Here is reality. Don't question any more of it. Just listen to what I say."

And I was wondering two things. First of all, what's been the reaction about Dawkins writing this book in the scientific community, and second, what is the overall reaction to the fact that, you know, the one thing that makes science fun, as you would say, that whole idea of being curious and asking questions, he doesn't seem to be so open to all of that.

DR. LOUIS: You're asking me a number of interesting questions. One is what's been the scientific reaction to this most recent children's book, and I simply don't know because now is too soon. I think in general, you know the scientific guild does not always like popularizers. So famously Carl Sagan was nominated for membership in the National Academy of Sciences, and was one of the only people ever to be voted down. You know, scientists want to be very careful about the details and get every single i dotted and t crossed, and to popularize well, you need to broaden things and say sometimes things that you might want to qualify and put footnotes on. So even someone like Dawkins is often disliked by colleagues who think he's too much of a popularizer.

On the other hand, we also know as scientists that it's not good if we don't popularize because the public deserves to know what we're doing and deserves to have a way of weighing what we're doing. Otherwise we're basically claiming ourselves to be some kind of priesthood, which I think is wrong.

So in that sense I think we have an ambivalent view of someone like Dawkins. I think the tide is turning a little bit and the people are tired of all this anti-religion rhetoric, and I think they recognize that if you make science and atheism seem to be connected, then people that don't hold to atheistic points of view might start distrusting science. I think

that has happened in the United States on a large scale, and I think that's fundamentally dangerous for science.

And I think on the question of curiosity, I think Dawkins would claim that he is trying to teach children to be curious. Others would say that he's not, and that obviously dependent on the one's point of view. It's interesting that the new atheists have turned to the market so heavily. So if you go on Dawkins' website you can buy jewelry. You can buy ear rings. You can buy other paraphernalia at other similar sites. You can buy little tracts that you can give to people. So it's interesting but not surprising that he and his fellow travelers are doing this kind of stuff.

MR. CROMARTIE: Okay. Karen and Fred.

KAREN TUMULTY, *The Washington Post*:And I want to thank you as well, and I especially love learning that we are stardust, which means that Joni Mitchell was an astrobiologist.

(Laughter)

MS. TUMULTY: But, you know, as I was thinking about that and as I was thinking about, you know, the evidence that science can, in fact, reinforce theology and how we got here, I wonder if there's anything within science that would reinforce theology in where we're going in terms of an afterlife or if there is some part of an organism that doesn't die when the rest of it does.

I mean, is there anything that reinforces that or is that just truly a leap of faith?

DR. LOUIS: So that's a good question that I haven't thought about so much. Maybe I'll take one little caveat to how you framed the question, which is that part of what I'm trying to argue, I think, is that science, certainly natural science in and of itself doesn't tell us a lot about theology either way. Those are other ways of knowing I think that Professor Berger was mentioning.

So whether it can tell us something about the afterlife, my guess is almost by definition not because certainly the Christian tradition of the afterlife is that something's

nonmaterial, and that by definition science doesn't deal with that—in the Christian tradition science doesn't tell us a lot about nonmaterial things.

It does tell us some things. I haven't thought about that properly. I mean, clearly, one thing that's come out of brain science is that, you know, if you have a change to your brain structure, an accident in which your frontal lobes are changed, like Phineas Gage, the guy who famously had a metal rod come through his head, your moral behavior can change. So clearly, there are, lots of questions, very complicated questions about dualism that I think I don't know enough about to be able to say anything smart. So I'll leave it at that.

But I think it's obviously a very important question for all of us.

MR. CROMARTIE: Okay. Fred Barnes is up next and then Shelby.

FRED BARNES, *The Weekly Standard*: I have two questions. One is, correct me if I'm wrong, but I think you said there are 15 physicists at Oxford who are actually church going Christians.

DR. LOUIS: Yes, at least that many.

MR. BARNES: At least that many. Are some of these scientists who have become Christians after they became scientists?

DR. LOUIS: I think so, yes.

MR. BARNES: Can you tell us about any of them and how that happened, how they happened to be converted?

DR. LOUIS: Yes. So it's interesting. Conversion stories are often very different—they're often quite complex and individual. I'll tell you one which is a biologist friend of mine who was basically agnostic, and in his late 30s, early 40s read Richard Dawkins' *The Blind Watchmaker*, and thought, "Why is this guy so cheesed off? Let me read the other side," and became—he's now a Christian from that. So he thanks Richard Dawkins for steering him towards that.

(Laughter)

And I should say that Richard Dawkins has become somewhat of a symbol—and sometimes a symbol that we like to make fun of, but I'm thankful for him because I think what he's done is said, "You know what? This question really matters. Whether there is God or there's not God really matters."

And maybe he hasn't always gone about the discussion in the way I would be happy with, but at least he said you can't just kind of sit on the fence. You should think about this. I think he's done us a favor in that sense, which is that we should be thinking about this. These are really important questions that we as a society should be having a civil discussion about.

And so even if I don't always agree with what he says and the way he says it, I do think he's bringing up important questions.

MR. BARNES: My second question is about what you call truths not accessible to scientific method, and earlier you mentioned marriage that you learned, I mean, from this reliable knowledge that you've learned. I'm not sure how to ask this question, except to say—

MR. CROMARTIE: Ask it.

MR. BARNES:—can you elaborate more on these truths?

I mentioned this to my wife during the break, and she said, well, Christianity itself, if you become a Christian you learn reliable knowledge and truths that you wouldn't if you had not become a committed Christian.

But I wonder whether these truths—I guess one way of asking this: are these truths—what is the nature of them? Are they lesser truths? Are they greater truths? Are they all kinds of truths?

DR. LOUIS: Yes. So that's a helpful—that's a nice analogy between the idea when you get married there are things that you learn about what it is to be married that you just can't learn unless you make a commitment. So some knowledge is related to commitment.

And Christians, would say the same is true of Christianity. There are aspects of knowing God that are not accessible to you until you make a commitment of some kind towards God. And I don't think there's a lesser truth in any kind of way. It just says that some kinds of knowledge can only be accessed upon making a commitment of some kind.

That's an old theological tradition.

I don't like to use the word 'lesser knowledge" or you know.

Certainly it's true so that maybe if I—there's a little picture I like to use sometimes. So this is actually an analogy from Alvin Plantinga. So you probably know this joke.

You come down a dark street and you see a man looking around for his keys. He's looking, looking, and so you ask him why and can I help you and you look with him for a while. And after a while neither of you found it. You search every square inch of space under the lamp, and you ask him, "So, you know, where did you lose your keys?"

And he says, "Well, actually, I think it was at the end of the street."

And you say, "Well, why are you looking here?"

And he says, "Well, because the light is brighter here."

And so to the argument that science is the only way of obtaining reliable knowledge. You know, science is a great and glorious enterprise, to use the words of Peter Medawar, the greatest, I think, humans have ever engaged in. It is like a bright light, and it shines very brightly. If you say that the only place where we can look for the keys is under this lamp and that if the keys aren't under the lamp, therefore, they doesn't exist, then that is like saying that science is the only path to knowledge.

And to say that somehow the truth under the lamp is more truth than the truth further down the street is, I think, the wrong metric.

MR. CROMARTIE: Okay. Shelby Coffey.

MR. COFFEY: You've just been wonderful today taking a wide range of questions and speculating on them, and I wanted to mention the title of a short story that has always haunted me which had a particular title. It was a desolate work about the way in which people treat each other, man's inhumanity, and the title of it was "Where There Is Nothing There Is God," which led me to want to turn upside down Frank Foer's question and ask you to speculate on what is not God in your view?

DR. LOUIS: Well, so I think creation is not God, and so in some sense we are other than God. So creation is not God. God may sustain, but we are not gods. We are the creation of God's. That would be a classic theological point.

My guess is I, don't know the short story, but my guess is that it's a more existential—

MR. COFFEY: Oh, yeah. It was unrelated, but it was just sort of the word play of it.

DR. LOUIS: Yeah. No, it's an interesting question, but I think I would say that, you know, by definition we are not God. Creation is other than God, although it obviously depends for its sustenance on God and was created by God.

MR. CROMARTIE: I've got Doyle who's been waiting for a long time and Allison and Sally, but we may not get to all of you. So, Doyle, you are up.

DOYLE McMANUS, *Los Angeles Times*: I think my question is brief. Of all of the branches of science, journalists ought to be reasonably conversant with at least one, which is statistics, but I'm not. If a statistician took the number of possible universes at ten to the 500th, what would the probability be that in at least one of those in the firing squad would miss? Which is it?

DR. LOUIS: That's actually a very deep and profound question. It has less to do with statistics. It has more to do with our ability to calculate the properties of this universe.

So here's a simple counter-example. If you have an infinite number of odd numbers, none of them have the property of evenness. So even if you have an infinite number of universes, it's not at all the case that therefore some of them would allow life.

So the problem with all of the universes is the question. You can have an infinite number of them. You know, what kind of infinity are there? So the problem isn't statistics, but the problem is how you count.

MR. CROMARTIE: The problem is how you what?

DR. LOUIS: The problem is not statistics. The problem is how do you—what is the sequence? If you were to make a theory of infinite number of universes and then you could ask yourself even if you do have them, why is there one that allows life if there turned out to be just one? And where did they come from in the first place?

MR. McMANUS: It doesn't prove or disprove. I think the question is does it weaken the fine tuning argument.

DR. LOUIS: It would if you could—well, if you could show that there are many universes and that there's some kind of stochastic distribution of constants and that there's a finite number in the regime that allows life—it's hard—it's a question that just is basically speculation and probably will remain speculation forever even though it's fun to think about.

MR. CROMARTIE: I think we have time, if I may say, to have one more for Allison. Allison will have our last question.

ALLISON POND, *Deseret News*: This may actually be a good concluding question. I was hoping you could comment a little bit on your work with the BioLogos Foundation.

DR. LOUIS: Sure.

MS. POND: And some of the conversations that you have with pastors and others about these issues, and maybe what are the prospects for reconciliation between some of these groups.

DR. LOUIS: Yes, so I do quite a lot of work with the BioLogos Foundation. The BioLogos Foundation is a foundation that Francis Collins founded which is aimed at helping Evangelical Christians think in a more fruitful way about evolution. I want Evangelicals to

think more fruitfully about science because I'm one, but also because I think as a scientist it's really important that they do.

And so my experience is that the average Evangelical doesn't want to be in an anti-science camp. They don't want to be the group that is against science, but they may feel forced to do so for all kinds of reasons that we discussed earlier, but I'm hopeful for the discussion on that side.

On the other hand, experience tells us that all these kinds of things take a very long time. So by analogy we can look at something like the idea that the Earth was not the center of the universe, the Copernican revolution, which nowadays none of us find to be problematic at all. We think of course the Earth is not the center of the universe.

But back in the day that was a big controversy, and one of the reasons it was a big controversy was because the church had picked up a kind of Aristotelian cosmology, which talks about the earthly sphere and the heavenly sphere and the Earth needs to be at the center for that.

And in fact, if you think about it, you know, if Jesus ascended up into heaven, where did he go then if the Earth was not in the center of the universe? And where is hell then if it's not in the center of the Earth?

So all of those kinds of concepts were the issues that people struggled with, which now in retrospect we think, well, those were actually silly. They were not silly, but those are not issues that we currently find to be very difficult.

And I hope that this question of evolution will one day be looked in that same way. But experience tells me that that might take a long time. In BioLogos we've had quite a bit of friction with some Evangelical groups who have called us heretics, and I think it's going to be a while before that gets sorted out.

I think that on a pragmatic level what's important is that we can show the young Evangelical students, high school students who are about to go to college that their faith doesn't stand or fall on whether the earth is 10,000 years old. That's what I really want. I

think what it will achieve in the shorter term is that they'll at least see that there are other models to consider.

But whether the church as a whole will find that easier or harder to, I don't know. I think it's going to take a while.

Is that helpful?

MS. POND: Yes.

MR. CROMARTIE: Well, ladies and gentlemen, let me just say as a moderator, it is always a fear when we put these together that one of the sessions might be a dud, and we have had no duds. Are you in agreement with me on that?

(Applause)

I just want to say to Professor Berger and Professor Campbell and Professor Louis, we're so grateful, for the time you took, the work you put into your presentations. It has been extremely helpful, enriching, and we're very grateful.

◆ **END** ◆