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The Language of God | Francis Collins

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The Veritas Forum

Dr. Francis Collins, world-renowned geneticist, physician, and Director of the National Institutes of Health (NIH), is uniquely positioned at the intersection of science and faith. Formerly an atheist, his New York Times best-selling book, *The Language of God*, chronicles his conversion to Christianity and its impact on his scientific practice. In this talk, given at a Veritas Forum at Caltech, Collins explores the evidence that now informs his worldview.

Transcript

Dr. what do you believe? Nobody ever asked me that question before, not like that, not in such a simple, sincere way, and I realized I didn't know the answer.

[music] Francis Collins, world-renowned geneticist, physician, and Director of the National Institutes of Health, unironically wears neckties with DNA strands on the Earth. He's also uniquely positioned at the intersection of science and faith.

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[music] Thank you very much, Christoph, for that kind introduction and good evening to all of you.

Good heavens, this place is really filled up with people, which is wonderful to see. The students who've worked so hard to put this effort together with the Veritas organization must be very happy to see this turnout on a rainy evening here in Pasadena. We are here to talk about big questions.

Maybe the biggest question of all, does God exist? I won't give you a proof tonight, but I hope I will give you some things to think about, things that have led me from being an atheist to becoming a believer and a follower of Jesus. And I will try to explain to you that

pathway in a fairly abbreviated form, and also explain to you how I see no conflict between that perspective and that of a scientist who is rigorous in his views of data and won't allow you to put one over on me when it comes to views of nature. But who also sees that the study of nature is not all there is.

So come, let us reason together here this evening and see what we might learn. And as Socrates said, let us follow the truth with her so ever it leads. And of course, Veritas means truth, and I think that is very much what this forum stands for.

I would like to start perhaps by telling you a little bit about the science that I've had the privilege of being involved in, which is the study of our human DNA instruction book, the Human Genome. When the popular press reports on this as they increasingly have been doing since the study of the human genome has gotten pretty far along, they invariably have covers such as this one of Time magazine that use double helix as the motif, because that is after all the work. And as that is after all the wonderful structure of this wonderful molecule, the instruction molecule of all living things.

They also in this instance seem to be depicting Adam and Eve, which is interesting as a question mark perhaps about whether these things are connected and I will certainly argue that the faith and the science perspectives are appropriate to consider together. But I have a sneaking suspicion that they have another motivation because I also notice in other magazines that have covers about DNA, they always feature not only double helixes but naked people. And you can draw your own conclusion about what editors have decided about how to sell magazines.

So we are going to talk about this molecule, this amazing double helix shown here spilling out of the nucleus of the cell, carrying the information that needs to be passed from parent to child generation after generation by the series of these chemical bases, here abbreviated ACG and T. And it is the order of those letters that basically must be there in order to provide the instructions to take each organism from its original rather simple beginnings as a single cell to a rather fancy organism like a human being. The genome of an organism is its entire set of DNA instructions. The human genome adds up to 3.1 billion of those letters.

And that is a phenomenal thing to think about. If we decided we were going to read the human genome tonight because it would be a useful thing to admire, we would probably regret it after we got started if we'd made a real commitment to do that because we would be here reading it an average pace of ACG, TT and so on. Seven days a week, 24 hours a day for 31 years.

And we have that information now which is a pretty amazing thing to say and you have it, even before we knew its sequence, you had it already and it's inside each cell of your body. And every time the cell divides you got to copy the whole thing. And occasionally mistakes get made and if they get made during your life, well they may not cause much

trouble but if they happen to get made in a particularly vulnerable place they might start you on a path towards cancer.

And if a mistake gets made in passing the DNA from parent to child, well then that child might end up with some kind of a birth defect. But once in a very long time that change might actually be beneficial and that of course is how evolution works with gradual change applied to this DNA sequence over long periods of time resulting in what Darwin put forward by the means of natural selection, a gradual evolution in the introduction of new species. So DNA is if you're a biologist kind of the center of the center here in terms of trying to understand how the whole system works.

The Human Genome Project was proposed rather controversially in the late 1980s and most of the scientific community was deeply skeptical about whether this was a good idea or not. It might cost too much money, it might not be feasible, it might just attract mediocre scientists because it seemed kind of boring. Well none of those things turned out to be true, it certainly wasn't boring and I'm happy to report that in fact it went better than expected.

And for me as the person who had the privilege of serving as the project manager of this enterprise to be able to announce not just a draft which we had in June of 2000 but a finished Human Genome in April 2003. Exactly to the month, 50 years after Watson and Crick described the double helix and completing all of the goals of the genome project more than two years ahead of schedule and more than \$400 million under budget dog on it which doesn't happen very often. [applause] And I could give you hours of descriptions of what's happened since April of 2003 in terms of taking this foundational information and building upon it particularly for medical benefit.

And for me as a physician that was one of the most exciting aspects of why we did this in the first place. I will spare you the details but I will say that I think the dream is beginning to come true of how this is going to apply for medical benefit because with these tools from the genome project we have been able increasingly and especially in the last couple of years to identify specific genetic risk factors for cancer, heart disease, diabetes, asthma, schizophrenia for a long list of conditions that previously were very difficult to sort out. And in circumstances where knowing you're at high risk allows you to reduce that risk by changing your diet or your lifestyle or your medical surveillance, this opportunity to practice better prevention on an individualized basis is getting pretty exciting.

And this is called personalized medicine and it applies not only to this kind of prevention but if you do get sick it may provide you with a better chance to get the right drug at the right dose instead of something that doesn't work or perhaps even gives you a toxic side effect and that's what pharmacogenomics is about. And perhaps the biggest payoff in the long term although also the longest pipeline is to take those discoveries of the real

fundamentals of what causes these diseases and turn those into insights that will lead us to therapeutics be they gene therapies or drug therapies that are really targeted to the fundamental problem instead of some secondary effect. And we're beginning to see that now especially in the field of cancer we will see much more of it over the coming decade and I would predict that in another 15 years medicine will be radically different because of all of these developments stimulated by the genome project and with the scientific community plunging in with great energy and creativity to make the most of the opportunity.

So that's what I've had the chance to do over the last 18 years involved in the genome project and before that chasing down genes for disease and that has been a wonderful experience as a professional working with lots of other skilled people making great friends and having the chance to learn new things about biology that were not known before. But now let me ask you to look at these two images because we're about to talk about the worldview question. I think this is a provocative way to begin to think about that because what you see are two images that look somewhat similar to each other but they stand in for a somewhat different worldview perspectives.

This being of course a beautiful stained glass window the rose window in Westminster Cathedral. And this is an unusual view of DNA, not looking at it from the side but looking down the long axis of DNA so you see that radial pattern. And the question that many people pose in which I pose to you tonight is okay those are two worldviews the scientific and the spiritual do you have to choose.

Do you have to basically throw in your lot with one or the other and neglect the other one or is there a possibility here of being someone who could merge these two, not necessarily building a firewall between them but actually having both of those perspectives within your own experience. I think many people today are arguing that these worldviews are at war and that there is no way to reconcile them. That has not been my experience and that's what I particularly would like to share this evening and then I hope we will have some time for questions from those of you who would like to pursue that in one way or another.

So I think I owe you at this point a little bit more of a description about my spiritual perspective I described my scientific pathway. How is it that I stand up here before you this evening in a distinguished university and talk about being a believer in God. Many of you might have assumed that the only scientists who were those who learned faith in childhood would have it later on but that's not my story.

I was raised in a family that was wonderfully unconventional. My father had been a folk song collector in the 1930s in North Carolina. After the war he and my mother did the 60s thing except it was still the 40s.

(Laughter) I don't think it involved drugs but they did buy a dirt farm and tried to live off

the land. I did not go very well. I discovered that that was not a credible way to have enough income to serve a growing family.

I was born on that farm. By that time my father had gone back to teaching at the local college and my mother had started writing plays and they founded a theater in the Grove of Oak trees up above our farm house which I am happy to say is about to have its 54th consecutive summer season. I got raised in this wonderful mix of ideas, of music, of theater, the arts.

My mother taught me at home until the sixth grade which was also very unconventional in the 1950s and she taught me to love the experience of learning new things. But the one thing I didn't learn much about was faith. My parents didn't really denigrate religion but they didn't find it very relevant.

When I got to college I had those conversations that one has, even though I might have had some spiritual glimmers along the way, they quickly disappeared in those dormitory conversations where there's always an atheist who's determined to put forward that argument about why your faith is actually flawed and mine wasn't even there at all. It was pretty easy for the resident atheist to dismiss my leanings of any sort. I was probably an agnostic at that point although I didn't know the word and then I went off to graduate school and studied physical chemistry and very much was involved in a theoretical approach to trying to understand the behavior of atoms and molecules.

My faith really then rested upon second order differential equations which are pretty cool by the way but just the same I became increasingly of a reductionist mode and a materialist mode and I had even less tolerance than for hearing information of a spiritual sort and considered that to be irrelevant. Some cast appropriately should be cast off information left over from an earlier time. But then I had a change of heart as far as what I wanted to do professionally.

I loved what I was doing in chemistry but I discovered that biology, which I had pretty much neglected, actually had a lot going for it. Recombinant DNA was being invented. There was some chance here that we might actually begin to understand how life works at a fundamental level and realizing that that was a real calling for me and also that I wasn't sure whether I wanted to be a researcher or a practitioner.

I went to medical school. That had not been part of my life plan and it's still rather amazing. The medical school left me in with that story but they did.

I arrived at medical school as an atheist but it didn't last because in that third year of medical school I found myself as one does taking care of patients. Wonderful people with terrible illnesses. Illnesses that medicine was not going to be able to solve in many instances.

People who saw the approach of death knowing what was coming and to my surprise seemed to be at peace about it because of their faith. That was puzzling. As I tried to imagine myself in that situation, I knew I would not be at peace.

I would be terrified. That was a bit disturbing but I tried to put it out of my mind until one afternoon when a wonderful elderly woman who was my patient who had very advanced heart disease that we had run out of options for and who knew her life was coming to a close told me in a very simple, sincere way about her faith and how that gave her courage and hope and peace about what was coming. As she finished that description, she looked at me sort of quizzically as I sat there silently feeling a little embarrassed and she said, "Doctor, I've told you about my faith and we've talked about my family and I thought maybe you might say something." [laughter] Oh, and then she asked me the most simple question, "Doctor, what do you believe?" Nobody had ever asked me that question before, not like that, not in such a simple, sincere way.

And I realized I didn't know the answer. I felt uneasy, I could feel my face flushing, I wanted to get out of there, the ice was cracking under my feet, everything was all of a sudden muddled by this simple question, "Doctor, what do you believe?" So that troubled me and I thought about it a little bit and realized what the problem was. I was a scientist, or at least I thought I was, and scientists are supposed to make decisions after they look at the data, after they look at the evidence.

I had made a decision that there was no God, and I'd never really thought about looking at the evidence. That didn't seem like a good thing. It was the decision that I wanted the answer to be, but I had to admit I didn't really know whether I had chosen the answer on the basis of reason, or whether because I was a scientist.

Or whether because it was a convenient form of perhaps willful blindness to the evidence. I wasn't sure there was any evidence, but I figured I'd better go find out, because I didn't want to be in that spot again. So what did I do? Well, you know, I figured there are those world religions.

What do they believe? I'd better find out. And I tried to read through some of those sacred texts, and I got totally confused and frustrated. And there was no Wikipedia to help me either.

It's much easier now. There's even a book on the shelf called World Religions for Dummies, but they didn't have that then either. So at a loss, I knocked on the door of a minister who lived down the road from me in Chapel Hill, North Carolina, and said, "I don't know what these people are talking about, but I figure it's time for me to learn." So, okay, you must be a believer.

At least I hope you are. You're a minister. Let me ask you some questions.

So I asked him a bunch of probably blasphemous questions, and he was gracious about that. And after a while said, you know, you're on a journey here trying to figure out what's true. You're not the first one.

And in fact, I've got a book here written by somebody who went on that same journey. From an academic perspective, in fact, it was a pretty distinguished Oxford scholar. He found around him there were people who were believers, and he was puzzled about that, and he said about to try to figure out why people believe, and figured that he could shoot them down.

And well, why don't you read the book and see what happened? So he pulled this little book off the shelf, and I took it home and began to read. And in the first two or three pages, I realized that my arguments against faith were really those of a schoolboy. They had no real substance.

And the thoughtful reflections of this Oxford scholar whose name, of course, is C.S. Lewis, made me realize there was a great depth of thinking and reason that could be applied to the question of God. And that was a surprise. I had imagined faith and reason were at opposite poles.

And here was this deep intellectual who was convincing me quickly, page by page, that actually reason and faith go hand in hand. Though faith has the added component of revelation. Well, I had to learn more about that.

Over the course of the next year, kicking and screaming most of the way, because I did not want this to turn out the way that it seemed to be turning out. I began to realize that the evidence for the existence of God, while not proof, was actually pretty interesting. And it certainly made me realize that atheism would no longer be for me an acceptable choice.

That it was the least rational of the options. I won't go through the whole chronology as it actually happened, but let me summarize for you the kinds of arguments that ultimately brought me around to the position of recognizing that belief in God was an entirely satisfying, intellectually event, but also something that I was increasingly discovering I had a spiritual hunger for. And interestingly, some of the pointers to God had been in front of me all along, coming from the study of nature.

And I hadn't really thought about them, but here they were. Here's one, which seems like an obvious statement, but maybe it's not so obvious. There is something instead of nothing.

No reason that should be. This phrase of Wigner, the Nobel laureate in physics, caught my eye, because I had been involved, of course, as a graduate student working with quantum mechanics with Schrodinger's equation. And one of the things that had

appealed to me so much about mathematics and physics and chemistry was how it was that this particular kind of depiction of matter and energy works.

I mean, it really works well. And a theory that is correct often turns out to be simple and beautiful. And why should that be? Why should mathematics be so unreasonably effective in describing nature? Hmm.

There's the Big Bang. The fact that the universe had a beginning, as virtually all scientists are now coming to the conclusion, about 13.7 billion years ago, in an unimaginable singularity, where there's a big bang. And of course, that's a big bang.

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And of course, that's a big bang. And of course, that force would not need to be limited by space or even by time. Oh, now we're getting somewhere.

So all right, let's imagine there is a creator, let's call that creator God, who is supernatural, who's not bounded by space, not bounded by time, and is a pretty darn

good mathematician. And it's starting to make some sense here. Well, God must also be an incredible physicist.

Because another thing I began to realize by a little more reading is that there is this phenomenal fine tuning of the universe that makes complexity and therefore life possible. Those of you who study physics and chemistry will know that there's a whole series of laws that govern the behavior of matter and energy. They are simple, beautiful equations, but they have constants in them, like the gravitational constant or the speed of light.

And you cannot derive at the present time the value of those constants. They are what they are, they're givens. You have to do the experiment and measure them.

Well, suppose they were a little different. Would that matter? Would anything change in our universe if the gravitational constant was a little stronger or a little weaker? Some days I think it's a little stronger, but I don't think it really is. So that calculation got done, particularly in the 1970s by Barrow and Tipler.

And the answer was astounding. That if you take any of these 15 constants and you tweak them just a tiny little bit, the whole thing doesn't work anymore. Take gravity, for instance.

If gravity was just one part in about 10 billion weaker than it actually is, then after the Big Bang, there would be insufficient gravitational pull to result in the coalescence. Of stars and galaxies and planets and you and me. And you'd end up, therefore, with an infinitely expanding sterile universe.

If gravity was just a tiny bit stronger, well, things would coalesce all right, but a little too soon. And the Big Bang would be followed after a while by a big crunch. And we would not have the chance to appear because the timing wouldn't be right.

And that's just one example. You can't look at that data and not marvel at it. It is astounding to see the knife edge of improbability upon which our existence exists.

So what's that about? Well, I can think of three possibilities. First of all, maybe theory will someday tell us that these constants have to have the value they have. That there is some a priori reason for that.

Most physicists I talk to don't think that's too likely. There might be relationships between them that have to be maintained, but not the whole thing. A second possibility.

Perhaps we are one of an almost infinite series of other universes that have different values of those constants. And of course, we have to be in the one where everything turned out right or we wouldn't be having this conversation. So that's the multiverse hypothesis.

And it is a defensible one as long as you're willing to accept the fact that you will probably never be able to observe those infinite series of other parallel universes. So that requires quite a leap of faith. The third possibility is that this is intentional.

That these constants have the value they do because that creator God, who is a good mathematician, also knew that there was an important set of dials to set here. If this universe that was coming into being was going to be interesting. So take those three possibilities and which of them seems most plausible.

Apply Occam's razor, if you will, which says that the simplest explanation is most likely correct. Well, I come down on number three, especially because I've already kind of gotten there in terms of the other arguments about the idea of a creator. And this is interesting, but of course, so far, how far have we gotten? We've gotten to Einstein's God now because Einstein certainly marveled at the way in which mathematics worked.

Einstein was not aware as far as we know of the fine-tuning arguments at quite this level, but probably would have embraced them in the same way. But we haven't really gotten to a theist God yet. We've gotten to a deist God.

So how do we get there? Well, now we come back to Lewis in that first chapter of mere Christianity, which is called right and wrong as a clue to the meaning of the universe. And here what is being talked about is the moral law. I didn't take philosophy in college, so I didn't really quite know what this was all about.

But as I began to recognize what the argument was, it rang true. It rang true in a really startling way. Those things where you realize, I've known about this all my life, but I've never really quite thought about it.

So what's the argument? The argument is that we humans are unique in the animal kingdom by apparently having a law that we are under, although we seem free to break it because that happens every day. And the law is that there's something called right and there's something called wrong, and we're supposed to do the right thing and not the wrong thing. Again, we break that law.

When we do, what do we do? We make an excuse. Which only means we believe the law must be true and we're trying to be let off the hook. Now people will quickly object, now wait a minute.

I can think of human cultures that did terrible things. How can you say they were under the moral law? Well, if you go and study those cultures, you will find out that the things that we consider terrible were in their column called right because of various cultural expectations. So clearly the moral law is universal, but it is influenced in terms of particular actions and how they size up in the right and wrong assessment.

Well, the moral law sometimes calls us to do some pretty dramatic things, particularly in

terms of altruism, where you do something sacrificial for somebody else. Now what about that? People may argue and they have and they will continue to, that this can all be explained by evolution, and those are useful arguments to look at. So for instance, if you're being altruistic to your own family, you can see how that might make sense from an evolutionary perspective because they share your DNA.

So if you're helping their DNA survive, well it's yours too, and so that makes sense from a Darwinian argument about reproductive fitness. If you are being nice to somebody in expectation, they'll be nice to you later. A reciprocal form of altruism, well okay, you can see how that might also make sense in terms of benefiting your reproductive success.

You can even make arguments, as Martin Noak has at Harvard, that if you do computer modeling of things like the prisoner's dilemma, you can come up with motivations for entire groups to behave altruistically toward each other. But a consequence of that, and all the other models that have been put together, is that you still have to be hostile to people who are not in your group, otherwise the whole thing falls apart as far as the evolutionary drive for successful competition. Well does that fit? Is that what we see in our own experience? Where are those circumstances where we think the moral law has been most dramatically at work? I would submit they are not when we're being just nice to our family, or just nice to people who are going to be nice to us, or even just when we're being nice to other people in our own group.

The things that strike us, that cause us to marvel and to say that's what human nobility is all about, are when that radical altruism extends beyond those categories. When you see Mother Teresa and the streets of Calcutta picking up the dying, when you see Oscar Schindler risking his life to save Jews from the Holocaust, when you see the good Samaritan. Or when you see Wesley Autry, Wesley Autry, a construction worker, African-American standing on the subway platform in New York City, and next to him, a young man, a graduate student, went into an epileptic seizure, and to the horror of the young man.

And to the horror of everybody standing there, the student fell onto the tracks in front of an oncoming train. With only a split second to make a decision, Wesley jumped onto the tracks as well, pulled the student still having the seizure in that small space in between the tracks, covered him with his own body, and the train rolled over both of them. And miraculously, there was just enough clearance for them both to survive.

And here is a picture of the next day, as Wesley describes the situation standing next to the young man's father. This was clearly radical altruism. These people were of no acquaintance of each other, had no likelihood of seeing each other in any other circumstance and belong to different groups as we seem to define them here in our society, one being African-American, one being white.

And yet, New York went crazy, and they should. What an amazing act. What an amazing,

risky thing to do.

Now, evolution would say, Wesley, what were you thinking? Talk about ruining your reproductive fitness opportunities. This is a scandal, isn't it? So think about that. Again, I'm not offering you a proof.

But I do think when people try to argue that morality can be fully explained on evolutionary grounds, that's a little bit too easy. That's a little bit too much of a just-so story. And perhaps it might ought to be thought about as potentially having some other reflected reason for its presence.

And I would ask the question, because Louis asked it in his chapter, if you were looking not just for evidence of a God who was a mathematician and a physicist, but a God who cared about human beings, and who stood for what was good and holy, and wanted his people to also be interested in what is good and holy. Wouldn't it be interesting to find, written in your own heart, this moral law, which doesn't otherwise make sense, and which is calling you to do just that? That made a lot of sense to me. So after going through these arguments over the course of a couple of years, and it was that long, fighting them, oftentimes wishing that I had never started down this road, because it was leading me a place I wasn't sure I wanted to go.

I began to realize that I had a certain series of immutable issues that were leading me in the direction of awe, awe of something greater than myself, reflected here by this phrase from Immanuel Kant, the philosopher, two things fill me with constantly increasing admiration and awe. The longer and more earnestly I reflect on them, the starry heavens without, and the moral law within. My goodness, that's just where I was.

But I had to figure out then, okay, if there is the possibility of this kind of God, and a God who cares about humans, what is that God really like? And now it was time to go back to the world's religions and try to figure out what they tell us about that. And as I read through them, now somewhat better prepared, I could see there were great similarities between the great monotheistic religions, and they actually resonated quite well with each other about many of the principles, and I found that quite gratifying, and was a bit surprised because I had assumed that they were radically different. But there were differences.

Now about this time, I had also arrived at a point that was actually not comforting, which was the realization that if the moral law was a pointer to God, and if God was good and holy, I was not. And as much as I tried to forgive myself for actions that were not consistent with that moral law, they kept popping up. And therefore, just as I was beginning to perceive the person of God in this sort of blurry way, that image was receding because of my own failures.

And I began to despair of whether this would ever be a relationship that I could claim or

hope to have because of my own shortcomings. And into that area of increasing anxiety came the realization that there is a person in one of these faiths who has the solution to that. And that's the person of Jesus Christ, who not only claimed to know God, but to be God, and who in this amazing and incomprehensible at first, but ultimately incredibly sensible uplifting sacrificial act died on the cross and then rose from the dead, to provide this bridge between my imperfections and God's holiness in a way that made more sense than I ever dreamed it could.

I had heard those phrases about Christ died for your sins, and I thought that was so much gibberish, and suddenly it wasn't gibberish at all. And so, two years after I began this journey on a hiking trip in the Cascade Mountains up in Oregon, with my mind cleared of those distractions that so often get in the way of realizing what is really true and important, I felt I had reached the point where I no longer had reasons to resist, and I didn't want to resist. I had a hunger to give in to this.

And so that day, I became a Christian. That was 31 years ago. And I was scared, and I was afraid I was going to turn into somebody very somber and lose my sense of humor and probably be called to Africa the next week or something, but... Instead, I discovered this great sense of peace and a joyfulness about having finally crossed that bridge.

And also, to have done so in a fashion that seemed to live up to my hopes, that faith would not be something you had to plunge into blindly, but something where there was in fact reason behind the decision. And I guess I should have known, because as I began to learn a bit more about the Bible, I encountered this verse in Matthew where Jesus is being questioned about which is the greatest commandment in the law, the Pharisees here trying to trap Jesus and saying something they can point out as being inconsistent with the Old Testament. And Jesus replies, "Love the Lord your God with all your heart and with all your soul and with all your mind." Wow, there it was.

All your mind. We're supposed to use our minds when it comes to faith. Mark Knoll has written a book called "The Scandal of the Evangelical Mind" to suggest that perhaps we haven't done such a good job of that.

And here it was. That's part of the commandment. "Love the Lord with all your mind." Well, okay.

This was an exciting time, but I was already a scientist, and I was already interested in genetics. So as I began to tell all these people that I knew of this good news, they said, "Doesn't your head explode?" You're in trouble, boy. You're headed for a collision.

These worldviews are not going to get along, and especially, isn't evolution incompatible with faith? What are you going to do about that? So I had a lot of those conversations. In fact, I've continued to have those over the course of quite a few years. There was one in particular that left an indelible mark on me, and I thought, just for fun, I would share it

with you, because the Inquisitor in this case is somebody you might recognize, somebody with a rather quick intellect, and a sharp way of trying to convey his point.

And if you stay up late at night, you might have actually seen him before, because he tends to come on. I don't know what time zone we're in here, but he comes on pretty late, and it's Stephen Colbert. Well, that was a white knuckled experience.

I thought when I went to be on Colbert that we'd have a chance to talk about the plan before we're suddenly in front of millions of people, but that's not how it goes. I was there in the green room waiting for him to turn up, the clock's ticking, it's five minutes before showtime. He finally pops in and says, "Oh, you're Collins.

I'm going to get you. You're going to go down." So that was the pre-interview. So, okay, Stephen, what really is your problem here? Let's talk about this.

If evolution is such a stumbling block in this science-faith conversation, we better ask the question whether it is well-founded or not. And certainly there are people saying evolution is on its last legs, evolution is known by scientists to have many flaws, but nobody wants to admit it. What are the actual facts of the matter? Well, I can tell you from my perspective as somebody who studies DNA that DNA has become probably the strongest window into this question that we could imagine.

Darwin could not possibly have imagined a better means of testing his theory except maybe for a time machine because along comes DNA with its digital code and it provides us insights that are really quite phenomenal. And in fact, the bottom line is that DNA tells us that Darwin's theory was fundamentally right on target. We have not worked out some of the mathematical details of some of this, but I think it's fair to say that here in 2009, serious biologists almost universally see evolution as so fundamental that you can't really think about life sciences without it at the core.

So what's some of the evidence to support what I just said? Well, looking at the fossil record is one thing, I'm not going to talk about that. I'm going to talk about DNA because I think it gives us more detailed information, but the fossil record is entirely consistent with what I'm going to say. We have, after all, compared now the genomes of multiple organisms.

We not only sequence the human genome, but the mouse, the chimpanzee, the dog, the honeybee, the sea urchin, the macaque, good heavens, the platypus. And those are just the ones that made the cover of nature or science. There's now about 30 more.

And when you put the DNA sequences into a computer and ask the computer to make sense out of it, the computer doesn't know what any of these organisms look like, nor does it know about the fossil record. And the computer comes up with this diagram, which is a tree, an evolutionary tree, consistent entirely with descent from a common

ancestor, a tree that includes humans. As part of this enterprise, in which it agrees in detail with trees that people have previously put together based upon anatomy or the fossil record.

Now you could argue, and people certainly have, that that doesn't prove that common ancestry is right. If all those organisms instead were created by God as individual acts of special creation, it's entirely plausible that God might use some of the same motifs in generating those organisms' genomes. And so the ones that looked most alike would have genomes that were most alike for functional reasons.

And I could not refute that on the basis of this particular diagram. But let's look a little deeper. Let's look into the details of genes, and also something called pseudogenes.

And let me explain a particularly interesting feature of one little snippet of DNA as an example of this. So first of all, we're looking here at three genes that happen to be in the same order in humans, cows, mice, and quite a lot of other mammals as well. EPHX2, GULO, and CLU are in that same order for these three species, which in itself is at least suggestive of a common ancestor.

Otherwise, why would these genes be clumped together this way? They are totally different in their functions. There doesn't seem to be any logical reason why they need to be near each other, but they are. But I chose this particular set of genes for a reason because they tell a very interesting story.

Because for the cow and the mouse, all three of those genes are functional. For the human, the one in the middle, GULO, when you look at its DNA sequence, it is really messed up. In fact, it is what we would call a pseudogen.

About half of its coding region has been deleted. It's just not there. It cannot make a protein.

It can't do much of anything except travel along from generation to generation as a little DNA fossil of what used to be there. Now, is there a consequence of this? By the way, this is a downgrade, not an upgrade. Most of our genes are not like this, but this one tells a particularly interesting story.

So GULO stands for Golunolactone oxidase. What in the world is that? Well, that's the enzyme, which is the final step in the synthesis of a score bic acid or vitamin C. And so it is because of that pseudogen, that deletion of GULO, that those sailors got scurvy, but the mice on the ship didn't. Because this is, for us, as humans, one of those things that apparently we got along fine without, except in unusual circumstances, a mutation arose.

There was no evolutionary drive to get rid of it, and so it is one we now have. We humans are all together, completely deficient in being able to make vitamin C, whereas

other animals are not. Now, look at that picture and try to contemplate how that could have come about in the absence of a common ancestor.

If you're going to argue that these are individual acts of special creation, then you would have to say that God intentionally placed a defective gene in the very spot where common ancestry would have predicted it to be. And God would have to do that presumably to test our faith, but that sounds like a God that I don't recognize. That sounds like a God who's involved in deception and not in truth.

I could give you many more examples like this, but when you look at the details, it seems inescapable that evolution is correct and that we humans are part of that. Well, if that's true, does that leave any room for God? There are certainly those who are using evolution as a club over the head of believers. Richard Dawkins perhaps being the most visible, and this book has sold millions of copies, one of those rare books that does not need a subtitle to tell you what it's about.

And Dawkins, who is an incredibly gifted writer and articulator of evolutionary theory for the general public, has shifted by the publication of this book into a very different space where he has become really in a very antagonistic way, a critic of religion not only claiming that it is unnecessary and ill-informed, but that it is evil, and that religion is basically responsible for most of the bad things in the world. Dawkins uses science as a core of his argument, trying to demonstrate that in the absence of scientific proof of God's existence, the default answer should be that there is no God. But of course, there's a problem here.

One of the problems is, as Chester points out, the assertion of a universal negative, which is a daring dogma indeed. The other problem is a category error. If God has any significance in most religions, God has to be at least in part outside of nature, not bound by nature.

Pantheism might be an exception, but most other religions would certainly agree that God is not limited, therefore, by nature itself. Science is. Science really is only legitimately able to comment on things that are part of nature, and science is really good at that, but if you're going to try to take the tools of science and disprove God, you're in the wrong territory.

Science has to remain silent on the question of anything that falls outside of the natural world. Dawkins and I had a debate about this in Time Magazine, which is still up on the web if you want to go and look at it, and basically went back and forth about a number of the issues, but this was an interesting part because I really challenged him about how it was possible from a scientific perspective to rule out categorically the presence of God. And if you read the interview at the end, he does say, well, he couldn't on a purely rational basis exclude the possibility of a supernatural being, but it would be so much grander and more complicated and awesome than anything humans could contemplate

that it surely must not be the God we were all talking about.

And I wanted to, you know, jump up and shout hallelujah, we have a convert, but I didn't. But it does reveal something that I think is important to notice, and that is that oftentimes when people are trying to disprove or to throw stones at belief, they caricature belief in a way that makes it very narrow and small-minded. And the sort of thing that a mature believer wouldn't recognize is the thing that is being torn apart.

And of course, that's the old trick of a debater. You mischaracterize your opponent's position, and then you dismantle it, and your opponent is left wondering, well, wait a minute, what happened there? I think that has very much been the case with the books by Hitchens and Harris and Dannett and by Dawkins himself, the four horsemen of the atheist apocalypse. So again, I would submit that if you want to be an atheist, you cannot claim that reason completely supports your position, because if the reason you were basing this upon is of science, it will fall short of being able to comment about God's existence.

So what then? How can evolution and faith be reconciled? Have I led us into a dilemma here by talking about my own faith conversion and then telling you that I think evolution is true? Well, actually, no. 40% of scientists or believers in a personal God, most of them, from my experience, have arrived at the same way of putting this together, a way that is actually pretty simple and almost obvious, but it's amazing how little it gets talked about. And it goes like this.

Almighty God, who is not limited in space or time, created our universe 13.7 billion years ago with that fine tuning, the parameters precisely set to allow the development of complexity over long periods of time, all very intentional. God's plan included the mechanism of evolution. That was the way in which the marvelous diversity of living things on our planet was to come to be.

And most especially, that plan included us, human beings. After evolution in the fullness of time, which is a long time for us, but maybe a blink of the eye for God, had prepared us efficiently advanced neurological house, the brain, which would be pretty necessary for what's to come here. God then gifted humanity with free will and with a soul.

Thus humans, at that point, received this special status, which in biblical terms is made in God's image, but I don't think God is a kindly gentleman with a flowing white beard in the sky. I think made in God's image is about mind and not about body. We humans, having been given those gifts, and here you'll recognize the story of the Garden of Eden, used our free will to disobey God, leading to our realization of being in violation of the moral law.

And thus we were estranged from God. For Christians, as I learned, as I was trying to figure this all out, Jesus is the solution to that estrangement. That's it, a very simple, but

I think entirely compatible view that does no violence either to faith or to science and puts them in a harmonious position that both explains the way in which origins can be thought about and puts us in a position to be able to further explore the consequences.

Now this is often called theistic evolution. It's not a term that many people are all that comfortable with, including me. Evolution is the noun, theistic is the adjective, sort of sounds like you're tipping the balance there in the favor of the scientific view, and a lot of people aren't quite sure what theistic means anyway.

So maybe we need a better term. One possibility is to think about what this means. Well, it means life, bios, by God speaking us into being, the logos.

In the beginning was the word, the first chapter of John, life through the word, bios through logos or just simply bio logos. And that is perhaps a useful alternative instead of theistic evolution. And in that regard, as the title of my book indicates, then maybe we could think about this universal code of life, the DNA molecule, as the language of God.

Well, you were probably already thinking of objections, and that's good, and I'm sure we'll hear a few more in a little bit. What are the things that trouble people about this synthesis? Is this just a little too easy? Well, some people are troubled about the long time that evolution seemed to require to do this, and why would God be so slow in getting to the point? Well, after all, that's our perspective, because we are limited by this arrow of time, where yesterday had to come before today, and that had to come before tomorrow. But remember that thing about God having to be outside of time in order to make sense as a creator? Well, that solves this one too, because if God is outside of time, then a process that seems really long to us may be incredibly short to God.

And tied along with that is an evolution of purely random process, and doesn't that take God out of it? Well, again, it might seem random to us, but if God is outside of time, randomness doesn't make sense anymore, and God could have complete knowledge of the outcome in a process that seemed random to us. And I suppose in that way you could say God is inhabiting the process all the way along. I don't think this is a fundamental problem, despite the way it is often portrayed as such.

This is the intelligent design question. Can evolution really account for all of those fancy structures that we have inside ourselves? The favorite poster child of ID being the bacterial flagellum, so what's the argument here? Well, the bacterial flagellum is this little outboard motor that allows bacteria to zip around in a liquid solution, and that flagellum has about 32 proteins that must come together in just the right way for the whole thing to work. And if you inactivate just one of those 32 proteins, it doesn't work.

So in a simplistic way, you would really begin to wonder how this could ever come to pass on the basis of evolutionary steps, because how could you have, just by chance, a 31 of those proteins coming along with no positive benefit, and only when you got the

32nd one would something be a value in that organism would have a reproductive advantage. That doesn't seem to be mathematically feasible, and it isn't, if you think of it in those terms. But as we study the bacterial flagellum, and other examples like this, it becomes increasingly clear that this did not arise out of nowhere.

But the parts of the bacterial flagellar motor have been recruited bit by bit from other structures, and brought into this in a way that gradually built up its capacity to serve the function that we now so admire. And in that case, that doesn't sound so different than the standard process of gradual change over time with natural selection acting upon it. So ID turns out to be, and I'm sorry to say this for those who have found this a very appealing perspective, but I think it is the truth that ID turns out to be putting God into a gap in scientific knowledge, which is now getting rapidly filled.

And that God of the gaps approach has not served faith well in the past, and I don't think it serves it well in this instance either. And unfortunately, the church has in many ways attached themselves to ID theory as a way of resisting what was apparently a materialistic and atheistic assault coming from the evolutionists, but attaching yourself to an alternative theory which itself turns out to be flawed is not going to be a successful strategy. And I think it's an unnecessary strategy because if you think about it, ID is not only turning out to be science, it's hard to defend.

It's also sort of an unusual kind of theology because it implies that God wasn't quite getting it right at the beginning and had to keep stepping in and helping the process along because it wasn't capable of generating the kind of complex structures that were needed for life. Wouldn't it actually be a more awesome God who started the process off right at the beginning and didn't have to step in that way? I might think so. And then the one that I think is most of concern to believers, and I'm sure there are people in this room who are already in that circumstance and wondering, now wait a minute, how do you really rectify what you just said about evolution with Genesis 1 and 2? And probably resonated a bit with the caricature that Colbert was presenting of that view.

Well, all of this comes down to what does science say and what does the scriptures say and are they really in conflict? And that requires one to get deeply into the question of scriptural interpretation. What is the meaning of a verse? What was the intention of the author? Who was it intended to be written to? What is the original language? What do those words mean in that language? Does this read like history of an eyewitness? Does this read like something that is more mythical and lyrical and poetic? I'm not an expert in that area of hermeneutics, but there are a lot of people who have spent their lives on that. And ultimately, when it comes down to that conflict between Genesis and science, it does seem that the conflict primarily results from an interpretation that insists on a literal reading.

And that that literal reading is actually a relatively recent arrival on the scene with many

deep thinkers in theology down through the centuries, not having the sense at all that that was a required interpretation. Furthermore, if you read Genesis 1 and 2 carefully, and do that tonight if you're interested, you will notice that there are two stories of creation, and they don't quite agree in terms of the order of appearance of plants and humans. So they can't both be literally correct.

So maybe that's supposed to be a suggestion to us as we read those that there is something more intended here than a scientific treatise. Given all of that, I think it is entirely possible to take those words in Genesis and fit them together with what science is teaching us about origins. And I was particularly gratified, as I was wrestling with that, to run across the writings of St. Augustine.

Augustine was mentioned in the introduction in a wonderful quote read from Augustine by Professor Christoph Koch. And Augustine was obsessed about this question of Genesis, wrote no less than four books about it, and tried to figure out what the meaning was. And ultimately concluded that there was no real way to know precisely what was intended by those verses, and warrant in a very prescient way, 1600 years ago, that people should be very careful therefore not to attach themselves to a particular interpretation that might turn out when new discoveries were made to be indefensible.

Here's that exhortation. Writing about Genesis, in matters that are so obscure and far beyond our vision, we find in Holy Scripture passages which can be interpreted in very different ways without prejudice to the faith we have received. In such cases, we should not rush in headlong, and so firmly take our stand on one side, that if further progress in the search for truth, which sounds a bit like science, justly undermines this position, we too fall with it.

I wish that exhortation were referred to more often. So, I've written about this in more detail in this book, *The Language of God*. I'll give you two other books you might want to look at that refer to these issues in very thoughtful ways, one by my friend, Darryl Falk, who teaches at Point Loma called *Coming to Peace with Science*, another by Carl Giberson, who teaches at Eastern Nazarene.

This book just came out last summer called *Saving Darwin*. And if those of you who are scientists and are interested in being involved in conversations with other scientists who are believers trying to figure out how to fit this all together, also give you the website of the American Scientific Affiliation, which counts some several thousand members who have this same perspective and have a wonderful journal and annual meetings to talk about these issues in deep ways. So, I'm actually encouraged that we're having this conversation here at Caltech.

I'm encouraged that there seems to be an interest, as evidenced by all of those who have turned out this evening, in having the conversation. I'm troubled by the fact that the stage often seems to be occupied by those at the extremes of the spectrum. On the

one hand, atheists, who are arguing that science disproves God, on the other hand, fundamentalists who say that science can't be trusted because it disagrees with their interpretation of particular scripture verses.

But I think there's hope here for having this conversation go somewhere. Another thing that I have had the privilege of doing is to start a foundation called the BioLogos Foundation. Coming soon, in about a month, there will be a website with that URL, which will provide suggested answers to the 33 most frequently asked questions that I've received in the last two years about science and faith, from more than 3,000 emails.

And I hope that will turn out to be a useful resource for people who want to dig deeper than we've been able to go to this evening. And I hope you will also, in a follow-up to this evening, if you're interested in this topic, take advantage of some of the opportunities that the students have put together, and also seek out ways to continue the conversations with students. And if you're interested in churches around here, there are many of them as well that have this kind of a topic as an open area for discourse.

This is the most important question that we started with, is there a God? My answer to that is yes. I can't prove it, but I think the evidence is fairly compelling. If this is a question that interests you and you haven't necessarily spent a lot of time on it, I would encourage you to.

It's probably not one of those you want to put off to the last minute. After all, you might get a pop quiz along the way. But I am delighted that the Veritas Forum provides this kind of opportunity for discussion and that Caltech has welcomed this kind of conversation to happen here tonight.

And I thank all of you for your kind attention. [applause]

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