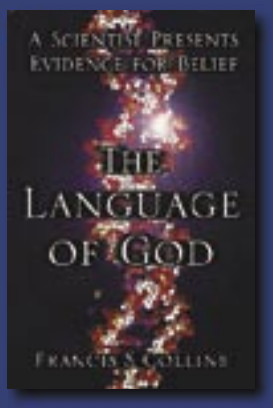
BOB SMIETANA

Cracking Life's Instruction Book



A conversation with Francis Collins, head of the Human Genome Project

The question was a simple one, asked by a dying woman to a young doctor thirty years ago.

"What do you believe?"

It was a question that Francis Collins, then a twenty-seven-year-old medical student and self-described "obnoxious atheist," had never considered before. But when an older woman with heart disease grabbed hold of his hands and asked him that question, Collins could only stammer out, "I don't think I believe in anything."

Confronted with a problem that science couldn't answer—how patients could face death without fear—Collins went to visit a local minister, who lent him C.S. Lewis's *Mere Christianity.* Reading Lewis, who had "gone down this same path from atheism to Christianity," helped Collins accept the possibility that God existed, and soon afterwards, to become a Christian.

Not long before Collins discovered faith, he had also discovered his life's calling. During a class at the University of North Carolina Medical School, a guest lecturer brought in several patients suffering from genetic diseases like sickle cell anemia into class. Collins, who had learned about DNA while doing graduate work in chemistry, saw firsthand the power of this tiny molecule—and decided to spend the rest of his life unraveling its mysteries in hopes of finding cures for genetic diseases.

Collins would go on to direct the Human Genome Project—which cracked the human genetic code and then released all of its data to the public, so that scientists around the world could use the information to begin finding cures for genetic disease.

In his new book, *The Language of God: A Scientist Presents Evidence for Belief,* Collins discusses his faith and his belief that "the God of the Bible can also be found in the science lab." Features editor Bob Smietana spoke with Collins in late July.

What is the most surprising thing that you discovered about the human genome?

The most surprising thing to me is just how few in number the gene count is. I thought there would be at least 100,000 genes in the genome. We are incredibly complicated beings and the idea that you could generate that kind of complexity on the basis of even 100,000 genes seemed extremely difficult to get your mind around. It turns out we have slightly fewer than 20,000—the same number of genes that you find in many other simpler species like fruit flies, for instance. That shocked everybody.

What did you learn from that discovery?

I think what that says is that our gene count is not really the place

to look if you're trying to explain what is specially complicated about humans. We get by with this very short list of incredibly elegant instructions that are capable of taking a single cell, which we all once were, and turning us into this enormously complicated being with 100 trillion cells, including a nervous system. That is just an absolute marvel and well beyond anybody's current ability to understand.

And it's all spelled out with an alphabet of four letters (ACGT) that represent four nucleotides.

With only four letters—3.1 billion of them in the right order with each of those packaged together into a gene with specific instructions, but only about 20,000 of those genes apparently being sufficient.

Does it surprise you that things don't go wrong more often?

With such a complicated system it must mean that there are fail-safe mechanisms at work so that if something starts to go wrong over in one corner, there's another way to compensate for it. The more you study the genome the more you begin to wonder, "How did this ever work?" But our observations are it works, it works marvelously most of the time.

Still, even the smallest error in DNA can cause enormous havoc.

One of the diseases my own lab is studying right now is this dramatic form of premature aging called progeria. These kids are born appearing completely normal and then they begin to age at about ten times the normal rate. They are usually dead around age ten of a heart attack or a stroke, and at that point look like very tired, withered little old people. We discovered three years ago, using the tools of the genome, that this comes about because just one letter has gone wrong out of three billion. That's enough to do it, because it's in a very vulnerable place.

Because we know what that mistake is, we are now on the brink of initiating a clinical trial with a drug that I think may be just the thing to prevent that outcome. We're quite excited about that. It is amazing when you contemplate the consequences of just a small error in such a big instruction book.

What kept you going during the process of figuring out the genome? It had to be enormously frustrating at points.

There were many moments during the 1990s where I thought we would never make it. But what kept me going was the incredible historic and spiritual significance of the task—reading our own instruction book. We only can do that once.

Also what kept me going was the opportunity to work with some of the best and brightest minds of the current generation, who all shared that dream, rolled up their sleeves, brought their best ideas, developed new technologies, and worked together in such a truly selfless way that it was a pleasure to be part of. And we gave away all the data every twenty-four hours on the Internet, with no intentions of getting any special credit or financial benefit from it. It was one of the most beautiful examples of science working for human benefit in a way that will stand the test of time.

And you're starting to see people use it?

I think already you can see the leading edge of how having this information is going to transform medicine. If you're in a family, for instance, that's had a number of individuals affected with breast cancer or colon cancer; it's now possible to figure out who else is at risk and offer them the kind of surveillance that you need in order to pick up a cancer while it's still early and treatable.

Already you can see examples where people who have been afflicted by disease have many different options as a result of the genome in terms of what kind of therapies to pursue. In a few instances some of those therapies are truly dramatic and life-saving.

Do you have a sense of how historic the mapping of the genome is?

All the way along we had the sense that this really was something very significant. This might in fact be looked at in a few hundred years as one of the most significant undertakings of humankind. To read our own instruction book—how do you beat that? People compared that to splitting the atom or going to the moon, but this has more consequences for each one of us because of its medical benefit potential. So, it's just been an enormous privilege and a fairly wild roller-coaster ride to be at the helm of a project of this significance.

Why are we all here? What's the purpose of life? What happens after we die? Is there a God? Science doesn't help you with those questions.

So what do you do now that you've solved the genome?

I'm deeply engaged in a whole host of follow-up large-scale projects to try to make the most of that discovery. I think about it as a foundation for a house we're trying to build.

The foundation is the genome project—the house is to apply that and to understand how life works and to particularly apply it to medicine in order to come up with better means of diagnosis, prevention, and treatment. That's really been my dream all along.

Have you thought some about the pitfalls of having all this information and ways we can be wise to make sure we don't step in them?

One of the things that I'm proudest of about the human genome project was that we decided from the very beginning to devote a significant portion of the funds and our attention to the ethical, legal, and social implications of this research. That had never been done before. Scientific advances had generally just sort of happened and then after the fact everybody ran around going, "Oh, gosh, why didn't we think about this?"

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This time we were determined to think about it ahead of time. . . .

I'm particularly worried about genetic discrimination in health insurance and in the workplace. We've had dozens, if not hundreds, of experts who looked at this issue and concluded that in the U.S. the only effective prevention is federal legislation. And after working on that outcome for ten years there is now a bill that has passed the Senate, ninety-eight to nothing, and its counterpart is under consideration in the House. The president has indicated he would sign the bill if the House will pass it, but at the moment the House has not scheduled any action. That is troubling especially since as of last week more than half the members of the House had signed on as co-sponsors, which you would think would mean that the bill would then be a done deal. But that's not how the process works.

In *The Language of God,* you describe scientific research as being a form of worship. What do you mean by that?

The ability to explore the natural world is also an opportunity to understand the majesty of God's creation—which is an awesome experience. When, as a scientist, I learn something that wasn't known before, I always realize that it wasn't known by us, but God knew it all along. As we unravel in increasing complexity the amazing aspects of the world around us in all of the sciences, but particularly now in biology, it seems as if we are given a little glimpse into the mind of God. For me as a scientist, that is an experience akin to worship.

As a scientist and a Christian, how have you kept from being caught up in the culture war between science and religion?

It's important to point out that 40 percent of working scientists say they believe in a personal God who answers prayer. That's a well-documented statistic. So it's not as if science is completely the domain of atheists; that is not the case at all. But in general people avoid bringing up anything that sounds the least bit spiritual in a scientific discussion because it is a sort of taboo.

I think in a certain way that's unfortunate. I understand that science has to explore the natural world using rigorous tools of investigation. But there are many questions that all of us I think are at least interested in, and science can't help us with them. Why are we all here? What's the purpose of life? What happens after we die? Is there a God? Science doesn't help you with those questions. Yet as thinking people and particularly as people in an academic environment where the search for truth is supposed to be our major motivator, we should be asking those questions, too.

In the book, you write that science can point to the possibility of God's existence. You use a quote from the Freeman Dyson, that the universe was expecting us—that an extraordinary number of things had to go right with the universe in order for us to be here.

When you look at just how right they had to go, it takes your breath away. We are living on this absolute knife edge of improbability. Our universe really should not have been a universe that could possibly support life, but it did. It is hard to look at the values that all of these constants ended up achieving—which had to be precisely tuned to their present value—without concluding that somebody or something was behind that.

Would you consider that more a philosophical question than a scientific one; though it's one that science can help you with?

Science can never prove or disprove the existence of God, because God is outside of nature and science can really only comment on nature. But there are certain paradoxes that science turns up in our study of the universe that seem to scream for an explanation. One of them is the fine tuning of all these universal constants. Another is the fact that the universe had a beginning.

If nature could not create itself, and I can't really see how the universe could have done that, then that demands something or someone to have done the creating; someone who is not limited by space and time as we are. That sounds like God to me. Again, those are arguments that I think can persuade a skeptic to give serious consideration to the possibility of God. Of course to become a believer you really have to go up to the edge of that cliff and decide whether or not to take the leap of faith. There's no getting around that.

In the book, you make the point that when Genesis was written, the theory of evolution, and our understanding of DNA and genetics would not have made any sense.

The chosen people of Israel would be very puzzled to be lectured about those things. And instead it seems to me, and to other much greater thinkers than I could ever hope to be, particularly St. Augustine, that Genesis was teaching us about God's character, about his intentions, about ourselves in the personification of Adam and Eve and our fallen nature in terms of what happened in the Garden. To take that description and insist that it is intended to be absolute literal, step-by-step, minute-by-minute descriptions of actual historical events, seems to go way beyond what a thinker like Augustine would have accepted.

Somehow in the last 100 or 120 years, that sort of reasoned consideration of alternative interpretations of Genesis has slipped away at least from large segments of Christian believers. I think that has been a reaction to evolution—a sense that faith was under threat and something had to be done about it.

You write, at one point, that God isn't threatened by our scientific discoveries.

As if we have to somehow protect him. Can you imagine?

The God of truth is a God who honors truth of all sorts. I don't think God is honored by believers refusing to accept truth that science has uncovered. God gave us the tools to explore his creation. I think he wanted us to understand the incredible complexity

and elegance of his creation. I don't think he intended us to forego the use of those tools. I don't think as Copernicus said, that God would be more honored by ignorance than knowledge. And I think Christians ought to be at the forefront of those who are exploring new frontiers and trying to gain new knowledge.

How do you think the culture wars have hurt both science and faith?

I think scientists, including some of my colleagues, who take their scientific credibility and try to apply it to a religious argument have really committed a logical fallacy and are putting forward science in a place it doesn't belong. They are offending people of faith and making them feel under attack in a way that's not justified by the actual strength of the argument. That has added to a general distrust of science by many parts of the religious community because what they hear coming from the mouths of certain scientists sounds like an absolute assault on what they hold most dear—namely the existence of an all-mighty, loving, and creative God.

On the other hand, if you insist that the only true source of knowledge about nature comes from the Scriptures and that scientific investigation is secondary, I think that attitude has driven more people away from God than into his arms.

In both instances this polarization is a very damaging one for the future of our society, and one we need to come to grips with. Perhaps those of us who live happily in harmony in the middle here have to stand up a bit more and basically explain to the extremists that they're not speaking for us.

I wonder if these extremes make our culture an unsafe place to say, "I don't know."

And that, of course, is a very dangerous outcome. Anybody who arrives at the place of being unable to say, "I don't know," has pretty much given up the chance to be very useful in a discussion of this sort. All of us have to be willing to say, "I could be wrong and there are aspects of the answers to these questions that I don't know and may never know, but hope to know as more knowledge is accrued."

You describe yourself as a "theistic evolutionist," someone who believes God created the universe and used evolution to do it. But you're suspect of intelligent design. Why is that?

I think there's a lot of confusion and our terminology hasn't been very helpful—a theistic evolutionist sounds like something that you wouldn't want to be, whereas intelligent design has a certain ring to it.

Intelligent design sounds like this is an endorsement of the fact that we are all here because of God's plan and I would embrace that. But when you look more closely at what intelligent design is actually describing—the details unfortunately, from my perspective, are not going to turn out to be right.

I don't think as Copernicus said, that God would be more honored by ignorance than knowledge.

Does the size of the genome and its complexity, and the time it took to get here, change the way you see God?

I don't know that those particular issues play a big role in the argument about whether God was behind it or not.

Certainly an atheist looking at that would say, "Well, you know, that just shows that evolution occurred over long periods of time by a random process and there's no need to invoke God in there at all."

I think the question of God is more not *what* happened, but *why* did it happen? Was there a purpose here? I think most of us believe that there's more of a purpose to life than this blind pitiless indifference that people like Richard Dawkins describe.

This is undergirded for me by this other observation that I tried to point out in the book, which is the existence of the moral law. It is unique to human beings, and gives us a sense of good and evil—a sense that we don't always adhere to—but that we know is there.

I find the moral law an extremely interesting feature of human beings, especially as it seems to fly in the face of what evolution would have created within us. Evolution really doesn't care whether we're good to widows and orphans. Evolution doesn't really care whether we reach out to somebody who's in serious trouble or try to heal the sick. Evolution only cares about whether we as individuals successfully pass on our DNA. Yet here we have a moral law that often calls us to do just the opposite. If you were looking for a place within ourselves, within our inmost being, where God might have planted a signpost, this seems to me to be a pretty good candidate. And nothing about atheistic evolution helps me understand that.

You took a break from the Genome Project at one point to spend a month volunteering at a clinic in Nigeria. In your book, you mention that it was a humbling experience—that the problems of that community were too big for you to solve. Then you helped save the life of a farmer. You write that he told you, "I get the feeling that you are wondering why you are here. You came here for one reason. You came here for me, and that ought to be enough."

Most of the important things we do in life happen one person at a time, where you're trying to help somebody. Just that one person is enough. I had forgotten that at that time and I occasionally forget it now and I have to keep remembering that young man when I make that mistake, because his words to me at that moment were so surprising and so completely on target.

When those kinds of things happen you certainly get a sense that there's more here than what the scientific explanation of DNA and RNA and protein is ever going to tell us. ❑