science

Why We're All Jesus' Children

Go back a few millenniums, and we've all got the same ancestors.

By Steve Olson

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On Monday Dan Brown, author of *The Da Vinci Code*, testified in a London courtroom to defend himself against the charge that he stole from an earlier book the idea that Jesus has a secret line of descendants who are alive today. But no matter how the court case turns out, both books are confused. If anyone living today is descended from Jesus, so are most of us on the planet.

That absurd-sounding statement is an inevitable consequence of the strange and marvelous workings of human ancestry. In the recent past, each of us is descended from a small fraction of the people who were then alive. We're descended from our parents one generation ago, our grandparents two generations ago, our great-grandparents three generations ago, and so on. We tend to think that the same exclusivity holds for the more distant past—that a European-American, for example, is descended from a few clusters of people who lived in Europe many centuries ago, or that an African-American has ancestors from just a handful of African villages.

But that presumption is wrong. Imagine that you could identify all of your great-great-great-great- … grandparents 20 generations back—from about the time Columbus stepped ashore in the New World. (You would never be able to, of course, because no paper records connect you to virtually any of those people, but pretend that God handed you a perfect genealogical record.) Assuming typical human mating patterns, your direct ancestors 20 generations ago consisted of somewhere between 600,000 and 1,000,000 different people. Taking the lower figure, perhaps 480,000 of the ancestors of the average African-American were living in Africa in the year 1492, and approximately 120,000 were living in Europe, the Americas, and Asia. For the average European-American, more than a half-million ancestors were living in Europe, with the rest scattered through Africa, Asia, and the Americas.

Now think about your direct ancestors living 40 generations in the past, in about the year A.D. 1000. The size of that group is harder to estimate. But as two co-authors and I explained in *Nature* in 2004, that group included many millions of people. Forty generations ago, almost everyone living today had ancestors in Europe, Asia, and Africa, and many present-day Asians, Europeans, and Africans had ancestors in the Americas because of the continual exchange of mates across the Bering Strait.

It gets even stranger. Say you go back 120 generations, to about the year 1000 B.C. According to the results presented in our *Nature* paper, your ancestors then included *everyone in the world* who has descendants living today. And if you compared a list of your ancestors with a list of anyone else's ancestors, the names on the two lists would be identical.

This is a very bizarre result (the math behind it is solid, though—here's a brief, semitechnical explanation of our findings). It means that you and I are descended from all of the Africans, Australians, Native Americans, and Europeans who were alive three millenniums ago and still have descendants living today. That's also why so many people living today could be descended from Jesus. If Jesus had children (a big if, of course) and if those children had children so that Jesus' lineage survived, then Jesus is today the ancestor of almost everyone living on Earth. True, Jesus lived two rather than three millenniums ago, but a person's descendants spread quickly from well-connected parts of the world like the Middle East.

Keep these observations in mind the next time you read about people being linked to famous ancestors. *Newsweek* recently gushed that "one in five males in northwest Ireland may be a descendant of a legendary fifth-century warlord." In fact, virtually *everyone* with any European ancestry is descended from that man. One-fifth of Irish males may be descended from him *in a direct male line*—that is, through their father, grandfather, great-grandfather, and so on. That's what genetic tests can measure. But almost everyone else in Europe, and many people living elsewhere in the world, is descended from him through genealogical lines that include

women. And of course, we're just as much descended from our mother's parents and from our father's mother as from our father's father.

In addition to Jesus and the warlord, we're also all descended from Julius Caesar, from Nefertiti, from Confucius, from the Seven Daughters of Eve, and from any other historical figure who left behind lines of descendants and lived earlier than a few thousand years ago. Genetic tests can't prove this, partly because current tests look at just a small fraction of our DNA. But if we're descended from someone, we have at least a chance—even if it's a very small chance—of having their DNA in our cells.

Geneticists like to point out that people don't get their DNA in equal proportions from our shared ancestors. From many of them, we have inherited no DNA. One genetic test can tell you how much DNA you might have inherited overall from your ancestors in Africa, Europe, Asia, and the Americas. But, as John Hawks points out elsewhere in ***Slate***, the results are very approximate. And do people really care how much DNA they got from various regions, or are they more interested in the genealogical question of where their ancestors lived? The answer to that question is "virtually everywhere."

A handful of uncertainties could push back to some degree the times I've mentioned. Maybe we all had the same ancestors four or five millenniums ago rather than three millenniums ago. But that uncertainty doesn't change the basic conclusion, which is that all human beings are tied up in dense webs of genealogical connections.

The risk of today's genetic genealogy tests is that they tend to divide people into groups, whereas the real message that emerges from genealogy is one of connections. For centuries, scientists have tried to sort people into biological categories. In the 18th and 19th centuries, they pounced on the idea of race and used it to formulate hypotheses about human differences that had disastrous social consequences. In the 20th century, scientists began to explore the greater complexities of our biological histories, which are impossible to capture in a word as simple-minded as "race." If genetic genealogy tests explored and explained these complexities, I'd have no problem with them. But most of today's tests hark back to the bad old days of racial science.

People may like to think that they're descended from some ancient group while other people are not. But human ancestry doesn't work that way, since we all share the same ancestors just a few millenniums ago. As that idea becomes more widely accepted, arguments over who's descended from Jesus won't result in lawsuits. And maybe, just maybe, people will have one less reason to feel animosity toward other branches of the human family.

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In 1999, Joseph Chang, a professor of statistics at Yale University, published a paper in *Advances in Applied Probability* showing that the most recent common genealogical ancestor in a randomly mating population of size n lived $\log_2 n$ generations ago, where $\log_2 n$ is the number of times you have to multiply 2 by itself to equal n. (Thus, $\log_2 n$ of 1 million is about 20, since 2 to the 20th power is 1,048,576.) I read Chang's paper while I was writing my book, *Mapping Human History: Genes, Race, and Our Common Origins*, and he and I began working to extend his result to more realistic human populations where mates are not chosen at random.

About that time, I also was reading about small-worlds graphs, which is a branch of mathematics that flourished in the 1990s. In a small-worlds graph, subgraphs consisting of random connections among a cluster of points (random marriages within a population form such a subgraph) are connected to each other by occasional links.

It doesn't take many of those occasional links for the entire collection of subgraphs to start behaving like one big randomly connected graph.

I realized that human ancestry could be modeled as a small-worlds graph. Even with very small rates of migration between populations that are separated geographically or socially, the entire population would behave in ways comparable to a randomly connected graph. Thus, ancestry for the population as a whole might conform roughly to Chang's observation about randomly mating populations. That conclusion gave me enough confidence to publish in my book some of the observations I've made in this article.

Meanwhile, Douglas Rohde, a computer scientist who was then at MIT and now works at Google, heard about the research that Chang and I were doing. He built an amazing computer simulation of the world's interlinked populations going back 20,000 years, which produced results comparable to those of Chang's theoreticical approach. The three of us worked together on the results published in the *Nature* paper.

Computer scientist Mark Humphrys anticipated some of our work on human ancestry in his fascinating "royal descents of famous people" Web site, which I wrote about in the May 2002 *Atlantic*. Douglas Rohde has summarized his work on human ancestry in an unpublished paper posted at his old MIT Web site. The esteemed geneticist Susumu Ohno also wrote about human ancestry in the Proceedings of the National Academy of Sciences. I used Ohno's paper to conclude that each of us had between 600,000 and 1 million distinct ancestors 20 generations ago.

Steve Olson's book Mapping Human History: Genes, Race, and Our Common Origins *was nominated for the National Book Award in 2002.*