

13 DNA AND MONEY

Breakthrough of the Year: Human Genetic Variation

Elizabeth Pennisi

Science 318/5858 (21 December 2007) 1842-43

"Equipped with faster, cheaper technologies for sequencing DNA and assessing variation in genomes on scales ranging from one to millions of bases, researchers are finding out how truly different we are from one another."

Genetics News Highlight of 2007

According to the Editors of *Nature*

First whole human genome decoded

James Watson, co-discoverer of the structure of DNA, and genomics pioneer Craig Venter announced that their full genomes had been sequenced. The achievements were the first in an anticipated wave of personal-genome sequencing and crucial steps toward personalized medicines tailored to an individual's genetic makeup. Watson's genome, announced in June, was analysed by Connecticut company 454 Life Sciences' new rapid-sequencing technique. Venter's, published in September, was the first fully sequenced diploid genome—detailing DNA inherited from both parents—and revealed that human genetic variation is greater than previously thought.

In November, Google-backed Californian biotech firm 23andMe

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launched a \$1,000 personal-genome service; the same month that Icelandic deCODE genetics offered DNA testing for disease-linked genes for the same price. And 2007 saw a splurge of research papers from genome-wide disease-association studies, including diabetes and cancer.

December 24, 2007

From the Human Genome to the Personal Genome

Innovations in DNA sequencing and genotyping are opening doors for personal genomics. Science writer Nathan Blow in *Nature* 449/7162:627 explores these technological advances and their implications.

Related articles review the state of the science of personal genomics, including economic feasibility and emerging technology that suggest it may soon be possible to sequence your own entire genome. Such an event could be the precursor to hundreds of gene-screening tests within the reach of consumers, inaugurating a whole new era in DNA testing for ordinary people.

According to Harvard biology professor Richard Lewontin, because the Human Genome Project was completed by 20 or more research institutes and much of it was "fill-in-the-blanks" computer guesswork, the Human Genome we now have is an artificial one corresponding to no living individual. Only by sequencing real human subjects and describing the vast variety of human genetics will medical science be able to achieve its aim of discovering the genetic basis of disease. This has been heralded as Phase II of the Human Genome Project, although it has attracted little funding (unlike Phase I).

October 15, 2007

Economies of Scale

High Density SNP Testing Is Transferred from Medicine to Forensics

An article titled "DNA Has Nowhere to Hide" in October's *Genetics* (published by *Nature* magazine) describes how the technology of high-density SNP genotyping that has opened up vast horizons in genome-wide association studies is now transforming forensic science.

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The new techniques can detect trace quantities of a suspect's DNA in a complex mixture containing hundreds of other individuals, substituting a rifle for what was previously a shotgun approach to crime-scene evidence. High-density SNP testing uses allele profile frequencies—somewhat as a DNA fingerprint and population statistics are used to infer ethnicity in our DNA Fingerprint Test.

October 6, 2008

Google Wants to Do What?

Google Wants to Index Your DNA, Too

Marjorie Backman

Business Week Online, 4/21/2008, p.7.

Google is investing in genetic-screening companies, notably Navigenics, backed by start-up venture capital firm Kleiner, Perkins, Caufield & Byers. Navigenics conducts genetic tests to determine a person's vulnerability to 18 diseases. Google has pumped \$4.4 million in 23andMe.

April 21, 2008

Iceland's deCODE Defunct

Nature 462/401

Published online 23 November 2009

In a report by Erika Check Hayden, the journal *Nature* gloats that the innovative personal-genomics company deCODE Genetics has gone out of business, leaving the disposition of valuable genetic data unclear.

"After struggling financially for years, the genomics company deCODE, based in Reykjavik, Iceland, filed for bankruptcy on 16 November," wrote Hayden, who follows the genealogy-and-genetics business beat for *Nature*. "The question now is whether other companies looking to commercialize genomics will follow the same path."

DNAPrint of Sarasota, Florida, went down that path last February

without even an obit in scientific journals.

But according to Kari Stefansson, deCODE's CEO, the fate of the data never was in play since it belonged to individuals who had their DNA tested at their own expense with the service lab of deCODE. The lab, Islensk Erfdagreining, continues to operate today "under the same data and privacy protections as ever, rooted in the Icelandic community and within a tried and tested regulatory environment," wrote Stefansson in a comment on the online report by *Nature*.

Such an accidentally-on-purpose misunderstanding is more than sloppy science journalism or bad science. It reveals the fundamental hostility of academic geneticists and related disciplines to commercializing or even popularizing DNA. Geneticists should stop thinking they are doing God's work. They should give up the illusion that the great generality of humankind can only understand, profit from and benefit from their work if they, the scientific intelligentsia, condescend to allow it, controlling the conditions and goals of its use.

November 28, 2009

The \$1,000 DNA Test

"Complete Genomics is about to release fast, cheap sequencing into a competitive market."

Erika Check Hayden

Published online 6 October 2008 in *Nature*

The era of the \$1,000 genome has arrived. That's the claim from Complete Genomics, a young company based in Mountain View, California, that revealed today that it plans to sequence 1,000 human genomes next year—and 20,000 in 2010.

October 6, 2008

15th Anniversary of New Genome Sequencing

At a time when it seemed that American science had bitten off more than it could chew with the Human Genome Project, Craig Venter and his innovative company published "A New Strategy for Genome

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Sequencing." Appearing in the journal *Nature* in 1996, the Venter multicenter approach bypassed laborious gene mapping and allowed the HGP to meet its goal of full sequence information on the human genome in 2000.

"In the race to sequence the human genome," write the editors of *Nature's* DNA Technologies Milestones, "research groups had to choose between the random whole genome shotgun sequencing approach or the more ordered map-based sequencing approach."

The choice of randomness versus order was present from 1982, but the Venter strategy was resisted for many years. Finally, in 1996 it was accepted and given an equal emphasis with the more-orthodox approach.

After a standoff between the two groups of scientists, "a showdown ensued, with the biotechnology firm Celera Genomics wielding whole-genome shotgun sequencing and the International Human Genome Sequencing Consortium wielding map-based sequencing. Yet when the dust settled, it was a draw—both groups published their initial drafts of the human genome concurrently in 2001."

The maverick technology helped make high throughput genomic sequencing at commercial labs an economy reality and gave birth to a range of new DNA tests within the reach of ordinary consumers like you and me. Today, 15 years later, those interested in autosomal ancestry testing and personal genomics have biologist and entrepreneur Craig Venter and his irascible persistence as a scientific pioneer to thank.

November 21, 2011

Gazing into the Crystal Ball

Genome-Sequencing Anniversary

The Golden Age of Human Population Genetics

Molly Przeworski

Science 331/6017 (4 February 2011) 547

doi: 10.1126/science.1202571

The first draft of the genome provided the road map for the past decade of research in human genetics, allowing for the design of platforms that have been used to query variation in populations worldwide and helping

to drive down the cost of sequencing by several orders of magnitude.

Within years, tens of thousands of complete genome sequences will be available from humans and from extinct hominids, as well as from thousands of other species. Given the human mutation rate, we will soon know of variation among individuals at almost all sites in the genome.

For population genetics, this ushers in a previously unimaginable opportunity to reconstruct the entire genealogical and mutational history of humans and pushes us against the limits of what we will be able to infer about the evolutionary and genetic forces that affected every region of the genome. Why are disease mutations present in human populations? What is the genetic basis of our cognitive and physiological adaptations? What was the sequence of demographic events that led to the colonization of the globe by modern humans? Stay tuned, and before long, we should know as much as genetic data alone can tell us.

Yes, we've heard exalted claims before, like 10 years ago, when the next phase of the Human Genome Project was to be devoted to the "conquest" of disease. How many diseases have been conquered in 10 years, after billions of research dollars? Guess. None.

And as far as population genetics goes, the whole story of "classic" Darwinian evolution seems to be unraveling before our eyes with every passing month (except of course in textbooks and the creationist opposition, where it never changes). If we can't be sure about evolution, how can we decide what is true about early human migrations?

February 5, 2011

Ancestry Painting and Global Similarity

We were surprised to see what DNA testing companies are calling their autosomal products these days. Ours is the DNA Fingerprint family of products, but 23andMe calls their entry "Ancestry Painting and Global Similarity" and "Personal Genome Service." Others offer "Genetic Ancestry Analysis," "Family Finders," and "Ancestral Origins."

Before the introduction of DNA fingerprinting for ancestry purposes, DNA testing was limited to the father's male line or mother's mitochondrial lineage. Newer autosomal tests can be taken by a male or female. They analyze all your lines at once, not just the two traditional ones of genetic genealogy. Autosomal DNA is the great equalizer, but it's

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not being marketed very adroitly.

A beginner's class titled "Ancestry Tracing with an Autosomal DNA Test: Conceptions and Misconceptions" will be presented by DNA Consultants principal investigator Donald N. Yates, Ph.D., at the upcoming Arizona Family History Expos on January 22, 2011. It will provide an overview of autosomal DNA tests that are capable of yielding a more-complete picture of your family tree and its roots. Covered are the science and history of DNA fingerprinting, what markers are delineated, the databases used for finding matches, and methods and strategies for interpreting your results, including follow-up websites, social networking and readings.

December 4, 2010

A Biography of DNA

Book Review: *The Language of Life* by Francis S. Collins
Nature 463 (21 January 2010) 298-299

Abdallah S. Daar in reviewing this new book by National Institutes of Health director Francis Collins maintains "we have entered the era of rapid, inexpensive genetic testing and genome sequencing" and must simply come to terms with the phenomenon of personal genomics and consumer genetics. In the next decade, he predicts, the price-tag for sequencing a human genome will drop to a few hundred dollars. The cost for the Human Genome Project was about \$3 billion over 13 years.

Collins' book is *The Language of Life: DNA and the Revolution in Personalized Medicine* (Harper/Profile: 2010).

February 3, 2010

Yes, We Have No Patents

Can someone patent your DNA? Not anymore. It sounds Kafkaesque, but this practice has been business as usual in certain companies for three decades according to Jesse Holland in his AP article, "Court says Human Genes Cannot Be Patented."

This month the Supreme Court unanimously voted to deny patents on unaltered human DNA. The action invalidates more than 5,000 patents.

Yet, the court opted to approve patents on genetically altered DNA. Just what is the difference, and what does it mean for consumers?

Justice Clarence Thomas wrote that "a naturally occurring DNA segment ... is not patent eligible merely because it has been isolated" ("Supreme Court Bars Patents on Unaltered DNA" by Dianna Stafford). In other words, finding something in nature is not the same as inventing something.

According to Holland the court has said, "Laws of nature, natural phenomena and abstract ideas are not patentable."

Imagine that the first person that found a banana got a patent on it. Forget banana cream pie, banana pudding, or banana and peanut-butter sandwiches. Bananas would be exorbitantly expensive. Why? No one else would be allowed to grow bananas because that person would have a monopoly. It would be, "Yes, We Have No Bananas," for real.

Remember Angelina Jolie? We weren't just shocked that she had a preventative, double mastectomy by choice. We were shocked at the sticker price for the test that determined that she had a faulty gene and had inherited a higher genetic predisposition for breast cancer. Some \$3,000. The test was too expensive for most women to even consider. And why? According to Holland, the company sells the only BRCA (diagnostic) gene test because it holds the patent and can keep the cost prohibitive." This means "their patents allowed them to have a monopoly on genetic testing for hereditary breast and ovarian cancer."

In other words, no one else could sell you this test. This company is not the only one that has such a patent, but it has been the deciding one for this case. Jason Koebler quotes Larry Brody of the National Institutes of Health's genome-technology branch as saying "the ruling will make the field of diagnostics, at least for breast cancer, much more open."

As the case was brought on by the American Civil Liberties Union, he also quotes Sandra Park, of the ACLU's Women's Rights Project as saying, "Today, the court struck down a major barrier to patient care and medical innovation ... because of this ruling, patients will have greater access to genetic testing and scientists can engage in research on these genes without fear of being sued."

And according to Stafford, biotech-research companies will continue to thrive as the court has ruled that so-called complementary DNA, or "cDNA," which is manipulated in laboratories, "is patent eligible

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because it is not naturally occurring." She quotes Meeta Patnaik, a life-science diagnostics consultant working with Kansas City-based MRIGlobal and other clients on the greater importance of synthetic DNA for biomedical research:

In the long run, patentability of synthetic or cDNA may be more important for the continuation for biomedical research ... Myriad actually was one of the few with patents on actual genes with no manipulation ... Most other patents are method or process patents that include manipulation of the genes. Advances in technology already were enabling other manufacturers and developers to overcome these patent issues, so the impact is not as significant as it could have been.

In other words, the future has arrived. And, yes, it has more genetic-testing choices for consumers and patients.

June 21, 2013

The Remaining 10 Percent

Human Genome Was Sequenced, Right?

Well, not completely. According to Larry Moran, a professor in the department of Biochemistry at the University of Toronto, "We can say that only 90 percent of the human genome has been sequenced and the remaining 10 percent falls into 357 gaps scattered throughout the genome."

Read all the numbers at Moran's blog "Sandwalk—Strolling with a Biochemist."

February 6, 2012

DNA: Storage Medium of the Future

One strand would hold libraries of digital information

The next decade's version of Facebook, Twitter, or Pandora could be digitally encoded on DNA. How? The next app? A card in one's wallet? Who knows?

This is not a new idea. It has been suggested before that entire libraries of information could be encoded on DNA and others have tried it without success. But no one thought it was possible until, according to an article

in *Nature* by Monya Baker, "DNA Data Storage Breaks Records," reported that a team of Harvard researchers encoded a book on DNA and said there was plenty of room for more. A lot more. The possibilities could be limitless.

Cells die and replicate, so using cells is not a very secure system. The team, led by George Church, a synthetic biologist from the Medical School in Boston, devised a new system using ink to convert the data onto glass chips instead of cells. It worked. Of course, we're a long way from understanding this completely. And there are problems. It isn't feasible at the moment to encode an entire library onto DNA. It is far too costly. You can't use DNA to drive your computer instead of your hard drive. But it could happen. At first, many thought no one would want to drive a car, fly in an airplane, or even use a computer. In a similar manner, this could be the first glimpse of ushering in a new era just as all those were. How exciting!

But what would be the advantages? Durability and security of limitless information. Imagine what we would know if we could still go to the Library of Alexandria. Even today, beyond the everyday virus, there are talks of cyberwars and cyberthreats that could potentially shut down vast data and threaten the security not just of your personal computer but of nations. What if we no longer had to worry about those things? How would that change our world?

Also, if DNA can store this much information, what is being stored on it now that we don't even know about? What libraries of information are on our own DNA that we have yet to read? What will it tell us about ourselves in the future that we have yet to discover?

December 27, 2013

An Autosomal DNA Test Reflects How Unique You Are

It is great to be a part of any team, whether it is playing football for the Dallas Cowboys, or just working with your co-workers at work, but you are also an individual. In the same way, you may have patriotic pride in knowing you are an American, or lay claim to roots from any other country, but that isn't the whole story.

For instance, you are more than just an American if you come from

America. America has long been known as the melting pot of nations. In fact, 99.9 percent of us with the exception of some members of isolated tribes, like the Hopi and the Seminole, have ancestors from all around the globe. An autosomal DNA test will reflect how unique an ancestry you have and show you your top matches to specific regions. What objections could there be to that? Here are some answers to the most common ones:

"We are all related anyway if you go back to Adam." This argument is only half true and is too simplistic an analysis. It reflects the idea that we are all mixed, and while that is mostly true, the implication that we all have the same ancestry is not true. Some people may have no ancestry at all from a certain region. Also, even if two people both have Spanish-Portuguese connections, one may have a stronger genetic connection than someone else.

"I already know who my ancestors are." That is wonderful that you already have some knowledge of your ancestry. It is a great place to begin, but it isn't all you can discover. Why not? There are always gaps in our knowledge when it comes to genealogy whether from skeletons in the closet or typos on a census or unknown adoptions. Most people only know about one or two lines very well. Even if your data is perfect, an autosomal DNA test can test for some 100 lines of ancestry in a comprehensive manner on both sides of your family and can uncover hidden lines and deep ancestral markers. There are always surprises.

"I already had a DNA test." A lot of people do not understand that there are different types of DNA tests. They tell you different things, are based on different science, and cannot be compared. If you took either a Y-DNA (Male) test or a Mitochondrial (Female) test, those tests only look at those lines. Also, the information you get depends on the size of a company's academic database/s. If you go to a large library in a big city, you can check out more books than if you go to a rural library in a small town.

"I don't care about my ancestry." I find this the oddest objection to getting a DNA test. How could you not care who your ancestors were? Their story is part of your story. It might be why your family had certain traditions, for instance. And that is a story you can hand down and share with others.

March 7, 2012

Replace Shoe Leather with DNA

What do you know about your family history? Most people do not know much beyond their grandparents. If you want to get started discovering your personal genealogy, where do you begin? You begin with careful research.

My husband and I got started researching our family genealogy the old-fashioned way. We drove to archives and libraries. Sometimes, we drove for hundreds of miles to only arrive an hour or so before the library closed. We nearly went blind looking at microfiche to run down some of our Native American and other ancestors hopping from one county line to the next and giving the census taker a slightly different name each year. Most people look for royalty. I was beginning to think some of our ancestors were outlaws.

This was long before Native American DNA testing or any direct-to-consumer DNA testing for ancestry became possible.

However, genealogy is a good place to begin if you want to become familiar with your ancestors. First, find an online genealogy program. Depending on what you want, some are free and some are not. Fill in your parents' names and what you know in a family tree and print it if you wish. Next, call up or go interview as many relatives, especially elderly relatives, as you can. It might be good to record them. Make sure you ask about specific dates and places and think of significant life events when it comes to genealogy: weddings, funerals, military records, adoptions, etc. Don't forget to ask them stories about your family history. Ask them if there are any secrets hidden in your genealogy. Of course, it doesn't mean they will tell you, which is why you may want to finally do some DNA testing. Why? DNA, unlike people, doesn't lie.

After you have all this information, you can start to work on an online family tree. Fill in what you know and slowly begin work on the rest. Just do so carefully. Do not copy unsourced genealogy information into your family tree. This is a common error. Just because someone published their family tree, does not mean all their genealogy information is correct. Every ancestor in your family tree should have a record, like a census record or military record, attached.

No matter how hard you work on your genealogy though, you cannot find everything because of adoptions, hidden lines, missing records or

misinformation like name changes. For these reasons, some of your information might be wrong, or you may have overlooked something. Consequently, you might want to look at what is called Genetic Genealogy or DNA testing for ancestry to provide more clues to your ancestry like deep ancestral markers or hidden genetic connections. The male and female DNA tests (Y-chromosome and mitochondrial tests) will give you information only about those particular lines and link you with cousins. An autosomal DNA test based on forensic science will provide a comprehensive analysis of your ancestry matching you not to people but populations.

What better hobby than to discover your family's story?

May 8, 2012

Cooking the Data

Don't get me wrong. Fudge? I love fudge. And I can make some dream fudge because I come from a line of Southern belles who made fudge so divine that when these ladies served it and a few other Southern delicacies to General William Tecumseh Sherman in their antebellum home on their rose-dappled china, he decided not to burn down Savannah, Georgia, after all. But fudging? I hate fudging. And professional genealogists and scientists are not immune. Fudging facts has become a national pastime.

And not everyone who claims to be a professional is one. According to Kimberly Powell in her *About* article, "5 Family History Scams to Avoid," some so-called "professional" family historians are making a career out of recreational genealogy when they aren't qualified:

It is relatively easy for an amateur family historian to set up shop and charge money for tracing family trees. This is absolutely acceptable as long as the genealogist in question does not misrepresent their abilities or training ... Just because a genealogist doesn't have professional certification doesn't mean they don't know what they are doing. Professional genealogists are not usually licensed ... However, there have unfortunately been cases where people have been easily misled ... There have even been cases when so-called genealogists have "faked"

genealogical data to produce family histories for their clients.

Just that happened to me. A so-called "professional genealogist" called me up wanting to put my family tree in his genealogy book as he was writing about a line of mine. My people in a book! Then he said, "I really couldn't figure out how you were related to William, so I just made the assumption you were." Trouble is I really couldn't figure out how I was related to Irish William either, and I don't think I am.

As it turns out, this line is mixed with Native American and Melungeon ancestry. And almost all the males were named John for some reason. As soon as I had located one John, he had packed up his gear and mules and moved across the county line with all his family.

I learned much later that in the early days of this country, you had to play a game of "chicken" with the law. Why? The law might be more on your side in one county than another. And you had to keep up with it. He would go back and forth across state and county lines with slight misspellings of his name. Finally, he seems to disappear as far as the census records are concerned. I have had several different endings for the last John in this line play in my head—left with the Natives, took a ship to South America, got killed by a mountain lion, and so on. To this day, people will say to me, "Aren't you a cousin of so and so?" because they assume I am related to William. I just say, "If you just want to fudge the facts."

Initially, I was shocked about the assumptions the genealogist made but found out later this is common. Many people just connect dots. Don't facts matter anymore? They make the assumption that because someone else said so and so is a relative that it is true without checking the data themselves. Many download family trees instantly thinking they don't need to do any real work. Fudging will do. What a world of Wonderland we live in.

And the problem with surnames is largely ignored in articles like "What's in a Name? Y Chromosomes, and the Genetic Genealogy Revolution," by Turi E. King & Mark A. Jobling (*Trends in Genetics* V25 18 August 2009 351-360). King and Jobling even state that if you share a paternal surname with someone, then you have a far greater likelihood of being related to that person ignoring much data. This ignores the well-known fact that many immigrants changed their names

once they arrived to cover up Jewish or exotic ancestry and "Americanized" their names. It ignores the also well-known fact that some slaves took names of their masters. The craze for surname searches also ignores a rather glaring fact: Not all these lines are the same with the same origin. In fact, I only have one line that has only one immigrant. This means anyone in the United States that has that surname is related to me. But that is rare.

Unfortunately, faking the data is not just for genealogy. Science is not without their fudgers either. In an article titled "Disgrace," Charles Gross, a professor of psychology and neuroscience at Princeton University, reviews the whole subject of contemporary and historical scientific misconduct (*The Nation*, Jan. 9/16, 2012, pp. 25-32). He finds nothing new in the shocking case of Harvard's Marc Hauser, who was exposed two years ago for scientific misconduct, in of all fields, the biological basis of morality and genetic inheritance of doing evil.

Hauser apparently was guilty of the sin of fudging facts. The three ways to do that, all frowned upon, are by fabrication (making data up), falsification (altering or selecting data, cherry picking) and sheer plagiarism (which all but entering freshmen understand). But in fact, there is a long line of fudgers. For instance, in 1830, computer-science pioneer Charles Babbage published a book in which he distinguished "several species of impositions that have been practiced in science ... hoaxing, forging, trimming, and cooking." Babbage believed that forging was uncommon. Rarely are results completely counterfeited and pulled out of thin air.

For example, Gross classifies the Piltdown man as an example of hoaxing. This fossil combining parts of an ape and human skull was discovered in 1911 and not discredited until the 1950s. Most hoaxes are intended to poke fun at the public's credulousness, but the Piltdown hoax was undertaken by well-meaning British imperialists who hoped their construction would fill an awkward gap in the record. I suppose they were thinking, "If the missing link does not exist, we will just invent one."

"Trimming" is probably a form of scientific misconduct that few scientists confess to their most-exacting monitors such as the National Science Foundation but rather quietly cover up in bland hypocrisy. It consists of "eliminating outliers to make results look more accurate,

while keeping the average the same." Who has not committed that little white sin? Let him who is without self-assurance cast the first chad.

"Cooking," on the other hand, the purposive selection and distortion of data, might be a real concern for all of us. Gross goes on to inspect the career of Harvard's "war crimes professor" Richard Herrnstein, who became a co-author after his death of the book *The Bell Curve* about racial differences in intelligence. It is not a very pretty kettle of fish.

But what of our scientific heroes? Like Darwin? It is thought that Charles Darwin either essentially stole the idea of natural selection from Alfred Russel Wallace, the father of biogeography, or at the least, failed to credit some of his predecessors in his rush to fame and self-glorification.

Personally, I prefer my line of real fudge makers to anyone stretching the truth or downright fudging the data any day. Real fudge is a lot tastier going down.

January 10, 2012

Autosomal Testing the New Standard

How fast does the molecular clock tick? Americans, especially, like most everything fast. We don't think too much about the word slow. But two scientists have changed our minds about that. As often happens in science, two research teams independently reached the same groundbreaking results. The breakthrough in the present case concerns the mutation rate of DNA and has profound implications for human evolution as well as for autosomal DNA ancestry analysis.

What is the DNA mutation rate? This is the rate at which a genetic marker mutates or changes over time. James X. Sun et al. in the recent article in *Nature Genetics*, "A Direct Characterization of Human Mutation Based on Microsatellites," and A. Kong et al. in the recent article, "Rate of de novo Mutations and the Importance of Father's Age to Disease Risk," in *Nature* both made an important, recent discovery. The speed of mutation in DNA is slower and more stable than previously thought. They discovered this how? By the magic of math.

How can math help us discover our ancestry? DNA is stable. Because it is so stable, we can calculate our way all the way back to when we swung in the trees and threw guavas at gorillas. (Even early man was in the trees longer than previously thought according to Charles Choi in his

recent article in *Science*, "Early Human 'Lucy' Swung from the Trees.") And these calculations lead us to the stories of our ancestors.

What does this mean concerning autosomal DNA ancestry tests? They have even more scientific validity. Second-generation DNA ancestry testing is based on these very genetic markers, and that is confirmation that the alleles on your DNA that are examined using a statistical basis have been relatively unchanged for the past 20,000 years. That easily comprehends the period we know as world history and provides a time frame for valid inferences about population patterns and ancestry of individuals.

These common and not-so-common markers that everyone has are behind the method making it possible for anyone to take an autosomal ancestry test. Autosomal or non-sex-linked markers change at a much slower rate than the Y chromosome, for instance, which seems to be highly changeable, depending on the father's age (Kong 201). The Y chromosome is a marker only males have. It is used for other types of tests: male, haplotype, sex-linked DNA tests. Only males can take these tests, and it only provides information about that one male line.

Who knows what our DNA has yet to tell us? Or what DNA tests there will be in the future. This is an exciting new field. But what you can know now with a true and thorough autosomal DNA test is more than most realize is possible. The DNA Fingerprint Test is a simple test anyone can take that gives you a comprehensive snapshot of your cumulative ancestry.

September 15, 2013