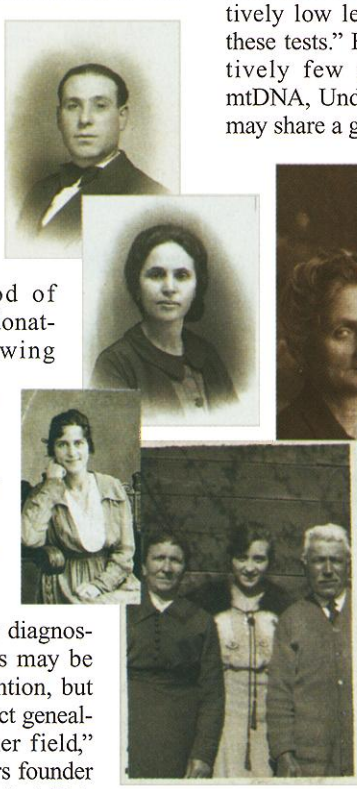
SCIENCE AND COMMERCE

Tangled Roots? Genetics Meets Genealogy

Genealogists are discovering the new high-tech tools of genetic analysis, but they may hope for more history than current techniques can deliver

Genealogy meetings are usually familiar affairs. Family historians swap stories and standard tools of the trade—faded maps, old census data, hot Internet sites. But the 700 participants who showed up for the 10th annual GenTech conference in Boston last month got a glimpse of the future. In the exhibit hall, Oxford Ancestors, a U.K. company, and Relative Genetics, a Salt Lake City lab, advertised cheek-swab tests that, for about $220, deliver a "genetic identity" by mail. Nearby, employees of Brigham Young University (BYU) in Provo, Utah, drew the blood of some 200 volunteers donating DNA to a growing genealogical database. And inside darkened lecture rooms, scientists wowed crowds with colorful tales of ancient blood ties.



Welcome to the latest commercial frontier in the genome revolution. Drug development, new diagnostics, and designer genes may be getting most of the attention, but "genetics is going to affect genealogy faster than any other field," predicts Oxford Ancestors founder Bryan Sykes, also an Oxford University geneticist. Unlike the hazy genetics of, say, disease susceptibility, ancestry is strikingly simple, Sykes says: Fathers pass down Y chromosome DNA (Y DNA), and mothers mitochondrial DNA (mtDNA), generation after generation. "There's no proof of principle needed," says Sykes. "We can glean masses of information for genealogists with simple genetic tools."

But the commercial marriage between genetics and genealogy is raising some concerns. The genetic tools, most agree, are still rudimentary, and interpreting genetic data can be vexing. "The statistics are not always easy," comments geneticist Mark Jobling of the University of Leicester, U.K. "And that can be hard to put across fairly to a customer." He and others worry that customers walk away with fuzzy statistics and fantasy. "I think these companies have a role to play, as long as the science is done well," remarks Peter Underhill, a molecular anthropologist at Stanford University. "My concern is that people comprehend the relatively low level of resolution offered by these tests." Because the tests analyze relatively few markers along Y DNA or mtDNA, Underhill says, millions of people may share a given molecular profile.

Blood ties. Relatives look alike, and so do their DNA sequences. Genealogists hope genetic tests will help build family trees.

FAMILY PHOTOS: K. BROWN

The quest for roots

Genetic genealogy does have a reputable pedigree. In tracing an individual's origins, these companies are adapting the same tools that population geneticists have used over the past 20 years to retrace ancient human migrations. In 1989, Sykes became the first to report recovering ancient DNA from archaeological bone. Since then, he has delved into the DNA of the so-called Ice Man, Cheddar Man, and other historical mysteries.

Along the way, Sykes, among others, realized that there's another market for this DNA detective work: genealogists. Today, four fledgling companies (see table) specialize in genetic genealogy. If they succeed, others are sure to follow. After all, who doesn't want to know where he or she came from?

Some clues are hidden in mtDNA, a tiny ring of genes that coils inside the mitochondria. Building a database of European mtDNA over the past decade, Sykes recently concluded that 95% of Europeans descend from just seven women, described in his provocative 2001 book *The Seven Daughters of Eve*.

But Y DNA tends to be the genealogist's tool of choice because it's handed down from father to son, as are most surnames. The two make a powerful combination. Five years ago, geneticist Michael Hammer of the University of Arizona in Tucson and colleagues studied Y DNA from Jews to validate the legend of Cohanim families, a Jewish priesthood handed down from father to son for 3000 years.

For both mtDNA and Y DNA, the historical clues are mutations, slight variations that distinguish the Smith family's genetic sequence from the Jones's. Some of these mutations are simple DNA substitutions, say a G for a C. Others are microsatellites, or sequence repeats, in which short strings of DNA repeat over and over.

The unique pattern of these mutations creates a person's genetic signature, or haplotype. By comparing a set of mtDNA or Y DNA markers from two people, researchers can determine whether they are likely to be distant relatives. They can even gauge roughly when their common ancestor lived: Was it a New York immigrant 200 years ago, or someone in Iberia centuries earlier?

Where do I come from?

If you suspect that your roots are European, Oxford Ancestors offers to take you back thousands of years. Aside from writing the check, it's an easy test: Simply swab the inside of your cheek, a ready source of DNA, and mail the swab. Company scientists will compare your mtDNA to the seven ancestral mtDNA sequences isolated by Sykes: the so-called seven daughters of Eve, who lived 10,000 to 45,000 years ago. Some weeks later, an "authorized certificate, suitable for framing" will identify your primal mother. She could be Ursula, Xenia, Helena, Velda, Tara, Katrine, or Jasmine, according to the names Sykes gave to each sequence's founder.

Although the mtDNA technique is reasonably accurate, some population geneticists sniff at the fanciful names and dramatizations. But that doesn't faze Sykes. "Academic snobbery," he retorts.

Similarly, Family Tree DNA in Houston, Texas, offers a Native American ancestry

test. For $319, the company will scan a customer's Y DNA for a genetic marker carried by more than 70% of male Native Americans. Another test, for men or women, compares a customer's mtDNA to that of five known Native American groups that share the same haplotype.

Although the tests point to probable Native American origins, they can't distinguish tribes or meet stringent court guidelines for definitive ancestry, cautions Family Tree DNA founder Bennett Greenspan, a Houston entrepreneur. "We can't tell whether someone's Choctaw or Cherokee," says Greenspan, whose company contracts with Hammer's University of Arizona lab for all DNA analysis.

Are the results accurate? That depends. Some populations, such as Native Americans and Jewish Cohanim families, do have strikingly unique genetic signatures: specific mtDNA or Y DNA mutations unique to that population. In those cases, genetics and genealogy do combine to craft a more likely family history than genealogy alone can.

Yet at least one geneticist has been accused of prematurely seeking profit from genealogy. Several years ago, geneticist Rick Kittles of Howard University in Washington, D.C., contributed to a project on DNA from skeletal remains of African Americans, funded by the National Human Genome Research Institute (NHGRI). Shortly afterward, Kittles announced plans to go commercial, by offering African Americans a $300 blood test to compare their DNA with a database of African ancestral DNA—promising a glimpse of the geographic regions, or perhaps even tribes, of native ancestors. But when a colleague blasted the research as too preliminary, Kittles found himself back-stepping, while Howard assured NHGRI that he wasn't using grant money to build a business. Today, Kittles says he's looking for commercial backers for the African Ancestry Project.

Where are my relatives?

While drafting a family tree, many genealogists hope to fill in more recent branches by finding relatives who are alive today. In fact, Family Tree DNA's most popular service is a sort of "family reconstruction" project, comparing the genealogy and genetics of at least six people who share a surname.

But confirming a distant cousin is just as tricky as finding a founding ancestor. Some Y chromosome haplotypes are more common than others. Researchers are still learning how frequently various haplotypes may occur in the general population. "If you have a kind of Y chromosome that's got a 10% to 20% frequency, then to find two males share this Y chromosome may not be very significant," says Leicester's Jobling.

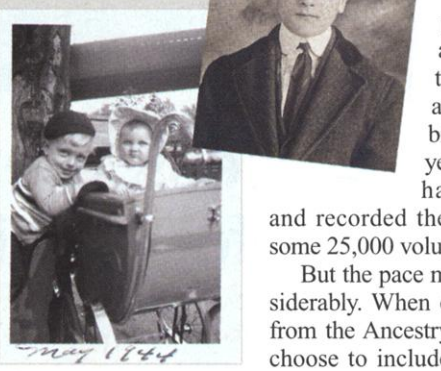
The most basic Y chromosome test offered at Family Tree DNA compares a dozen microsatellite markers among men. At that resolution, the company predicts that even an identical Y chromosome match means two men have just a 50% chance of sharing a common ancestor within the past 14.5 generations, or about 363 years. At best, the company's most sophisticated test would compare 21 Y DNA markers between the men—with a perfect match suggesting that they have a 50–50 chance of sharing a common ancestor within the past 250 years. In other words, you won't find your great-grandfather this way.

Family Tree DNA
www.familytreedna.com
12-marker and 21-marker DNA tests
Native American test, using Y DNA or mtDNA
Family reconstruction

Oxford Ancestors
www.oxfordancestors.com
MatriLine (mtDNA) test to trace European roots
10-marker Y DNA test
Viking Y chromosome test

Relative Genetics
www.relativegenetics.com or www.ancestry.com
23-marker Y DNA test
mtDNA genetic signature
Native American test, using mtDNA

GeneTree DNA
www.genetree.com
Partners with Relative Genetics, using the same tests



But Ron Lindsay, a retired IBM engineer in San Jose, California, isn't complaining. He has been documenting Lindsays worldwide for 40 years. And he hopes that Y chromosome tests of some Lindsays, planned at Family Tree DNA, will place him in an obvious clan: "If there are 500 Lindsay lines I could belong to, and our DNA can narrow that down to four or five, then that's a great tool."

History really begins to blur, however, when Y chromosomes are close—but not identical. If, for example, two men share a Y chromosome haplotype except for two mutations, Sykes says, chances are they shared a common ancestor 20 to 40 generations (500 to 1000 years) ago. "That's a long time ago," Sykes concedes. Such tentative ties, so far in the past, may not satisfy customers searching for a sense of family.

Another challenge is getting the molecular clockwork right. To trace back the time of a common ancestor between two men, researchers calculate roughly when any mutations in their DNA evolved. But that requires estimating how rapidly each Y DNA marker mutates—and those mutations vary considerably. "There are layers of complexity," Jobling says, "that could at some level be used to call into question any genealogical study."

That doesn't deter entrepreneurs. At the January GenTech conference, Relative Genetics announced a new partnership with MyFamily.com Inc. Together, the partners now offer the "Ancestry GenetiKit" via Ancestry.com, a popular Web site for genealogists. The Ancestry GenetiKit touts a 23-marker Y-chromosome test, an mtDNA Native American test, and mtDNA sequencing, among other services.

The ambitious efforts of Relative Genetics reflect the science—and optimism—of its lab director, BYU geneticist Scott Woodward. At BYU, Woodward is attempting to build "the world's most comprehensive genetic database." His team aims to collect DNA and genealogical histories from at least 100,000 people and then correlate that information, creating a database that represents the gene pools of populations at specific places and times, like a historical atlas of genetics. It's a big job. After almost 2 years, the BYU project has drawn the blood and recorded the family histories of some 25,000 volunteers.

But the pace may soon pick up considerably. When customers order tests from the Ancestry GenetiKit, they can choose to include their DNA and genealogical information in the BYU project. The line between the business and academic projects could grow very fine.

In fact, as Sykes signed books and Woodward recruited DNA donations at GenTech, it was sometimes difficult to see where science left off and business began. In an interview before the meeting, Woodward mentioned the need to "keep people's feet on the ground," to explain that science cannot reveal all family connections. "I don't want to mislead, but I do want to inspire," Woodward said. At the podium, however, the allure of DNA is hard to deny. Describing tests that found matching Y chromosome haplotypes between two men, Woodward played to the GenTech crowd: "This is what we wanted to have happen. These individuals belong to each other, and the DNA confirmed that."

–KATHRYN BROWN