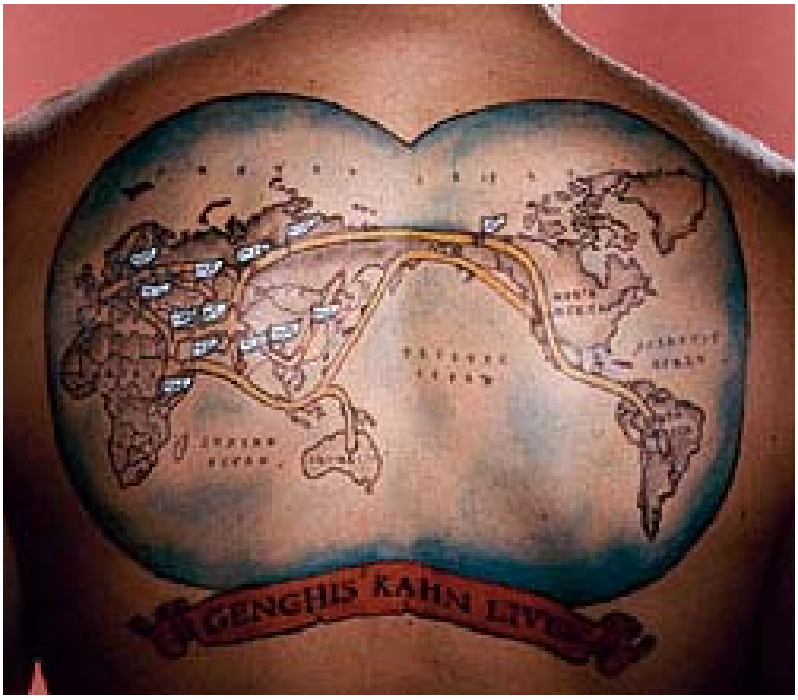
The Hidden History Of Men (Anthropology)

One day last fall, in the home freezer of Spencer Wells, there were these things: a large leg of lamb, a few quarts of milk, and underneath, DNA samples from 2,500 people in Central Asia. Wells is an anthropological geneticist and an energetic collector of DNA, especially Y chromosomes. He lived then in an old stone house outside Geneva, but he was raised in Lubbock, Texas. His own Y chromosome, like his name, hails from Connecticut—an ancestor was governor there in the 17th century. Before that, Wells's chromosome came from southern England, and before that, maybe 30,000 years ago, it came from Central Asia. From then and there to here and now, it was passed on, like an indelible stain, by a thousand fathers to a thousand sons, one after the other, until it ended up in Wells's father, a Lubbock lawyer, and then in Wells.

OUT OF AFRICA



Photograph by Grant Delin; Model: Ben Augustine/Gilla Roos; Tattoo: Leticia Valle

These genetic markers, denoted by the letter M, indicate where and when different Y chromosome lineages spread around the globe.

M168: 50,000 years ago
M130: 50,000 years ago
M89: 45,000 years ago
M9: 40,000 years ago
M45: 35,000 years ago
M173: 30,000 years ago

M20: 30,000 years ago
M242: 20,000 years ago
M3: 10,000 years ago
M172: 10,000 years ago
M17: 10,000 years ago
M122: 10,000 years ago

The DNA samples in the freezer, then, are samples of Wells's own roots—and of those of a good part of humanity. Before Wells collected the samples, the region was pretty much terra incognita, genetically speaking. Now some geneticists see it as a second font of human diversity. In Wells's view, the grasslands of Central Asia, so reminiscent of the East African savannas with their abundance of big game, are where the human race fattened up after it left Africa, 50,000 or 60,000 years ago. "It was essentially a meat locker," he says. "Loads of food. And that allowed them to build up the population density to then go out and move westward and then eastward."

The westward branch of humanity entered Europe; the eastward branch eventually crossed the Bering Strait and entered North America, and there the two branches met again in 1492. By that time they had come to seem very different from each other. Traces of how human beings had fanned out across the planet, acquiring superficial racial differences along the way, are written in our DNA and especially in the Y chromosome.

Before long, the record of that ancient migration will begin to vanish. Our ancestors took tens of thousands of years to spread around the planet; people today move from Lubbock to Geneva or from Tamil Nadu to Texas in hours. In the process they wipe out genetic clues to the past. Think of our genes as the vestiges of an ancient library in which geneticists are trying to piece together and decipher the books; now think of that ruin being paved over for a new airport. Archaeologists would want to mount a rescue dig—exactly what anthropological geneticists are doing these days. That, along with a young man's taste for adventure, is what has repeatedly sent Wells bouncing across the Central Asian steppes in a Land Rover. The DNA he has brought back records not just our distant history but also our more recent past—and in particular what happened around 800 years ago, when a prodigious fornicator named Genghis Khan splashed into the gene pool like a cannonball.

Wells is a tall, handsome man in his thirties, with strawberry blond hair and a chiseled face that quickly turns ruddy in the sun. Words stream out of him without a trace of a Texas accent—after Lubbock and before Geneva he went to Harvard and Stanford. He felt bottled up in Lubbock, he says, and is drawn to places like India, where you step out of a taxicab to face cows and crowds and people of many colors speaking strange languages: "It's incredible, and it's overwhelming. I love the feeling of being immersed."

At Harvard, where he got his Ph.D., Wells studied fruit flies with Richard Lewontin and became interested in understanding the reasons for genetic variation within a particular group. A population crashes due to disease, for instance, and is then restarted by a few individuals, or a few individuals migrate to a new, uninhabited region and start a new population. In both cases the genes of the founders become prevalent in the new population, even if they confer no particular selective advantage. "So much of what we see in the DNA, in genetic variation, is due to population events," says Wells. "Which is great, but I'm not interested in the population history of fruit flies. I am, however, very interested in the population history of humans."

Lewontin's advice was to go west, to Stanford, to work with Luigi Luca Cavalli-Sforza, the father of anthropological genetics. When Wells arrived at Stanford in 1994, Cavalli-Sforza's lab was just plunging into studies of the Y chromosome. Two researchers there, Peter Underhill and Peter Oefner, had recently invented a technique for rapidly finding DNA mutations—markers—at the same point in the genomes of two different people. The invention proved useful for tracing human migration. Most spontaneous mutations do neither harm nor good but simply accumulate in the genome, one at a time, as they are passed from one generation to the next. A mutation shared by everybody, therefore, must have arisen in everybody's common ancestor. The mutation marks the trunk of that population's family tree. Each successive mutation identifies a branching point, right out to the twigs at the tip of the tree, which represent individual humans.

Forensic geneticists use large numbers of markers to isolate and identify one of those twigs in a murder case. Population geneticists focus mostly on the bigger branches. A mutation that is near-universal in Asia, for instance, but near-absent in Africa is most likely a sign that somewhere in deep time a small group of founders with that marker left Africa and started a new population in Asia.

What complicates the picture, as it complicates so many things, is sex. DNA comes in chromosomes, and chromosomes come in matched pairs, and when a body makes a sperm cell or an egg, the two chromosomes in a pair recombine, exchanging large chunks of DNA. Over time, each chromosome becomes a patchwork of contributions from innumerable ancestors, both male and female. A recombined chromosome might tell you, for example, that your Ice Age ancestors came from Central Asia and a later ancestor was governor of Connecticut, but it would be missing their passage through England. Its story wouldn't make much sense.

That's why the Y chromosome has become the chromosome of choice for anthropological genetics. Unlike all the others, it has no matching partner, and only at its tips does it swap bits with the X chromosome. Remember: Men inherit a Y chromosome from their father and an X chromosome from their mother; women inherit an X from each parent. As a result the Y passes on largely intact from father to son, ad infinitum, each man adding at most a new mutation or two. The Y chromosome in every man on Earth today is thought to be more than 99.99 percent the same as the one carried by a common ancestor who lived 50,000 or 60,000 years ago. The tiny differences are the markers that record the spread of the human species around the planet—and which Underhill and Oefner's invention made much easier to identify.

HISTORY OF Y'S GUYS

The X and Y chromosomes carry the genes that determine sex. Men have one X, inherited from their mothers, and one Y, inherited from their fathers. Only 5 percent of the Y chromosome's DNA mingles with the X chromosome. The Y thus provides an unadulterated record of inheritance from father to son over generations. By analyzing Y chromosome samples from around the world, geneticists infer how and when humans originated in Africa and how they colonized the globe.

In the 1990s the Stanford group and Michael Hammer of the University of Arizona showed that "Adam" lived in Africa: The Y chromosome tree has its trunk and roots there. Earlier work with mitochondrial DNA—a nonchromosomal kind that escapes recombination, passing intact from mother to daughter—had shown that "Eve" lived in Africa too. Beginning around 50,000 years ago, the genetic evidence suggests, modern humans first migrated out of Africa. In his book, The Journey of Man, Wells sketches what is known of the subsequent story, but a lot of it is pretty murky.

As early as 1991, Cavalli-Sforza proposed the Human Genome Diversity Project: an effort to collect DNA samples from hundreds of populations worldwide. To Cavalli-Sforza and other geneticists who joined him, the proposal was altruistic in creating a record for all humanity of its history at a time when many of the world's smaller populations were facing absorption into a globalized culture. Some groups reacted with outrage at the suggestion that they donate their blood to Western science—it smacked of exploitation. Cavalli-Sforza's idea became hugely controversial, and the U.S. government never funded it. The research hasn't stopped, however. It has simply trickled on in a less organized way, driven in part by entrepreneurial scientists like Wells.

Cavalli-Sforza encouraged his young colleagues to pick an area of the world in which to do fieldwork. Wells picked Central Asia—"a black box—we knew nothing about it." Central Asia, to Wells, means the region from the Black Sea in the west to Lake Baikal farther east. It includes all the former Soviet "stans," from Turkmenistan to Tajikistan and on into Mongolia. It is a region of endless steppes cut by soaring mountains. It is, even today, an intimidating expanse of bad roads and many languages.

Wells's first expedition was to Uzbekistan, where in 1996 he and Ruslan Ruzibakiev, an immunologist at the Academy of Sciences in Tashkent, sampled DNA from 550 Uzbeks. There are more than 100 different ethnic groups in Uzbekistan. The chief result, Wells recalls, was that they needed to survey a much wider region if they wanted to understand the diversity of Y chromosomes.

That wider survey took place in 1998, and though it covered a lot of ground, Big Science it wasn't. It was five men crammed into a Land Rover, along with many boxes of syringes, tourniquets, and chemicals for extracting DNA from

blood. A small research grant from the Alfred P. Sloan Foundation paid for the equipment, but the Land Rover itself was donated by the vehicle's manufacturer. "We chipped in a little bit of our own money for living expenses," says Wells. "We also had friends who were very interested in this, who would give us a few hundred dollars here and there, which we collected in a big pot."

One morning in April they drove through the Channel Tunnel to France. They didn't stop to collect samples until they hit Georgia, because Europe's DNA is old hat. After that they didn't stop collecting until they had been to Kyrgyzstan and back, a total of 25,000 miles. They slept in borrowed rooms or offices, and even in yurts; they bonded with their local facilitators over streams of vodka. They had small adventures. A potentate in Uzbekistan insisted on driving the Land Rover; he gunned it and, top heavy with gear, it promptly rolled over. The man then hailed a passing car and left Wells and his companions nursing their bruises. Later, in Kyrgyzstan, a policeman tried to shake them down on the pretense that the Land Rover's color, red, was illegal. Wells stood firm.

One problem they did not have, he says, was getting blood donors. Local research contacts did a lot of the footwork, and the inmates of urban hospitals, both patients and staff, proved a rich source of blood. But Wells and his crew also visited factories and villages, sometimes going door to door. On occasion they found themselves staying for a dinner of, say, sheep intestines and koumiss, which is fermented mare's milk. "It's one of the worst things I've ever tasted," says Tatiana Zerjal, a graduate student who joined the expedition for a month in Uzbekistan and Kyrgyzstan.

To each donor or group of donors, Wells gave what he calls his blood speech, explaining DNA, the purpose of the expedition, their role in it, and then asking for "informed consent." On the television version of The Journey of Man, for which Wells traveled the world in 2002, retracing some of his earlier steps, he visits a man in southeastern Kazakhstan whose blood had been sampled on the 1998 expedition and who has turned out to have an important Y chromosome marker called M45. At a festive dinner, Wells gives him the blood speech again and concludes with a toast: "To your very important blood, which has brought us together." The man seems happy and relieved: As Wells candidly explains, he thought Wells had come back to tell him he had cancer.

Scenes like that demonstrate that truly informed consent can be an elusive goal in anthropological genetics, and yet it seems clear that Wells has done no harm to the man and has done our knowledge of the past a lot of good. M45 is an important branching point on the human family tree. One branch leads to M173, which is a mutation shared by most people of Western European descent. The other branch leads to M3, which is shared by most Native Americans. European and Native American men also have M45, but in Central Asia there are men, like Wells's Kazakh dinner companion, who have M45 but neither of the two later mutations—they have a large range of different ones instead. That indicates Central Asia is where M45 originated and where both Europeans and Native Americans originated, from a single source.

By counting the number of mutations that have happened since M45, Wells and his colleagues estimate that M45 is about 35,000 to 40,000 years old. The European marker, M173, happened roughly 30,000 years ago, which is when the first cave paintings appeared in France. M3 is present only in Native Americans, and so it must have happened after humans first crossed the Bering Strait and arrived in the Americas. Archaeologists have long debated the timing of that momentous event; most favor a date of around 13,000 or 14,000 years ago, but a few have held out for one as early as 30,000 years ago.

Wells argues that 30,000 years ago has to be the wrong date. The evidence is another marker, M242, that he and Mark Seielstad of Harvard identified. It arose after M45 but before M3, in the Asian population that was bound for America; Native Americans have M242, and so do some people still living in Central Asia. The Ice Age ancestors of Native Americans must have had that marker when they crossed the Bering Strait, and so the time of M242's first appearance puts an upper limit on the time of their passage. "We can definitely rule out a date prior to 20,000 years ago," says Wells.

Hammer and his Arizona colleagues, anthropologists Stephen Zegura and Tatiana Karafet, have recently confirmed that result. Their own Y chromosome collections tell them that the genetic separation of the Asian and American populations occurred no earlier than 17,000 years ago. And they think they have narrowed down a source region, an Asian ancestral home for Native Americans—the Altai Mountains of southwestern Siberia and western Mongolia.

The Altai is a remote region of 14,000-foot alps, deep river valleys, and large high-altitude lakes. “I think that has been a place where people have been for a long time,” Hammer says, “and have spawned many descendant populations. And I think some of those descendants ended up in the Americas.”

The Paleolithic migration into Europe, like the Paleolithic migration into North America, may have also departed from the Altai region, although it may have been from elsewhere in Central Asia or other locations. After 1492, in any case, those two great rivers of humanity, which had diverged 30,000 years earlier, began to converge again in America, and their waters commingled. Hammer estimates that 17 percent of Native American men today have Y chromosomes inherited from Europeans. (In African American men the European admixture may be from 5 to 30 percent.) These percentages show that history, and not just natural selection, has a big effect on the human gene pool—and that conquerors tend to spread their Y chromosomes.

EURASIAN JOURNEY

Graphic by Matt Zang

Spencer Wells and his team covered about 25,000 miles in their 1998 genetic survey of Central Asia. The map on the opposite page traces the expedition (red). The inset map shows the entire route and their return through northern Europe. The orange shading represents the approximate extent of Genghis Khan’s empire at the time of his death in 1227. Wells’s results show the presence of a particular Y chromosome variant in about 8 percent of the sampled male population in Central Asia. Because that variant originated in Mongolia not too long ago, Wells and his team contend that its prevalence in Central Asians reflects the influx of Genghis Khan and his powerful kin.

Genghis Khan was born east of the Altai Mountains, at the northern edge of the vast Mongolian steppe in 1162. His biographers agree, unsurprisingly, that he was driven by a lust for power. He was also driven by lust. Rashid ad-Din, vizier to a later khan, quotes Genghis as having said to have brought a new wife home from every campaign, maintaining a harem of 500. In his sixties and ailing, he crossed the Gobi Desert to massacre the Tanguts and died on that campaign.

The conqueror's body was carried back to Mongolia, but his tomb has never been found. A team of archaeologists led by John Woods of the University of Chicago has spent several summers searching for it. It is not just the physical remains of Genghis Khan that are missing, says Woods. Although he fathered a huge empire, there is no artifact that can be definitively linked to him. There may be something else, however. The idea first came to Tatiana Zerjal while she was looking at an odd pattern on her computer screen.

After the 1998 expedition with Wells, Zerjal returned to Oxford, where her adviser, geneticist Chris Tyler-Smith, then had his lab. While Wells screened the Central Asian Y chromosomes for single-nucleotide mutations such as M45, Zerjal searched for a different DNA variable called a microsatellite. A microsatellite is a short, repetitious sequence of DNA—CACACACA, for instance—in which the number of repetitions can change from one generation to the next and often does.

When a Y chromosome is passed from father to son, the chance that a specific single nucleotide will change from, say, T (thymine) to A (adenine) is on the order of one in a few tens of millions. But the chance that a given microsatellite will change from, say, 11 CA (cytosine and adenine) repeats to 12 is on the order of one in a few hundred. That's why a particular pattern of microsatellites can profile a particular individual—to show, for instance, as Tyler-Smith and Zerjal had done shortly before embarking on their Central Asian work, that Thomas Jefferson had fathered a son by his slave Sally Hemings and that his Y chromosome had been passed down to a man living in Pennsylvania today. In the human family tree, says Tyler-Smith, "the single-nucleotide polymorphisms give you the trunk and the main branches. The microsatellites give you the twigs at the end."

As Zerjal screened Central Asian Y chromosomes for 16 different microsatellites, one combination showed up repeatedly. It was far more common than expected, and men all over Central Asia had it—which is also not what you'd expect. "Suddenly, I thought, 'Wow, this is Genghis Khan,' " says Zerjal. At first, Tyler-Smith says, "We thought it was more or less a joke."

But as Zerjal worked through more than 2,000 Y chromosomes, the joke wouldn't die. On her computer diagram of how the chromosomes might be related, fully 8 percent of them clustered together in a starlike pattern, meaning they had either the identical set of microsatellites or one that differed at just one of the 16 locuses. Those mutations were most diverse in Mongolia, indicating that the original star-cluster chromosome had come from there. And judging from the small number of mutations it had accumulated, it came from there only about a thousand years ago.

It could not have spread so fast and so far by chance, yet natural selection made a poor explanation: The full sequence of the Y chromosome has been determined, but it doesn't seem to do much except make the bearer male. Zerjal and Tyler-Smith started reading up on Mongolian history. They noticed that the vast range of the distinctive star-cluster chromosome corresponded almost exactly to the extent of Genghis Khan's empire. The only outlier is a small ethnic group called the Hazaras, who live in northern Pakistan, which Genghis never conquered. The puzzling chromosomes are more frequent in the Hazaras today than in any other population, even the Mongols. But the Hazaras migrated into Pakistan from neighboring Afghanistan only in the 19th century, and they brought with them an interesting oral tradition: They claim to be direct descendants of one of Genghis Khan's battalions. Some even claim, with genealogies to back them up, to be direct descendants of Genghis Khan himself. The Hazaras don't refute the case, says Tyler-Smith; they cinch it. "It was a conclusion that was forced upon us."

That doesn't mean those Central Asian men have inherited some interesting trait from Genghis Khan, like his fierceness or his lust. To the extent that such traits are genetic at all, they probably involve many genes, none of which is likely to be on the Y chromosome. And although the rest of Genghis Khan's genome has certainly, if Zerjal and Tyler-Smith are right, made an outsize contribution to the Central Asian gene pool, it has been chopped to bits and mixed in so thoroughly over the centuries by genetic recombination that no one today is likely to have his whole suite of genes for any particular trait. What they have, in his intact Y chromosome, is more like an invisible birthmark.

Genghis Khan was not necessarily the first to have it; its rough age of 1,000 years suggests he inherited it from an ancestor, perhaps a great-great-great-grandfather. Nor was he the only one to spread it: His brothers, sons, grandsons, and some of his cousins would have had the same Y chromosome. His sons and grandsons ruled the empire he built; one grandson, Kublai, was emperor of China. Presumably they enjoyed sexual opportunities similar to Genghis's, and some were just as vigorous about exterminating competition. According to one chronicle written a century after Genghis's birth, there were more than 20,000 people of his lineage "living in the comfort of wealth and affluence."

To some geneticists, the whole story seems incredible. "It's complete conjecture!" says Underhill. "There are no living relatives of Genghis Khan that anyone can document, as they did for Thomas Jefferson. And the other problem I have is they estimate the age of that lineage to be about a thousand years—it could be easily 3,000 years old, depending on which mutation rate you use. You could have 3,000 years of this chromosome dispersing across Central Asia. You don't need to invoke Genghis Khan screwing every woman in sight. It just doesn't compute with me."

"What is the alternative?" asks Tyler-Smith. "We know from the genetics that this pattern originated in Mongolia or nearby a thousand years ago or some similar time. So the alternative to its being spread by Genghis Khan is that his Y chromosome, despite his reported 20,000 descendants, is not visible in the genetic record now, but that of another person has spread in this unprecedented way. To me that is just less plausible. I think it was his military ability that allowed it to spread. If it hadn't been for that, it would have been just another low-frequency chromosome."

The fastest and most famous case of evolution by natural selection is the case of the British peppered moths: In the 19th century, as mills and factories began to darken the air with soot, a rare all-black mutant quickly became more common in Britain than the normal white moth with black spots because it was less conspicuous to predators. Genghis Khan's Y chromosome, says Tyler-Smith, spread at a comparable rate through Central Asia. "It shows that a kind of social selection can operate in humans, whereby people inherit status and the reproductive advantage that goes along with that," he says. "It can have a large effect on the genetics."

Man does not evolve by natural selection alone. Darwin even believed that sexual selection—in choosing mates, we choose the genes we pass on to the next generation—was a more important source of "differences in external appearance between the races of man." That idea has never really been tested, says Wells. In recent decades geneticists, beginning with Richard Lewontin, Wells's adviser, have clearly showed how insignificant the genetic differences among races are: The diversity within any single population is far, far greater. "But, by God," says Wells, "I can tell the difference between somebody who comes from the Outer Hebrides and someone who comes from Cambodia. They look different." Science has yet to explain that.

How humans settled the planet, in prehistoric and historic times, and how they came to be so diverse, are interesting questions for anthropological geneticists to tackle, if only those questions can be freed from their association, in some people's minds, with racism and colonialism, and if only the geneticists can get enough support. But they face another more difficult problem: globalization. People today are feverishly uprooting themselves and their Y chromosomes, moving, as it were, from Cambodia to the Outer Hebrides, from their yurts into the nearest multiethnic city. All the lineages Wells has found in Asia, he likes to say, could probably be found in a single nightclub in New York City's East Village, engaged in precoital rituals. "Socially, I think it's fantastic," Wells says. "It just makes my life bloody difficult." A geneticist taking samples in that nightclub would be like a wine lover who never gets to see the labels: He would find tremendous diversity, but without geographic context it would be meaningless. He would be powerless to understand the fantastic migrations that had brought all those different people to that one place and time.

We are headed toward a world in which we will have erased the historical record in our genes just as we have acquired the means to read it. For several years now Wells has been trying to organize an effort to do on a global scale what he already did in Central Asia—similar to the ill-starred Human Genome Diversity Project. The idea is simply to preserve a genetic snapshot of humanity. "It's the sort of thing where, once you lose the information, you're never going to get it

back," he says. "It is our single, unique human history, and it would be nice to know what that is as we hurtle into the future and start to change our own genetics.

"The clock is ticking. We need to get out there and do some more sampling."