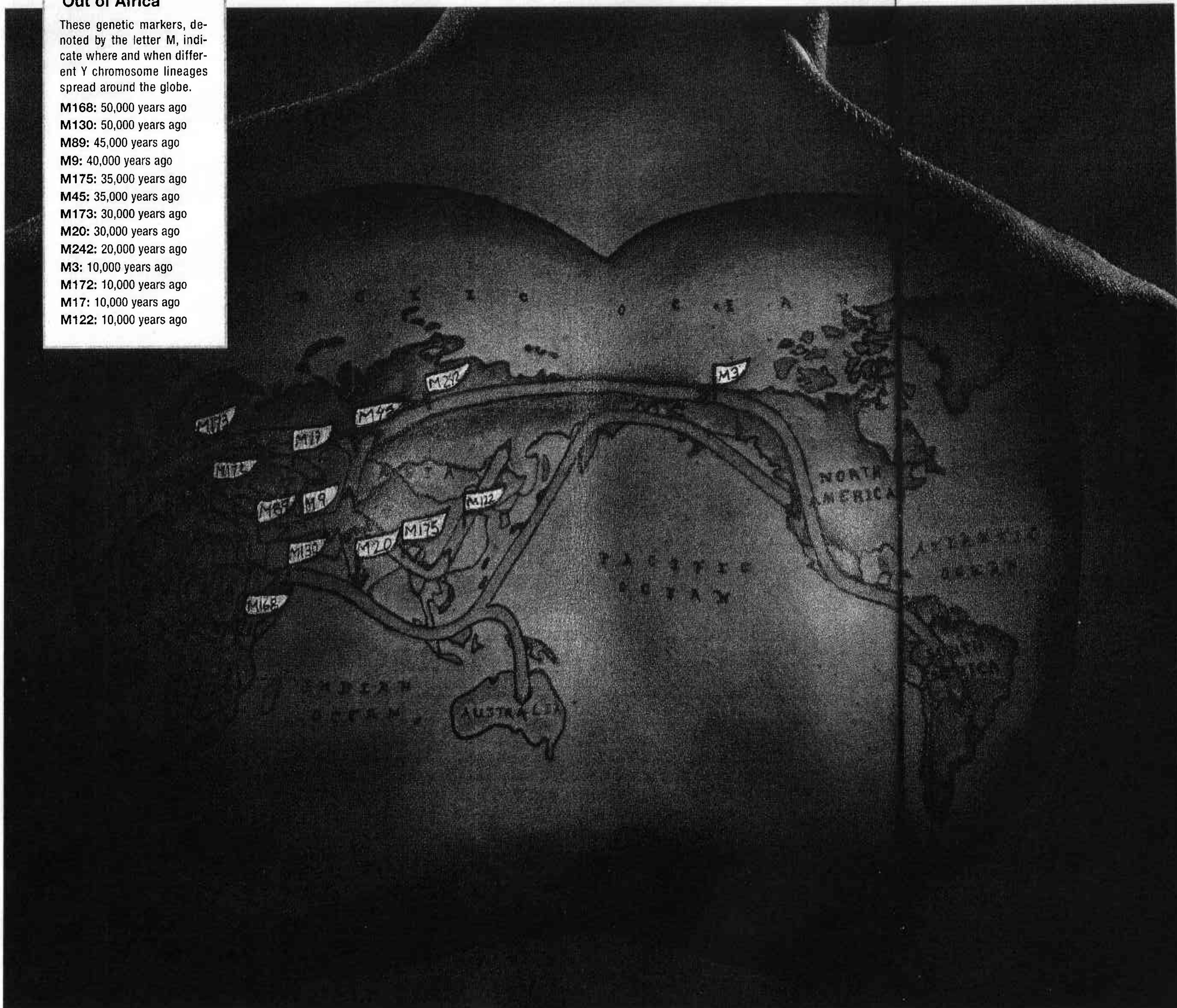
Out of Africa

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
M175: 35,000 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



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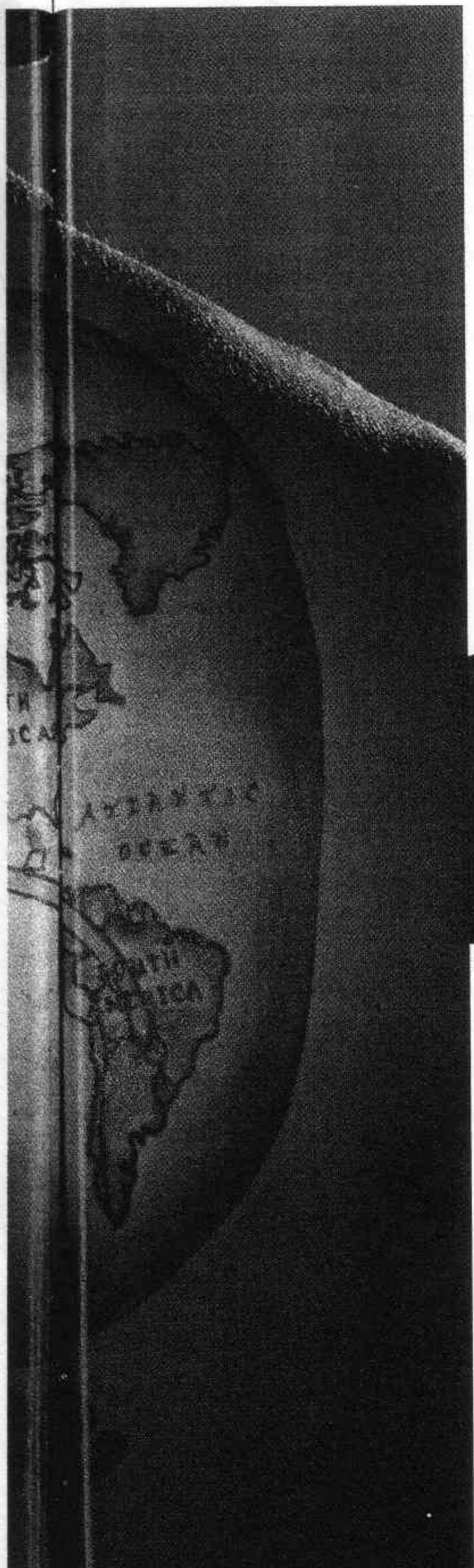


THE hidden history OF men

BY ROBERT KUNZIG

A research team braves Central Asia to capture a surprising genetic record of human migration and military conquest

PHOTOGRAPH BY GRANT DELIN

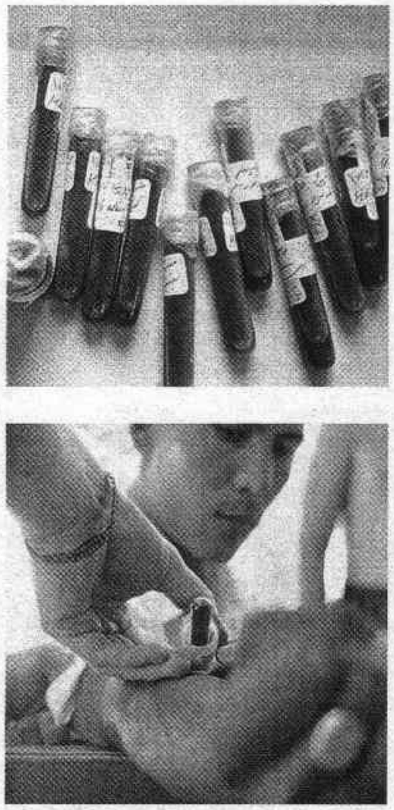
ONE DAY LAST FALL, IN THE HOME freezer of Spencer Wells, there were these things: a large leg of lamb, a few quarts of milk, and underneath, DNA samples from 2,500 people in Central Asia. Wells is an anthropological geneticist and an energetic collector of DNA, especially Y chromosomes. He lived then 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.

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."



Top: During three separate trips, Spencer Wells and his team took blood samples from more than 2,500 Central Asian men. They extracted the white blood cells—which contain DNA—and brought them back to the lab in Oxford, England, for genetic analysis. Bottom: A team member draws blood from a farm worker in a village east of Almaty, Kazakhstan.

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

PHOTOGRAPHS: THIS PAGE, MARK READ (2); OPPOSITE PAGE, ANDREW SYRED/PHOTO RESEARCHERS; PREVIOUS PAGE CREDITS: MODEL: BEN AUGUSTINE/GILLA ROOS; TATTOO: LETICIA VALLE. MAP ADAPTED FROM *THE JOURNEY OF MAN* BY SPENCER WELLS.

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.

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

History of Y's Guys

The X (left) and Y (right) 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.