GENETICS

Y Chromosomes Point to Native American Adam

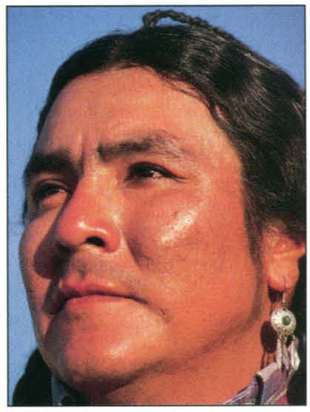
A man who lived some 20,000 years ago carried a set of genetic markers that are now found in up to 85% of native American males

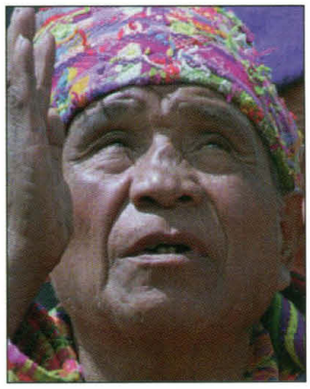
Many of the native peoples around the Americas—from southern Argentina to North America—can trace their heritage back to a single founding father, according to a group of Argentine researchers. Three years ago these researchers, along with another group, discovered the traces of a single common ancestor in the Y chromosomes of native American men in South and Central America. Now they have traced this ancestral father's influence throughout the Americas. The studies by Nestor Bianchi and his colleagues at the Instituto Multidisciplinario de Biologia Celular (IMBICE) of La Plata suggest that the Native American Adam lived roughly 20,000 years ago and is the common paternal ancestor of at least 85% of all native Americans in South America and almost half those in North America.

"We now know that if you are a Native American individual and you have [a particular Y chromosome] mutation, you can trace your ancestry back to a single individual who came to the Americas sometime during the settlement of this continent," says Peter Underhill of Stanford University, who led the other group that discovered this common Y chromosome variant. The age of the ancestral New World father falls within the broad range of other genetic estimates for when the Americas were first thought to be settled, although there's no undisputed archaeological evidence for settlement before about 12,500 years ago. And the mutation's abundance suggests that many of the first Americans arrived in a single migration from an ancestral Siberian home—a home that other researchers are identifying.

Since 1995, Bianchi and his colleagues have been tracing Native American genealogy by studying variations in the Y chromosomes of volunteer donors from more than 20 native populations around the Americas. Two men who carry the same markers on their Y chromosomes must be descendants of the same male ancestor, says Bianchi, because of peculiarities in the way the Y is inherited. Most chromosomes exist in pairs, which allows them to recombine—swap pieces—during the formation of the sperm cells. As a result, a son who has inherited a particular chromosomal marker from his father won't always pass it to his offspring. But the Y escapes this scrambling, because it lacks a counterpart. "It is transmitted intact, like last names, from the father to the male children, over the generations," Bianchi says.

Three years ago, the La Plata researchers and Underhill's group independently announced the discovery of a common Y haplotype—a common set of markers—among indigenous groups in Central and South America. They proposed then that most extant male aborigines in this region are the offspring of a single patrilineage. Now Bianchi and his colleagues have broadened their search, analyzing Y chromosomes from a much larger sample—a total of 200 men—from North America as well as South and Central America.





Sons of Adam. Men from native American groups as diverse as the Navajo, Maya, and Yanomamo (*shown clockwise from top*) share a common Y chromosome.

The researchers looked at two different marker sites, each of which exists in multiple variants, or alleles, along with a mutation that Underhill had detected in the Y chromosomes of Amerindian men. In last December's *American Journal of Human Genetics* they reported what they had found: A specific combination of two marker alleles and the mutation turned up in between 40% and 95% of the men they studied, depending on the population. All of the men who carried this common haplotype, they concluded, are the descendants of a New World Adam who colonized the Americas thousands of years ago.

The next step was to determine how long ago he walked the earth. Although most native American males carry the three markers, their Y chromosomes differ at many other sites, presumably because the chromosomes have gathered mutations since the Adam first passed on his copy. By working out how long it would have taken to accumulate those differences, the researchers could determine how long ago the original father, carrying the ancestral Y, had lived. By using the mutation rate seen in other parts of the Y chromosome, they figured that the New World Adam had lived, very roughly, 22,500 years ago. (The results have wide error bars, from a minimum of 13,700 years to a maximum of 58,700 years).

Bianchi and his colleagues note that Native Americans in North America are less likely to carry the telltale combination of markers than are South American natives, perhaps because North American natives have a greater admixture of African or European genes. The presence of other Y types could also indicate that the first Americans arrived from Asia in several different waves, as some anthropologists have proposed. Indeed, in work that is in press, Andrew Bergen, a researcher at the National Cancer Institute, reports that he has identified a second, less common Y chromosome, suggesting that the New World Adam had a rival.

The La Plata group now hopes to identify specific mutations that took place in the ancestral haplotype after it entered the Americas and correlate them with geographic regions, perhaps finding clues to the migratory pathways of those first settlers. Meanwhile, other researchers are looking farther afield, seeking the original Asian home of the New World Adam.

Two papers in the *American Journal of Human Genetics*—one published in February and the other this month—compare the Native American Y chromosome with genetic material from natives in Asia. The researchers who led the two teams—Fabricio Santos of

the Federal University of Minas Gerais, Brazil, and Tatyiana Karafet of the University of Arizona, Tucson—say that they have identified a set of chromosome markers that looks like the ancestor of the New World Y in two small Siberian ethnic groups: the Kets from the Yenissey River Basin and the Altaians from the Altai Mountains. And in Y chromosomes from populations in other parts of Asia and Europe, they have found clues that the ancestral Y's own precursor originated in central Asia, then in ancient migrations spread eastward into Siberia and as far west as England.

Other genetic evidence has also hinted at a central Asian population that spread both east and west (*Science*, 24 April 1998, p. 520). Says Andrew Bergen, one of the researchers: "In essence, the ancestral founding Y chromosome found its way to America, and also supplied Europe."

–DIEGO HURTADO DE MENDOZA AND RICARDO BRAGINSKI

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CLIMATE ANTHROPOLOGY

Taking Global Warming to The People

Thanks to ever-finer tools for calculating the costs of climate change, scientists are making a case to deal with global warming now

Cruising down northern Vietnam's Red River on a research boat 2 years ago, Mick Kelly started to get a queasy feeling. It wasn't seasickness that troubled him—it was the sight of a feeble earthen dike meant to protect people south of Ha Long City if a storm-whipped South China Sea were to push the river over its banks. Kelly, an atmospheric scientist at the University of East Anglia, United Kingdom, knew that the risk of a calamity is likely to grow: Computer models suggest the South China Sea could creep tens of centimeters higher over the next century and spawn more frequent and violent storms. Hadn't local officials considered building a better barricade, Kelly asked his Vietnamese colleagues? Their answer: Politicians had indeed debated the project but splurged for new roads instead.

When the 2000 scientists on the United Nations Intergovernmental Panel on Climate Change issued their landmark report 4 years ago spelling out the risks of global warming, they cited possible shifts in vegetation and storm patterns. Now, researchers such as Kelly are focusing on the human dimension of those changes. They have launched dozens of projects to assess how various segments of society—farmers, forestry managers, and politicians, for example—are bracing for future climate events. And even as negotiations drag on over implementing the climate change treaty signed so far by 76 nations, scientists are stepping up efforts to help communities devise ways to cope with, and even benefit from, global warming. In Vietnam, says Kelly, "it's the human dimension that will determine just how much an area remains at risk from sea-level rise, not the physics."

Although forecasts of regional effects of global warming are still far from precise, last year's vicious El Niño events have helped focus attention on the kinds of local devastation that might be in store. Also highlighting the need for contingency planning is a report released last month by the nonprofit Pew Center on Global Climate Change, which forecasts a bleak future for the U.S. heartland. If global warming shifts agricultural patterns, the report states, some farming communities could become "ghost towns as people seek economic opportunity elsewhere."

As a sign of the emergence of what some call "climate anthropology," the National Oceanic and Atmospheric Administration (NOAA) and several other U.S. agencies are placing an increasing emphasis on projects with a human dimension, which are expected to total $85 million next year. "We're finding that the effects of climate look totally different when you add people to the equation," says Michael Hall, director of NOAA's Office of Global Programs. "A physicist who forecasts that La Niña will cause heavy rains in Indonesia might stop right there." But if you factor in land-use practices—for example, planting an extra rice crop in the winter season because of the increased rain, or catastrophic floods in a region denuded by clear-cutting—"you begin to get a fuller view of climate's good and bad sides," Hall says.

Warning light. Recent disasters—such as this March 1998 blaze in northern Brazil, blamed on an El Niño–driven drought—could offer a field guide to coping with global warming.

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A developing field. Scientists are hoping to ground such socioeconomic forecasts in lessons drawn from present-day calamities. Working last year in Ceará, a semi-arid state in northeast Brazil, anthropologist Timothy Finan of the University of Arizona in Tucson and his colleagues interviewed some 500 farm families struggling through a year-long El Niño–related drought that scorched the region's corn and bean fields. Finan's team found that most farmers had failed to comprehend—or had not even seen—the jargon-laden drought forecasts issued by the government, so they did not stockpile food. The researchers also observed that the government had distributed food and water only when household shortages threatened mass starvation.

"If global warming scenarios are right, they've got to learn how to live in a drought environment," says Finan, whose group has advised the Ceará government to plan ahead by creating nonfarming jobs, drilling wells for isolated farmers, and desalinating groundwater for drinking. With funding from the World Bank, Ceará's government is taking steps toward implementing some of these recommendations. "In a sense, our job is to get people to plan, to think ahead," Finan says. "And that's happening right now."

While one Brazilian state is moving to minimize the toll of future droughts, Vietnam's social and economic trends are only exacerbating its vulnerability to flooding. Shore-hugging Vietnamese towns have for centuries relied on dikes and mangrove wetlands for protection from typhoons. Since 1994, Kelly and East Anglia economist Neil Adger have queried 250 farmers and government officials about the upkeep of this storm shield. The duo has documented an alarming trend: People increasingly are clearing coastal mangroves for shrimp farms and croplands.

Officials realize the danger of losing mangroves, Kelly says, but they feel pressure to boost the economy. In response, Kelly, Adger, and Nguyen Hoang Tri of the Vietnam National University in Hanoi have analyzed the costs and benefits of conserving mangroves.