



Li Hui extracts DNA to help nab modern killers—and probe ancient myths.

# BRINGING LEGENDS TO LIFE

Geneticist Li Hui believes a DNA database can authenticate mythical figures from before the dawn of China

By **Kathleen McLaughlin**, in Chengtoushan, China

Inside a museum built over Stone Age ruins here, two workers last month attached an industrial-sized suction cup to a vacuum-sealed glass case. Air hissed as the seal was cracked and the lid was gently lifted away, exposing an eroded human skeleton. Li Hui, a geneticist from Fudan University in Shanghai, China, had his prize. He leaned over the remains, once a major figure in Neolithic Chengtoushan, an early site of rice cultivation in southern China's Hunan province. The bones are alone in their glass casket, but when excavated in the mid-1990s they were draped with a jade necklace and surrounded by sculptures of a phoenix.

As a ghoulish green light bathed the skeleton, Li wrapped his hand in a plastic bag to minimize contamination and delicately

plucked a bone fragment that had chipped off the femur. Then he nodded, and the workers sealed the display case back up. Back in his laboratory, Li will extract and analyze DNA from the bones, using techniques from the burgeoning field of ancient DNA. But unlike others in this hot field who want to understand ancient populations and migrations, Li is seeking scientific support for some of China's most cherished legends.

Scientists here believe the skeleton could be as many as 6500 years old, 2 millennia older than China's first historical dynasty, the Xia—a time, according to legend, when deities known as the Three Sovereigns ruled the land. Chinese credit the sage-kings with laying the foundations of their culture: inventing silk and medicine, for instance, and fashioning China's written characters.

Based on the luxurious relics buried with the skeleton—which archaeologists dubbed “the mayor”—Li believes he may have been a chieftain of a clan associated with Fuxi, one of the mythical sovereigns. Fuxi is credited with rice cultivation, and the phoenix is a symbol associated with that sovereign.

By comparing DNA from the bone chip to sequences in a vast database of DNA samples gathered around China, Li hopes to probe that tantalizing possibility. It is the latest and boldest of his efforts to turn myths into history with the help of DNA. “We are retracing and rebuilding history to understand the development and adaptation of Chinese people,” Li says, “so we can imagine the future of Chinese people—what will we evolve into?”

Li's quest has won cautious praise from some scholars. Paleoanthropologist Chris

Stringer of the Natural History Museum in London calls Li's work "ambitious" and notes that DNA has proven to be a more powerful tool for elucidating prehistory than he and others could have imagined even a few years ago. Others have qualms. "I can't think of any historian who would be interested in this, except as a way of analyzing people in China today and how they think about the past," says Sigrid Schmalzer, a historian at the University of Massachusetts in Amherst and author of *The People's Peking Man: Popular Science and Human Identity in Twentieth-Century China*. She and some colleagues see a skein of nationalism running through the attempt to establish a cohesive Chinese culture predating the Xia dynasty. "There is a very strong interest in China in laying claim to a Chinese identity just as far back as you can take it," Schmalzer says.

Li shrugs and says, simply, that there is a gulf between historians and geneticists, and that he is following where the facts lead him. He has debunked some historical claims, he notes, but he says he already has support for the Three Sovereigns legend: studies of the Y chromosome—the male sex chromosome—that trace about half of modern Chinese men back to three ancient groups. "What makes me believe that [the Three Sovereigns legend] is true is the perfect match of the mythology, archaeology, and genetics in timescales and geographic distribution," he says. Chengtoushan's mayor, Li says, may even have been the historical figure revered as Fuxi.

**OVER THE PAST 2 DECADES**, scientists in Li's home base, Fudan University's Key Laboratory of Contemporary Anthropology, have collected blood samples from more than 400,000 people across China to map ethnic groups. "Chinese people want to know their links to each other," Li says, which made it easy for him and his mentors to gather samples. "Before DNA, they liked to study their family records. They want to know who they are related to."

The Fudan group's original goal was not to probe myths, but to build a genetic tree for the people speaking China's 400-plus dialects and languages. Having sampled DNA of individuals who collectively speak 324 tongues, the team is about three-quarters of the way toward reaching its goal. The lab's founder, Fudan University Vice President Li Jin, believes the map will give a more precise picture of China's diversity than does the government's classification of Chinese people according to 56 official ethnicities.

Li Hui, 38, joined Li Jin's lab as an undergraduate in 1998. He made his first big splash a decade later, when he used the

growing DNA collection to discredit a theory that indigenous Taiwanese—the original occupants of the island, where the Nationalists fled in the waning days of China's civil war in the late 1940s—descended from Micronesians and Polynesians. Rather, their genes could be traced to the Dai people of southern China, he reported in *Evolutionary Biology* in 2008. That finding was in line with the Chinese government's view that the island has always been Chinese.

Fudan's DNA trove serves the state's interests in practical ways as well. Police call on the group once a week, on average, to help solve crimes. Because most of China's 1.4 billion people share just 100 surnames, and until recently these clans stayed put in their home villages, the database allows the geneticists to go beyond police DNA forensics and pinpoint a suspect's surname and hometown. The geneticists have identified victims or provided leads in about 50 cases so far, Li says.

The team's latest forensic success came last summer, after police in Gansu province sent them DNA swabbed from a crime scene. Over 14 years, 11 women and girls had been raped and killed in western Gansu, and the police deduced that the cases were related. Analyzing the DNA, Li's group ascertained the serial killer's surname likely was Gao, and zeroed in on his likely home village in Gansu. That was enough for police to go on; in August they captured a man named Gao Chengyong, who confessed to the crimes.

**LI HUI'S FIRST FORAY** into Chinese mythology came in 2013, when he analyzed DNA from a relative of the Emperor Cao Cao, a renowned warlord who ruled during the second century C.E. For centuries, rumor had it that Cao Cao's grandfather was a eunuch, meaning the emperor's father had been adopted. On national TV, Li debunked that claim. The DNA showed that

Cao Cao's grand-uncle and his descendants were related—evidence of an unbroken family line.

Now, Li is taking on the Three Sovereigns, possibly China's most cherished legend. By examining Y chromosome sequences in their database, he and his Fudan colleagues have

built a circumstantial case for the existence of the mythical clans. Y chromosome haplogroups—sets of DNA variations that tend to be inherited together—indicate that about half of Chinese men today are descended from three lineages: the Three Sovereigns, Li says.

Li's assumption that the match between the genetic pattern and the mythical threesome is more than coincidence raises some eyebrows. "I am not sure where one starts out with assumptions about genetic connections that necessarily relates to the mythical founders of Chinese civilization," says Rowan Flad, an archaeologist at Harvard University, who studies the emergence of complex society in Stone Age China. "Population genetics and genealogy rooted in origin stories don't initially strike me as the most compatible data sets."

Li will try to prove otherwise. In his Shanghai lab, cluttered incongruously with DNA sequencing machines and stuffed monkeys, he will extract the mayor's DNA and compare it to sequences in the database. Li suspects the DNA will reveal that the mayor belonged to an ethnic group linked to early rice cultivation—and that ethnic group would be the Fuxi clan.

Li sums up his quest in a poem, written in Tang dynasty style, that he composed to honor Chengtoushan. It's an ode to the secrets that the site may reveal. "Ancient histories so far from the books. ... Who built this first city. ... Please, let me hear your distant tune." ■

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This intricate rubbing depicts Fuxi, the sage-king of Chinese mythology credited with developing rice cultivation.

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Editor's Summary

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