

**Golden days.**

New archaeology museums, such as this one in Chengdu, are springing up all over China.

## Archaeologists Raise The Old With the New

Researchers work to transform China's development boom from a curse into a blessing for ancient sites

**CHENGDU, CHINA**—Amid tangles of highways and phalanxes of high rises in this booming capital of Sichuan province, more than 30 hectares of prime urban real estate—three times as large as New York City's Battery Park—is meticulously landscaped around two massive glass, steel, and stone pavilions. But unlike many of the high-rise buildings, this \$75 million, 2-year-old complex is not the modern headquarters of a successful Chinese corporation. Instead, it is a museum paying homage to a 3000-year-old settlement and its surprisingly rich culture, which until recently was completely unknown.

This sprawling ancient site, called Jinsha, lies 1000 kilometers from the traditional center of Chinese civilization along the Yellow River (see p. 934) and deep within a region long assumed to have been a cultural backwater until it was absorbed into the Qin dynasty in the 3rd century B.C.E. In recent decades, however, archaeologists have uncovered astonishing evidence of sophisticated and largely independent cultures in the region dating back to 2500 B.C.E., cultures that are helping to rewrite the origins of Chinese civilization (see p. 930).

A decade ago, Jinsha was still buried. Until its accidental discovery during a construction project, the site was verdant farmland on the outskirts of a city with a mere 5 million people. Today, thanks to savvy archaeologists and their allies in city government, the new Jinsha Site Museum not only offers a welcome haven from urban sprawl but also sets aside a large area for future digs. The excavated

area is covered with a vast glass roof, and a separate building houses state-of-the-art exhibits. Chengdu hotels and department stores proudly sport the site's icon, a gold sun disk surrounded by four birds, as a symbol of the city's unique past.

Jinsha creates a place of beauty, bolsters civic pride, and pulls in tourists—and its success is encouraging other cities to follow suit. “Dozens of local governments have come to see this,” says Zhu Zhangyi, 49, who is now the museum's vice curator. “It has become a model.” Western archaeologists are deeply impressed, too. “The priority is to teach people about their past,” says Gary Crawford of the University of Toronto, Mississauga, in Canada. “They are willing to put real money into that—and we could learn some lessons from that.”

Archaeologists say models such as this are desperately needed in a country developing more rapidly than any other in human history. Half of the world's concrete is poured in China. There are more than

2 million kilometers of highways, double the amount there was in 1986. And cities like Chengdu—which now boasts more than 10 million people and adds a million a year—have mushroomed, eating up land along rivers and on plains typically favored by ancient peoples. The pace of construction threatens to destroy sites ranging from Paleolithic campsites to Han royal tombs, and with them, a treasure trove of data critical for understanding the role of East Asia in early human migrations, animal and plant domestication, and urbanization.

Halting or even slowing development in a society eager to emerge from rural poverty is not possible. Instead, archaeologists



Past protector. Chengdu's Wang Yi saves sites.

CREDITS (TOP TO BOTTOM): A. LAWLER/SCIENCE; COURTESY OF ROWAN FLAD

Downloaded from [www.sciencemag.org](http://www.sciencemag.org) on September 11, 2009





## LANDING THE LOOTERS

In the summer of 1998, a reservoir in a rural area of Hunan in southern China dried up. As the water receded, local farmers found ancient pottery and porcelain from the 10th to 13th century C.E. Song Dynasty, which produced some of the world's finest ceramic art. Within a few weeks, hundreds of looters were openly digging at the site. Despite an outcry from a television reporter and a few cultural-heritage specialists, local officials refused to intervene. It was not until the following February that police arrived to stop the illegal digs, arrest the culprits, and clear the way for a team of archaeologists to save what they could.

In a land chock-full of wealthy tombs and poor farmers, grave robbing is an ancient tradition. But in the past decade, China has tightened its laws against looting, a reflection of changing attitudes toward archaeological treasures (see main text). Now those who destroy the country's past face jail terms and even the death penalty, although no one appears to have actually been executed for looting. Earlier this year, the United States and China agreed to work together to prevent smuggling of looted Chinese antiquities. "The situation in China has improved dramatically in recent years," says Stefan Gruber, a lawyer at the University of Sydney in Australia, who follows the Chinese situation closely.

But he adds that although "the central government has good ideas, the local governments do not necessarily follow their orders." Archaeologist and China expert Lothar von Falkenhausen of the University of California, Los Angeles, remains deeply concerned. "The looters

are absolutely everywhere," he says. "Archaeologists can't keep up, and the looting often takes place with the connivance of local authorities." Von Falkenhausen adds that the new U.S.-China agreement merely shuts American dealers out of a market increasingly driven by wealthy Chinese collectors.

The pace of destruction is difficult to quantify, but it is clearly still taking place. In the northeast, for example, between 4000 and 15,000 tombs from the Neolithic Hongshan culture (see p. 930), which produced rich jades in fantastic animal shapes 5000 years ago, have been damaged or destroyed by looters during the past decade, says He Shuzhong of the National Administration on Cultural Heritage in Beijing. In the southern province of Hubei, 2000-year-old graves filled with jewelry, documents written on bamboo, and other artifacts have been stolen. "When an archaeological team finally went in, there was nothing left to save," says one archaeologist familiar with the destruction.

In response to such damage, museum and site security has recently improved. At the Yanghai cemetery in the remote western province of Xinjiang, for

**Twins.** Both plaques are probably from Erlitou, but only one was dug legally.

example, looters who a decade ago helped themselves to jewelry in the 3000-year-old graveyard are now stymied by a high fence, locked gate, and live-in caretaker. Recent high-profile cases, coupled with educational initiatives, are making China's vast population aware that looting is illegal and unpatriotic.

Although strict laws likely dissuade many looters, they can have a perverse effect. Local farmers near Erlitou, one of China's oldest urban centers (see p. 934), now hesitate to bring artifacts found during plowing to archaeologists, perhaps fearing stiff penalties, says Chen Guoliang, an assistant researcher at the site.

Clicking on his laptop in his office at the Erlitou dig house, Chen pulls up several images of similar turquoise-inlaid bronze plaques that appear to be in a style arguably unique to Erlitou.

The use of these elaborate objects remains unclear, and archaeologists are eager to find more in context. But only one was legally excavated from the site. How and when the others were found remains a mystery, though Chen believes that they almost certainly came from Erlitou. Today, the other plaques reside in public and private collections around the world, from the Miho Museum in Japan to Harvard University in the United States. (Many museums have taken at face value claims by sellers that artifacts were legally exported.) Once taken out of their context and sold, says Chen, such artifacts—whose provenance is difficult to verify—no longer have a story about China's heritage worth telling.

—A.L.



are exploring creative ways to collaborate with both government and developers, and using museums like Jinsha's to build popular support for preserving key sites. Thus China's development boom is powering a new wave of archaeological discovery and appreciation even as it threatens sites. Courts are increasingly willing to enforce harsh penalties on looters (see sidebar, this page). And in a dramatic departure from the past, local governments are now willing to lend support and funds to preserve sites. "It was a great fortune we discovered [Jinsha] in 2001," says archaeologist Zhu, who led the team that examined the site just ahead of developers. "If it had been earlier, it would have been impossible to preserve the whole area."

During a recent visit by *Science*, however, archaeologists at several provincial centers also warned that they must race to keep up with the bulldozers and have largely set aside purely academic endeavors in order to rescue sites. The recent economic downturn, rather than easing the pace, has only quickened it, as the central government pumps hundreds of billions of dollars into dams, canals, and highways to stimulate the economy. Says Zhu: "We have to do our best to persuade our government that if it doesn't move aggressively to protect sites, there will be nothing left in 10 or 20 years."

### Water over the dam?

The current boom is hardly the first threat to China's past. Qin Shi Huang, the man credited with first unifying China in the 3rd century B.C.E., consolidated the Great Wall and left behind the famous terracotta army in his mausoleum—two of the modern nation's most famous tourist attractions. But he also ordered that evidence of previous rulers be destroyed in order to ensure his importance in history. More than 2 millennia later, China's revolutionary leader Mao Zedong encouraged his people to obliterate "old ways of thinking," triggering the destruction of thousands of ancient buildings and artifacts. During the years of the Cultural Revolution in the late 1960s and early 1970s, archaeological publishing ceased, university courses were restricted to political subjects, and many researchers were forced out of their jobs.

Today, the more insidious threat is not to China's visible past but to the undiscovered sites that lay safely underground until recent development. The most infamous example of this third wave of destruction is the Three Gorges Dam project, which began in 1993 and eventually drowned a 600-kilometer stretch of the middle Yangtze River. The government initially allotted \$37.5 million for archaeological salvage, although archaeologists called for at least \$500 million. The amount was only marginally increased, and sal-

## GO EAST, YOUNG ARCHAEOLOGIST

Zhijun Zhao started his career like many promising Chinese students: by studying in the United States with an eye to staying. He got his Ph.D. at the University of Missouri, Columbia, and rose through the academic ranks, acquiring the nickname "Jimmy" and eventually landing a comfortable job at a museum in Kansas City. He also got a coveted green card that put him on the path to U.S. citizenship—all the ingredients of the American dream. "Big houses and cars—I could have lived the easy life," he muses today.

But instead, in 1999, Zhao made a bold decision. He returned to China and opened a lab at the Institute of Archaeology in Beijing, which at the time lacked many of the modern facilities common at any American university. He was given 5000 yuan—about \$600 at the time—in start-up money. "I spent 4000 yuan on a microscope," Zhao recalls with a laugh. He held on to the green card for a full year.

Zhao's move was a gamble. But today, many Chinese-born scientists educated in the West return to China, says Wang Wei, director of the Beijing institute. Although in the past, that return may have been pushed by difficulties in language, culture, and getting a job overseas, now China is exerting a magnetic pull. As archaeology attracts attention, central and provincial governments are spending more on new facilities and better salaries (see main text). Researchers are drawn home by family ties and professional opportunities. "We want all of our overseas scholars to come back," says Wang. "And we do our best to provide a good environment for researchers."

The homeward pull is a relatively new phenomenon. With rare exceptions, war and politics isolated China from the outside world between World War II and Mao Zedong's death in 1976. For the most part, archaeological finds made behind the Bamboo Curtain remained unknown in the West, while new theories and methods failed to penetrate into China.

Starting in the 1980s, large numbers of Chinese students, including archaeologists, began to study in the West. Some stayed, though others tried to keep a foothold in China as well. For example, Tianlong Jiao studied at Harvard University and is now an archaeologist at the Bishop Museum in Honolulu. He moves easily between worlds, doing fieldwork on trade and agriculture in South China and often visiting colleagues at the Beijing institute. But his status as a researcher in both countries may already be an anomaly. "I am probably among the few, if not the only one," he says.

Zhao says he has no regrets about returning to his homeland. His 2008 budget is 1.5 million yuan, or \$220,000, and his modest lab in a Beijing suburb has an enthusiastic staff of mostly young researchers. On a recent weekday,

his team ate lunch together and chatted about work, taking breaks at a Ping-Pong table in a nearby room. Some are specialists in dating ancient wood—dendrochronology—while others analyze spores and pollen to understand paleoenvironments, and another group identifies isotopes in animal bones uncovered in a recent dig. English as well as Chinese textbooks line the walls.

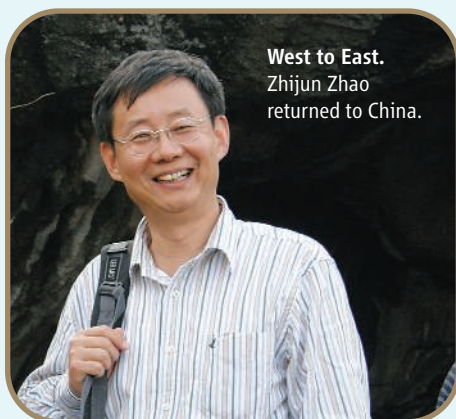
This analytical approach to archaeology marks a radical coming of age for the field in China, where organic material—from human bones to pollen—is still routinely ignored in the search for valuable grave goods. Zhao's example, other archaeologists say, is a powerful motivator for adopting newer techniques. The world is taking notice; a May workshop on archaeological methods in Beijing drew experts from several countries.

Zhao still bemoans the difficulty of getting things done in China, compared with the ease of life in the United States. But he says China's authorities place no restrictions on his work: "Anything related to scientific research is OK." The energy of his home country is palpable just outside his lab, where new high rises are sprouting all around while a group of elderly women perform their morning tai chi exercises.

Last year, Zhao returned to the United States to give a talk and made a pilgrimage back to Columbia to see his former colleagues. "I was surprised," he says. "Nothing had changed."

In China, you see change every day. There is just more activity and more opportunity."

—A.L.



vage work was not finished before the dam was completed in 2006 (*Science*, 1 August 2008, p. 628). "We may have missed a few sites," says one Chinese archaeologist sheepishly.

Other massive projects have received less publicity but are having a tremendous impact. The \$8 billion South-North Water Transfer Project will divert water from the wetter areas of central and southern China to its thirsty north, through a complex mix of reservoirs, canals, and dams. When complete by 2014 (*Science*, 25 August 2006, p. 1034), the central route—an average of 110 meters wide—will cut across nearly 1300 kilometers, much of it in central Henan Province, which is traditionally considered the homeland of Chinese civilization.

Ma Xiaolin, vice-director of the Henan Provincial Institute of Cultural Relics and Archaeology in Zhengzhou, says work on the canal has uncovered some 340 sites in Henan alone, from Neolithic settlements

to Tang Dynasty tombs. Ma says time and funding for salvage work are ample, but there are complications. Archaeologists are now excavating a 2000-year-old king's tomb and have requested that the government alter the canal route. "No decision has been made," says another scientist familiar with the site. "It's a sensitive issue."

That sensitivity reflects the tension between development and preservation. China passed a heritage protection law in 1982, but archaeologists say it was only haphazardly enforced until recently. "In past decades, we were in a very bad position," says Wang Yi, who leads the Chengdu City Institute of Archaeology and Cultural Relics. "Since the first law was passed 27 years ago, we have been fighting against developers. And in the past, local governors were enemies of archaeologists. ... We could not counter a city's development."

But that is changing. In 1997, the government made violations of





cultural heritage laws a criminal act punishable by jail terms and even the death penalty. In Chengdu, the manager of a real-estate company went to jail for 5 years for failing to do archaeological salvage work before construction. “There have been those who destroyed sites and artifacts—but now, if they do, they get in big trouble,” says Wang. “Even government officers don’t dare break this law.”

### Hearts and minds

Along with the legal stick comes a carrot. Both the city and provincial government see that development “is not just about an increase in GDP,” asserts Wang. “We have to make this mainstream, so that all branches of government and citizens support archaeology.” He and a growing number of other Chinese researchers are increasingly involved in outreach activities to create a broader constituency for protecting sites. “It is impossible not to lose some sites,” says Wang Wei, director of the Institute of Archaeology in Beijing. “But the public is starting to appreciate the importance of cultural heritage—and that you can move the site of a planned building.”

The archaeologists’ efforts can be seen in a new and surprising phenomenon: multimillion-dollar popular archaeological museums that have opened in recent years across China, sporting three-dimensional movies, elegant restaurants, and exhibits that equal or surpass those in major U.S., European, and Japanese cities. Many, like the Jinsha museum, are on land protected from further development. “For less than \$100 million, the Chengdu municipal government bought a history 1000 years older than it had before,” Zhu says over sushi in the chic museum restaurant.

In another example, last October a gleaming monument of Iranian marble opened outside the southern port city of Hangzhou to celebrate Liangzhu, which started flourishing around 3500 B.C.E. and is one of the oldest major settlements in China. Now 42 hectares around the site have been protected from major development. When a real-estate company sought to buy neighboring land, the government sold it for under market value in exchange for nearly \$24 million for the museum and private-sector expertise in big projects. “This was a real innovation,” says archaeologist Jiang Weidong, director of the Liangzhu Museum, over tea in his sleek Bauhaus-style office.

The exhibit lays out methods of excavation, the evolution of the site, and the day-to-day life of its people 5000 years ago, using cutting-edge artifacts, films, and displays. Visitors can even walk through a recreation of the settlement, showing both the jade-wearing elite—who were buried in elaborate tombs high on earthen platforms—as well as modest tradespeople and rice and millet farmers in wattle-and-daub houses.

Back in Chengdu, archaeologists are also using their facilities to win the hearts and minds of their citizens. After the 2008 Sichuan earthquake, curators at Jinsha opened the grounds to more than 40,000

people who camped out amid fears of aftershocks. To mark the first anniversary of the disaster in May, they waived admission fees and drew an impressive 50,000 citizens. Regular festivals promote the site as a cultural oasis amid the city’s congestion.

Such efforts raise awareness of the nation’s heritage, and plans for park and museum complexes at ancient sites are taking hold all over China, from the 3500-year-old city of Erlitou in the central plains to the ancient Silk Road city of Turfan in the far western province of Xinjiang (see p. 940). In May, a new underwater museum opened along the Yangtze, preserving 1200-year-old poetic inscriptions and measurements of annual high-water levels on rock from the waters impounded



**Big dig.** A massive new north-south canal threatens hundreds of ancient settlements.

by the Three Gorges Dam. Such museums also provide opportunities for archaeologists themselves, and some scholars who studied abroad are now finding ways to return to China for research or even permanently (see sidebar, p. 938).

### Getting the goods

In the rush to modernize, modest prehistoric settlements are at particular risk, although sometimes they can win a reprieve. In Shaanxi province, west of the central plains, for example, construction of a vehicle factory was put on hold after the discovery of an unusually complex, moated, Neolithic site with a line of pottery kilns suggesting specialized handcrafts, dated to a surprisingly early 4000 B.C.E. “The site was preserved, and the provincial government paid dozens of millions of yuan [tens of millions of U.S. dollars] to move the factory,” says Wang Weilin, vice director of the Shaanxi Archaeological Institute.

Wang, whose organization includes 130 archaeologists, says developers pay nearly \$3 million annually to cover the costs of salvage work in his province. But he is particularly concerned about smaller sites without dramatic architecture and artifacts. “We see traces of such sites, but we worry we might not catch up with development,” he says. Harvard University archaeologist Rowan Flad, who is collaborating with Wang, notes that international efforts “are often the only way



that work beyond that of a salvage nature can get done,” because of the time pressures on Chinese institutes.

Smaller, more ancient sites are also at greater risk because they typically lack what Chinese archaeologists privately call “*hao dongxi*,” which can be roughly translated as “goodies” in English. “There is a tendency among some Chinese archaeologists to look for the goodies, that is, the grave goods with artistic merit and which embody China’s cultural heritage,” says Magnus Fiskesjö, an anthropologist at Cornell University. “Fishbones don’t qualify.”

As a result, material with the potential for providing critical data on scientific questions, such as ancient diet, health, and social organization—including fishbones—is often overlooked, particularly during fast-paced salvage digs. Even human bones are often still disposed of rather than analyzed, says Fiskesjö.

That tendency is changing, albeit unevenly. In Zhengzhou, Ma, who studied at La Trobe University in Melbourne, Australia, is eager to show off his labs and storage facilities, which include well-labeled

blue bins of human and animal bones from a host of sites. “Smaller institutes just collect artifacts and throw away the rest,” he says. “We want to focus on new techniques involving plants, animals, and human skeletons and set up databases for each site.” With a healthy \$3 million annual budget, Ma’s institute has the funds to do more detailed research. But the organization is now juggling a dozen excavations, and he expects to conduct more than 30 digs this year alone—90% of which are salvage operations.

Despite—and because of—the pace of development, archaeologists in China appear surprisingly optimistic. “Given the investment from our government, the 21st century will be a golden age for archaeology in Sichuan,” predicts Chengdu’s Wang. With an interested public plus provincial government coffers filled by the economic boom, China is now paying heed to its archaeological treasures in a way that once might have been criticized as a bourgeois luxury. Says Jiang, smiling over green tea in his sun-filled office: “When your granary is full, you pay more attention to ceremony.”

—ANDREW LAWLER

## ARCHAEOLOGY

# Bridging East and West

China’s far west, home to unique ancient cultures, may help reveal how technology and goods flowed from West to East to shape Chinese civilization

**YANGHAI, XINJIANG PROVINCE**—No place on Earth is farther from an ocean than this dusty spot in the Taklamakan Desert in northwest China. But when archaeologist Lu Enguo recently excavated the sprawling 3000-year-old Yanghai cemetery here, he found a cowrie shell from either the Pacific or the Indian Ocean in the undisturbed tomb of a local shaman. That holy man—his body naturally mummified in the dry climate—was dressed in the style of the Russian steppes, with a headband of gold, a brilliantly colored woven garment, and a ceremonial bronze ax by his side. For him, the wealthy and fertile eastern land called China may have been just a rumor or tall tale.

Yet despite the distance to ancient centers of Chinese culture, Lu, who works for Xinjiang’s archaeology office in nearby Turfan, believes that this remote region may hold the key to understanding early Chinese civilization because of its crucial role in trade. Lu and many of his colleagues argue that as far back as the 3rd millennium B.C.E., during the rise of Mesopotamia, Egypt, and the Indus civilizations, Xinjiang may have served as a critical bridge between East and West, funneling some combination of bronzemaking, wheat domestication, and other technologies toward the incipient Chinese culture. Those technologies may have helped jump-start Chinese urban life along the Yellow and Yangtze rivers in the 2nd millennium B.C.E. (see p. 930).

That is a novel, even radical, idea among Chinese academics, many of whom still see Xinjiang as a distant region that enters history only when a unified China began to assert control in the early centuries B.C.E. Indeed, not so long ago, such discussion of outside influence on China’s origins would have been at best frowned upon and at worst dangerous. “Ten years ago, you could not even say that China adopted anything from the West,” says one Chinese archaeologist. After more than a century of humiliation at the hands of foreigners—both Western and Japanese—China’s leaders in the 20th

**Desert death.** A 4000-year-old child mummy peers out of his wooden coffin in Xiaohe cemetery on the edge of the Taklamakan Desert.