

Scientists Warn of Threats to Fossil-Rich Chinese Site

A thriving black market and competing bureaucracies could undermine the scientific payoff from Liaoning

BEIJING, CHINA—It was less than a decade ago that paleontologists became enthralled with spectacular new fossils from China's western Liaoning Province (*Science*, 15 November 1996, p. 1164). The steady stream of discoveries from these rich beds has given them an impressively detailed picture of life 125 million years ago.

But scientists at China's leading institute for vertebrate paleontology now fear that this treasure trove is rapidly being devalued. Weak laws, they say, have failed to halt the illegal excavation and trade in fossils, and confusing rules governing the work of legitimate scientists are hindering research. Some of those scientists have taken the unusual step of going public with their concerns in hopes of speeding reforms.

"The situation is urgent," Zhou Zhonghe and his colleagues at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) told the state-run Xinhua News Agency and other Chinese media outlets this spring. A new national law that would protect fossils and clarify their handling "is essential to solve [this complex] issue," says Zhou.

In China, fossils are important cultural relics as well as a significant natural resource. Existing statutes group vertebrate and hominid fossils into "precious" and "ordinary," with the former subdivided into three grades according to their value. New and important finds are major events and a source of national pride. Such was the case in 1995 for a primitive magpie-sized bird (*Confuciusornis*) unearthed at the Liaoning site, some 400 kilometers northeast of Beijing (*Science*, 12 January 2001, p. 232).

"You can't find such a rich reserve elsewhere," says IVPP's Wang Xiaolin, who has led the institute's fieldwork at Liaoning for the past 7 years. Fossils from western Liaoning

have helped to explain the ecology of the early Cretaceous period, he adds, as well as to resolve the question of whether birds evolved from dinosaurs. "It's been a gold mine."

Unfortunately, many local residents feel the same way. Although China's laws prohibit individuals from digging or trading valuable fossils, the province does license



Fossil wars. Above, villagers conducting a series of illegal excavations flee from authorities in Liaoning, where paleontologists such as Zhou Zhonghe (right, in white hat) are frustrated by problems in carrying out legitimate digs.



stores to sell ordinary fossils. "In western Liaoning, every county has a flourishing fossil market" that may contain illicit materials, says Wang. Precious fossils can also be purchased easily on the Internet, he notes.

Zhao Yibin, director of the fossil administration office within the Liaoning Land and Resources Bureau, insists that "we have basically stopped illegal excavation." But most paleontologists disagree. "I estimate that about 80% of *Confuciusornis* specimens are smuggled abroad or bought [illegally] by individual collectors," says Zhou. Wang says the excavators, some using mechanized tools, "are changing the landscape every day."

Recent incidents appear to back up claims that the problem is getting worse. On 24 June, Guernsey's of New York City auctioned off

two *Confuciusornis* specimens, one for \$5500 and the other for \$12,000, as part of a collection of dinosaur fossils, some of which were labeled simply "from Liaoning, China" (see p. 174). Under U.S. law, it is not illegal to import or sell such items.

In a raid outside Perth last month, Australian authorities seized 20 tons of Chinese fossils worth some \$3 million. The cache included hundreds of dinosaur eggs from Henan and Guangdong, says John Long of the Western Australian Museum in Perth, along with fishes and dinosaurs from Liaoning. Australian laws permit cultural material illegally exported from another country to be confiscated; no one has been charged, however. Late last year, a court in Shenyang, the capital of Liaoning Province, sentenced two men to 10 years in prison and fined them \$24,000 for smuggling some 2000 fossils into Korea in 2002. Three other men received 2-year sentences.

Rules of the game

IVPP scientists are angered by the illicit trade. But they also feel that the existing laws are enforced in an arbitrary and opaque manner that hinders research. A move to give provincial authorities more control has undermined IVPP's once dominant position. It has also complicated the process of obtaining permits.

A 2001 provincial law requires applicants to obtain a chain of signatures from provincial, city, and county authorities, with

the Liaoning Land and Resources Bureau at the center. One year later the national Ministry of Land and Resources issued regulations establishing its authority over the fossils, taking over from the State Administration of Culture Heritage, which had previously issued such permits to vertebrate paleontologists from IVPP and elsewhere.

Forced to deal with a different set of administrators, an IVPP team had its application turned down last fall after researchers had set up camp and waited 3 months for a permit. That follows a decision to push back a 2000 excavation to November, when the weather is unfavorable. Liaoning's Zhao says that the scientists on last year's dig applied to the wrong office and that his office, for fossil administration, would have handled

the matter expeditiously. IVPP scientists say that they were merely following the national regulations, which assign the lead role to the office of geology and environment.

Not all paleontologists are complaining. Gao Keqin of Peking University, who works on amphibian and reptile fossils, says he hasn't encountered any serious bureaucratic obstacles in arranging explorations during the last 2 years. Gao is collaborating with Zhang Lijun, who works at the Liaoning Land and Resources Bureau and is a part-time graduate student at Northeast University in Shenyang. The program is designed to strengthen the province's ties with outside university scientists.

Another battleground is temporary custody (they all belong to the nation) of the fossils from Liaoning. Local administrators generally want the fossils to remain in the province. But IVPP's paleontologists argue that, as a government-funded institute, they have the right to keep fossils. The local authorities are not always proper stewards, they assert, pointing to some 20 specimens

of *Confuciusornis* cemented into a wall at the Beipiao Paleontology Museum. Gao agrees that the topic is sensitive.

In response, Zhao says that IVPP has been allowed to keep the fossils it excavated and that fossils with major scientific significance should be kept by scientists. However, he would like to see scientists leave some fossils of lesser value to the local administration.

In the meantime, Liaoning's provincial law allows the trading of ordinary fossils. Local authorities think that fossils can be exploited as a natural resource, and their hope was that permitting local people to earn some income from legal trading would curb illegal trading. But some scientists say that legal trade just provides smugglers with a cover for their illicit activities. In the Korean case, the smugglers were reportedly able to purchase valuable fossils from supposedly legal fossil markets. "Liaoning is the only province that allows trading of ordinary fossils," says Gao.

IVPP researchers have tried to close

these loopholes by urging the government to pass legislation that would curb the negative effects of decentralizing authority over fossils and limit their exploitation. China's current Law on the Preservation of Cultural Relics and its criminal code contain only a few words on the protection of fossils. Their plea, signed by 51 prominent scientists and sent to former Chinese Premier Zhu Rongji in December 2000, centers on the issues of illegal excavation and decentralization. It failed to sway authorities, however, so this spring they began speaking out.

But even a new law might not clear away the confusion. Zhou is worried that legislators, if they fail to address the most pressing problems, "could make the situation more complex instead of improving it." Greater ambiguity would further jeopardize Liaoning's underground treasures, he warns, by tying the hands of scientists and leaving the unscrupulous free to ply their illegal trade.

—LEI DU

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U.S. Science

Weak Economy, Higher Stipends Send More to Graduate School

Observers are encouraged by record numbers studying science and engineering, but they worry about a drop in first-time foreign students

Graduate student enrollment in science and engineering (S&E) programs across the United States reached a record high in the fall of 2002, according to a new report from the National Science Foundation (NSF). The 6.1% increase, to 455,000, is driven by rising numbers of U.S. citizens, permanent residents, and foreign students already in the country and comes despite a 6% drop in the number of first-time foreign students.

Higher education groups and NSF officials say the increase in domestic enrollment, for the second straight year, is most likely a reflection of the economic downturn that began in late 2000. But they say the numbers, which come from NSF's annual survey of graduate students and postdocs, may also be an encouraging sign that initiatives to attract more domestic students into S&E are starting to pay off.

"When the job market hits rock bottom, as it did in 2002, it's not surprising to find more people entering graduate school to make themselves more marketable or to be in a holding pattern," says Eleanor Babco, executive director of the Commission on Professionals in Science and Technology in

Washington, D.C. Bianca Bernstein, director of NSF's division of graduate education, says the reduced appeal of professional degree programs, such as MBAs, could be a contributing factor.

Some observers also credit rising graduate stipends. "The government has certainly been sending out a strong message for some years that native students in science and engineering are a valued resource for the country," says Peter Syverson of the Council of Graduate Schools in Washington, D.C. "Maybe we're starting to see some results."

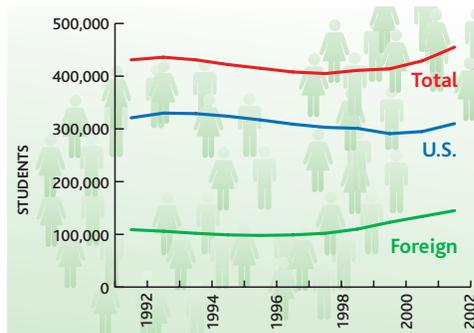
Even though the numbers look promising, George Langford, a biologist at Dartmouth College in Hanover, New Hampshire, and former chair of the National Science Board's education panel, points out that do-

mestic enrollment is still some 6% below a peak of 330,000 reached in 1993. "To ensure that the upward trend continues," he says, "we need a sustained effort by federal agencies and universities to attract more domestic talent to S&E."

Along with the encouraging outlook, the report strikes a sobering note by tying the drop in first-time, foreign-student graduate enrollment to the impact of the 11 September 2001 terrorist strikes. Changes in visa processing after 9/11, along with increasing

global competition for students, may have contributed to the decline, says Mary Frase of NSF's Directorate for Social, Behavioral, and Economic Sciences. "What we're seeing is consistent with State Department data showing a drop in student visa applications and visa approval rates," she says.

Now that more domestic students are enrolled, it's important to keep them in the science pipeline, says Bernstein: "It's necessary to ensure that these enrollments translate into completed degrees and lead to sustainable careers." —YUDHIJIT BHATTACHARJEE



Uptick. Domestic students are fueling a rise in U.S. graduate school enrollment in science.