Chasing the dragons

Stunning fossils from Liaoning province have created a boom for Chinese palaeontologists and local farmers alike. Rex Dalton reports from the wild frontier where researchers do battle with the black market.

The farmers of Songzhangzi, some 300 kilometres northeast of Beijing, had always ignored the rocky ridges that loom over their small village. Then they struck palaeontological gold. About three years ago, realizing that some people will pay good money for fossils, the villagers took out their picks and shovels and began burrowing into the strata.

The hillsides were soon honeycombed with grave-sized shafts, and fabulous specimens began to emerge. Those that fell into the hands of palaeontologists include *Liaoxiornis delicates*, the smallest known bird from the Mesozoic[1], and *Hyphalosaurus sinohydrosaurus*, a long-necked diapsid reptile[2]. More await description in the literature.

But others have almost certainly been lost to an illicit trade, as impoverished locals sold their finds to the highest bidder. And although the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) in Beijing brokered a deal with provincial officials to dig at the site, known as Dawangzhangzi, earlier this year, Songzhangzi today resembles a gold-rush frontier town, where science is losing out to commerce.

The story has been repeated at other important sites across Liaoning province, located between Beijing and the North Korean border. Chinese palaeontologists dig side-by-side with local farmers, knowing that stunning specimens are being lost to science all the time. In late May, some 30 leading palaeontologists from around the world — and me — experienced this difficult working environment for themselves.

Escorted by scientists from the IVPP, we visited quarries, museums and roadside digs on a four-day tour of Liaoning, organized as a prelude to the fifth quadrennial meeting of the Society of Avian Paleontology and Evolution (SAPE) in Beijing. The western researchers were awed by the breathtaking quality and evolutionary significance of the fossils on display. But we also learned just how easily important specimens can vanish into the black market for sale to private collectors.

The Liaoning beds have yielded a host of primitive birds and the feathered theropod dinosaurs that most palaeontologists believe are their closest relatives[3–11]. Together, these fossils have revolutionized our understanding of bird evolution, and made the Chinese scientists behind the discoveries among the most cited in their field. But it is not simply the good fortune of discovering these fossils that has propelled China's palaeontologists to the fore.

> A fossil dealer had set up a makeshift stall in the lobby of the palaeontologists' hotel.

As in many disciplines, China has sent bright young researchers to be trained in the West's top institutes. Among them is Zhou Zhonge, who completed his PhD at the University of Kansas in Lawrence last year. But the palaeontological buzz in China is now so great that he rushed back home, rather than stay abroad as a postdoc as Chinese scientists in other disciplines often do. "You have this chance to make these kinds of discoveries but once or twice in a century," says Zhou. "It is a great feeling, and the discoveries are not slowing down."

But these growing East–West links have brought tension, mainly due to restrictions placed on access to the Chinese fossils. Several young American palaeontologists attending the SAPE meeting were disappointed when they were only allowed to study a few specimens, despite repeated pleas to see more. And some Chinese scientists studying in the United States have not shared specimens as their collaborators had expected.

Buried treasures

But there were no complaints when palaeontologists on the SAPE tour witnessed the unearthing of a specimen of *Confuciusornis sanctus*, one of Liaoning's famed early bird fossils, at a dig near Sihetun, east of the city of Chaoyang. IVPP scientists have mined this hilltop site for several years. The excavation goes to a stratum dated to about 124 million years old, in which a volcanic eruption left avian specimens entombed on an ancient lake bed.

Workers from the local village used putty knives to begin scraping away the thin ash layer in a flat section about five metres square. Halfway through the section, the *Confuciusornis* was unearthed. "We are lucky to be alive when this material is being discovered," says Rick Prum, an evolutionary biologist at the University of Kansas. The excavators themselves were less effusive, however. One of them, Cai Yizhong, was asked his feelings about the fossil. "No feelings," he replied, via a translator.

Indeed, to many locals, interest in the fossils begins and ends with their cash value.

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Reeling them in: fossils of small fish unearthed at Songzhangzi.

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Catching the early bird: locals at Sihetun work to reveal what appears to be a *Confuciusornis* (right) to visiting western palaeontologists. But such fossils often end up on the black market.

Such specimens sell for thousands of dollars on the international market, and the villagers of Liaoning province know it. Before the SAPE group arrived, the Sihetun quarry had been filled in with loose rocks to prevent pilfering. It took weeks for villagers with wheelbarrows to remove this protective fill before the IVPP could conduct its demonstration.

Despite such measures, the fleet of new motorcycles driven by the village's young men — who make at most US$3 a day digging for the IVPP — pointed to earlier successful sales of fossils. Villagers get only a fraction of the international black market price, but even this is a massive improvement over what they normally earn in the local agrarian economy.

There are similar sites throughout the region. For instance, just outside the burgeoning city of Jinzhou, alongside a country road near to a village, scientists from a local musuem have discovered a deposit from the early Cretaceous. Erosion had already done much of the excavation: fish fossils were found without digging, and avian specimens are believed to lie just a metre or two below the surface.

Hot rocks

Preventing the pillaging of this site near a city of several million people will be a challenge. The legal issues are confused, even to the scientists involved. "It is very complex," says Zhu Min, IVPP's scientific director, who notes that the Chinese central government is in the process of rewriting laws on fossil collection. "This issue is very hard to deal with."

Officially, the government considers the fossils — in particular the avian specimens, dinosaur eggs and certain mammalian skeletons — as national treasures that cannot be sold legally. But privately, Chinese palaeontologists say that Beijing exerts little control over what happens in the countryside. Provincial officials, meanwhile, are clamouring for more autonomy, which can cause problems for Beijing-based palaeontologists (see "The world's loneliest musuem", right). In this transitional period corruption has become rife in provinces such as Liaoning, and controls over the illicit fossil trade are lax, to say the least.

Western palaeontologists on the SAPE tour did not have to look far to learn about the problems. They were right in front of us in the lobby of our hotel in Chaoyang: a fossil dealer had set up a makeshift stall. This offered a variety of commonly sold fish and reptile fossils. But it also offered specimens of *Confuciusornis*, trade in which is supposed to be strictly controlled, if not banned outright.

Other dealers were more subtle. One evening in Chaoyang, operators of a small, private 'museum' offered to show interested scientists their specimens. Half a dozen of us jumped into cabs. We rode through this gritty city of three million people, across rail tracks that still carry steam engines, and into

The world's loneliest museum

As well as the illegal fossil trade, palaeontologists from Beijing must also deal with the complexities of provincial politics. Relations with officials in Liaoning can be strained, as western palaeontologists learned when they visited the new Beipiao Fossil Museum, 12 kilometres outside the city of the same name.

The museum houses an enviable collection of fossils. A stunningly preserved *Caudipteryx* — one of only six known specimens of this feathered creature — takes pride of place. One palaeontologist remarked that any museum in the world would pay a hefty price for such a specimen.

Despite its palaeontological riches, the Beipiao Fossil Museum is one of the most inaccessible anywhere. The gravel road leading to it is so bad that buses have to stop about a kilometre away. The museum cost about US$1.2 million, according to Beipiao officials, the cost being split between local and central government. Proudly displayed photos show Zou Jiahua, a top official of the Chinese National People's Congress, dedicating the museum's construction.

But nobody seemed to know when it would open to the public, and the entire project had Beijing-based palaeontologists shaking their heads. "I have no idea why they put it there," said one. "But we can say nothing. If the locals in Beipiao are against you, you can do no collecting there."

The museum is also draining funds from the Institute for Vertebrate Paleontology and Paleoanthropology in Beijing. The valuable specimens require full-time guards, and Beipiao officials are charging the cost of the guard squad to the institute. They also double-charged the institute for a lunch given to visiting western palaeontologists.

These expenses can have a real impact on the Beijing institute, which has such a limited budget that it was unable to repair the elevator and some toilets in time for the June meeting of the Society of Avian Paleontology and Evolution, held at its six-year-old museum.

a poor neighbourhood. Away from the main boulevards, down an alley in a walled courtyard of a private residence, we found the 'Long Chen Fossil Museum'.

A garage-type building had been converted into a showroom, secured by steel doors. Inside, there was a *Confuciusornis*, fossils of mammals, fish and reptiles along with petrified wood. Some items carried price tags. The 'museum' operators sported the latest cellular telephones and drove a luxury new four-wheel-drive vehicle — a stark contrast in a neighbourhood where bicycles are the norm. They responded to jokes in English, but wouldn't answer my questions about their activities. A Chinese researcher said that he was once asked to facilitate the museum's sales. And the lobby salesman tried to sell a specimen to a visiting palaeontologist. Both turned down the offers.

Occasionally, there are arrests for fossil dealing. One person was detained last year at the port of Dalian trying to smuggle a dinosaur egg out in their baggage; an illicit shipment of fossils was discovered earlier this year at Beijing airport; and about two weeks before the SAPE meeting, police raided the Panjiyuan fleamarket in Beijing, seizing fossils and dinosaur eggs.

But given the open trade of fossils in Liaoning, and the availability of Chinese specimens on the western black market, enforcement seems more the exception than the rule. Last February, at a big fossil show in Tucson, Arizona, one dealer of Chinese origin, now based in the Los Angeles area, had dozens of *Confuciusornis* specimens stacked like newspapers. Dealers often claim to have documents from Chinese institutions authenticating the scientific exchange of such specimens. But from what I saw in Liaoning, these records can be created as easily as someone can stock specimens in a 'museum' in a back alley.

Chinese palaeontologists wage a constant battle to prevent the fossils ending up on the black market. Another disturbing aspect of this trade is that fossils can be damaged by forgers, who amalgamate pieces from different specimens in the hope of creating a fossil that will attract a higher price.

The prevalence of forgeries was made clear on the first day of the SAPE field trip. Word of an exciting new specimen at a museum in Jinzhou had spread to Beijing. But when the fossil was displayed on a table in the museum lobby, scientists from the IVPP and SAPE quickly realized it was a composite of several specimens. The forgery was so obvious that even an amateur could see two tibiae of different diameters were pieced together end-to-end to create a 'leg'.

Keep it real

IVPP scientists are working to educate both local farmers and provincial museum curators not to dress up fossils, emphasizing they are more valuable in their natural state. But it is an arduous process. Xu Xing, an IVPP graduate student who has worked for years in Liaoning province, says that there are "assembly line factories" where workers piece together fossils for sale on the black market. Earlier this year, he visited one of these factories to try to deter the practice. Xu hopes his message hit home, but he is worried that similar workshops will set up, given the black market's demand for fossils.

'*Archaeoraptor liaoningensis*' is the most famous forgery. Stephen Czerkas, the operator of a small Utah museum, had bought the specimen in the belief that it was an important link in bird and dinosaur evolution, and the fossil was described in the November 1999 issue of *National Geographic* magazine.

Archaeoraptor seemed to be a bird, but it had a tail similar to a group of theropod dinosaurs called dromaeosaurs. A panel of palaeontologists easily debunked the specimen earlier this year, with a computerized tomography scan confirming the specimen as a composite[12].

Czerkas repatriated the fossil to the IVPP in May. Xu, meanwhile, ventured into the netherworld of Chinese dealers last December in search of the rest of the theropod from which *Archaeoraptor*'s tail came. After locating it, he bought the remains from a dealer for $5,000, supplied by the National Geographic Society, which is now seeking to uncover *Archaeoraptor*'s true origins.

But since then, local dealers have learned that Czerkas paid $80,000 for *Archaeoraptor*. Now they are hiking up their prices, making it harder for the IVPP and other Chinese research institutes to buy specimens and rescue them from the illegal trade. As Xu and his colleagues work on manuscripts to describe both new species that made up *Archaeoraptor*, they can only wonder about the other stunning specimens that are disappearing into private collections without ever being scientifically described. ■

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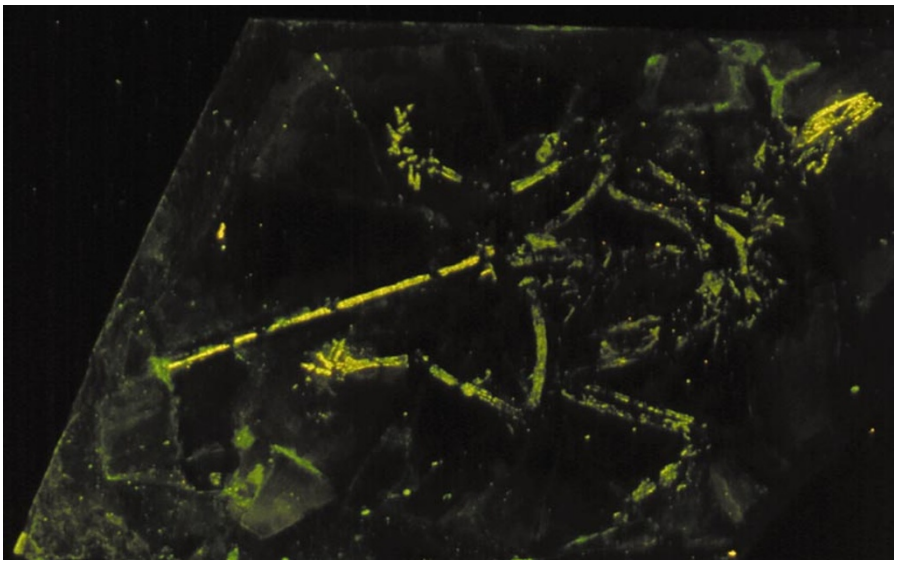
Home again: Xu Xing returns from the United States with *Archaeoraptor*.



O.L. MAZZATENTA/NATIONAL GEOGRAPHIC

Famous forgery: *Archaeoraptor liaoningensis* turned out to be a composite of two fossils.

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