nest positions — they were probably washed together by a storm — the authors argue that finding embryos and juveniles at different developmental stages strongly suggests that the species nested as a group.

FLIGHT PATTERNS

Examination of the microscopic structure of the embryonic bones also revealed a surprise, says Wang. Until now, hatchling pterosaurs were thought to fly almost from birth. The team found well-developed femur (thigh) bones — but the animals' forelimbs, which are necessary for flight, were underdeveloped. Wang concludes that the hatchlings could "walk on the ground, but not fly in the sky".

But Witton isn't convinced. He thinks that most pterosaurs probably had well-developed wings upon hatching, but that some features were made of cartilage, which is less likely to fossilize than is bone. "These animals would weigh just a few grams when hatched," he says. "Cartilage would be strong enough."

His own team's work, presented in September at the Symposium on Vertebrate Palaeontology and Comparative Anatomy in Birmingham, UK, has found that hatchling fossils of two other pterosaur species do appear to be flight-ready, with robust bones[3].

Deeming also cautions against inferring too much from what remains a limited data set — perhaps the *Hamipterus* embryos weren't close to hatching after all, he suggests. Palaeontologist Alexander Kellner of Brazil's National Museum at the Federal University of Rio de Janeiro, a co-author of the *Science* paper[1], hopes that other eggs already being unearthed from the Xinjiang site will fill some gaps. "We hope to find embryos in different stages," he says, "to have a complete embryological sequence." ■

1. Wang, X. *et al. Science* **358,** 1197–1201 (2017).
2. Deeming, D. *Science* **358,** 1124–1125 (2017).
3. Witton, M. P., Martin-Silverstone, E. & Naish, D. *PeerJ Preprints* **5,** e3216v1 (2017).

VIROLOGY

SARS outbreak linked to Chinese bat cave

Scientists find all the genetic elements of the deadly human virus in a single population of horseshoe bats.

BY DAVID CYRANOSKI

After a detective hunt across China, researchers chasing the origin of the deadly SARS virus have finally found their smoking gun. In a remote cave in Yunnan province, virologists have identified a single population of horseshoe bats that harbours virus strains with all the genetic building blocks of the one that jumped to humans in 2002, killing almost 800 people around the world.

The killer strain could easily have arisen from such a bat population, the researchers reported in *PLoS Pathogens*[1] on 30 November. They warn that all the ingredients are in place for a similar disease to emerge in future.

In late 2002, cases of a mystery pneumonia-like illness began occurring in Guangdong province, southeastern China. The disease, dubbed severe acute respiratory syndrome (SARS), triggered a global emergency as it spread around the world in 2003, infecting thousands of people.

Scientists identified the culprit as a strain of coronavirus and found genetically similar viruses in masked palm civets (*Paguma larvata*) sold in Guangdong's animal markets. Later surveys revealed large numbers of SARS-related coronaviruses circulating in China's horseshoe bats (*Rhinolophus*)[2] — suggesting that the deadly strain probably originated in the bats, and later passed through civets before reaching humans. But crucial genes, for a protein that allows the virus to latch onto and infect cells, were different in the human and known bat versions of the virus, leaving room for doubt about this hypothesis.

To clinch the case, a team led by Shi Zheng-Li and Cui Jie of the Wuhan Institute of Virology in China sampled thousands of horseshoe bats in locations across the country[3]. "The most challenging work is to locate the caves, which usually are in remote areas," says Cui. After finding a particular cave in Yunnan in southwestern China, in which the strains of coronavirus looked similar to human versions[4,5], the researchers spent ▶

KARL VAN GINDERDEUREN/MINDEN/GETTY

Horseshoe bats can carry SARS-like virus strains that could cause another outbreak, scientists warn.

five years monitoring the bats that lived there, collecting fresh guano and taking anal swabs[1].

They sequenced the genomes of 15 viral strains from the bats and found that, taken together, the strains contain all the genetic pieces that make up the human version. Although no single bat had the exact strain of SARS coronavirus that has been found in humans, the analysis showed that the strains mix often. The human strain could have emerged from such mixing, says Kwok-Yung Yuen, a virologist at the University of Hong Kong who co-discovered the SARS virus: "The authors should be congratulated for confirming what has been suspected."

But Changchun Tu, a virologist who directs the OIE Reference Laboratory for Rabies in Changchun, China, says the results are only "99%" persuasive. He would like to see scientists demonstrate in the lab that the human SARS strain can jump from bats to another animal, such as a civet. "If this could have been done, the evidence would be perfect," he says.

TRAVEL TROUBLE

Another outstanding question is how a virus from bats in Yunnan could travel to animals and humans around 1,000 kilometres away in Guangdong, without causing any suspected cases in Yunnan itself. That "has puzzled me a long time", says Tu.

Cui and Shi are searching for other bat populations that could have produced strains capable of infecting humans. The researchers have now isolated some 300 bat coronavirus sequences, most not yet published, with which they will continue to monitor the virus's evolution.

And they warn that a deadly outbreak could emerge again: the cave where the elements of SARS were found is just 1 kilometre from the nearest village, and genetic mixing among the viral strains is fast. "The risk of spillover into people and emergence of a disease similar to SARS is possible," the authors write in their paper.

Although many markets selling animals in China have already been closed or restricted following outbreaks of SARS and other infectious diseases, Yuen agrees that the latest results suggest the risk is still present. "It reinforces the notion that we should not disturb wildlife habitats and never put wild animals into markets," says Yuen. Respecting nature, he argues, "is the way to stay away from the harm of emerging infections". ■

1. Hu, B. *et al. PLoS Pathog.* **13,** e1006698 (2017).
2. Li, W. *et al. Science* **310,** 676–679 (2005).
3. Cui, J. *et al. Emerg. Infect. Dis.* **13,** 1526–1532 (2007).
4. Ge, X. Y. *et al. Nature* **503,** 535–538 (2013).
5. Yang, X.-L. *et al. J. Virol.* **90,** 3253–3256 (2016).

SPACE

Scientists pitch for remote human lab

Momentum builds for a crewed outpost around the Moon.

BY ELIZABETH GIBNEY

As the world's leading spacefaring nations plan for their next big outpost in space — a successor to the International Space Station — scientists are drafting a wish list of experiments for the most remote human laboratory ever built. NASA and the European Space Agency (ESA) are hosting meetings to discuss the science plans; the first took place on 5–6 December in Noordwijk, the Netherlands.

No nation has committed to fully funding the project, which does not yet have an estimated cost but is slated for launch in the 2020s. However, the space agencies are working on a plan to build an outpost in orbit around the Moon. Scientists are already jockeying for room on the platform. "I have been taken aback by the extent and the quality of proposals," says James Carpenter, human- and robotic-exploration strategy officer at ESA in Noordwijk, who organized the event and had to double its capacity to 250 people owing to the level of interest.

Known as the Deep Space Gateway, the platform is the "commonly accepted" next step once the International Space Station retires in the mid-2020s, says David Parker, director of human spaceflight and robotic exploration at ESA. The space agencies have made clear that its main purpose would be to test, from Earth's backyard, the technology for deep-space exploration and long-duration missions — including, eventually, going to Mars. "But we also want to work out how we get the best science out of it," says Parker.

COLLABORATIVE PROJECT

Scientists are eager to have input at the earliest stages of the planning process. Doing so could help the project to avoid the fate of the International Space Station, which some have criticized for failing to produce world-class science. But researchers should remember that the main purpose of both facilities is to support future exploration, says Richard Binzel, a planetary scientist at the Massachusetts Institute of Technology in Cambridge. "The space station is an instrument for human experience and, almost, space diplomacy," he says. "Where scientists get sniffy is in the claim that the science justifies the space station — it does not and it never has."

Still, researchers have already devised a vast array of experiments. The platform's location — outside Earth's protective magnetic field — would provide a unique environment for research, because conditions mimic those of deep space. It would also afford ready access

NASA

An outpost orbiting the Moon has been a key focus in proposals.