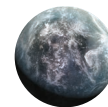


# NEWS IN FOCUS

**INFECTIOUS DISEASE** Chinese cave holds clues to origin of SARS virus **p.15**

**SPACE** Plans progress for next international space station **p.16**

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**EXOPLANETS** The search for a geological Goldilocks zone **p.20**

ALEX GOODLETT/NYT/REDUX/EYEVINE



The striking sandstone formations of the Valley of The Gods are part of the Bears Ears National Monument in Utah.

## CONSERVATION

# Archaeologists uneasy as Trump shrinks monument

*Cuts to Bears Ears site strip protection from thousands of ancient Native American sites.*

BY CALLY CARSWELL

A US government plan to slash protections for one of North America's richest and best-preserved archaeological landscapes has prompted a wave of concern among researchers. On 4 December, US President Donald Trump cut the Bears Ears National Monument in Utah from 547,000 hectares to 82,000 — removing protections for thousands of Native American cultural sites.

The president's action leaves the national monument, created last year by his

predecessor, Barack Obama, in legal limbo. Although presidents have clear authority to create monuments, many legal scholars argue that only the US Congress can change the areas' boundaries. On 4 December, several Native American tribes sued the government over its attempt to reshape Bears Ears.

The decision to remove protections from the monument comes at a time when people are increasingly encroaching on its cultural treasures. Looting of valuable objects such as ancient pottery has long plagued the Bears Ears area. And as tourism has grown in recent

years, so have inadvertent damage to walls and dwellings made of stone and mud, and the disappearance of potsherds and other artefacts.

Many archaeologists hoped that designating Bears Ears a national monument would help to mitigate this damage by allowing federal land managers to hire more staff, collect more baseline data on archaeological sites and do more outreach and education. Now those additional resources may never arrive, even as the publicity draws bigger crowds to the area.

"This is the worst-case scenario," says Jason Chuipka, vice-president of Woods Canyon ▶



► Archaeological Consultants in Cortez, Colorado.

Bears Ears' sandstone canyons and arid plateaus retain deep significance for Native American tribes. Obama established the monument in response to a petition from five groups: the Navajo, the Hopi, the Ute Mountain Ute, the Zuni and the Ute Indian Tribe of the Uintah and Ouray Reservation. But the move was fiercely opposed by some residents of neighbouring counties.

"The great research value of the Bears Ears to archaeology is that it's a relatively undeveloped landscape," says William Lipe, an archaeologist at Washington State University in Pullman. And perishable goods from ancient communities — including baskets, feather blankets and maize (corn) — remain intact thanks to the dry climate and dwellings that sit in alcoves sheltered from rain and sunlight.

Much of the material at sites in Bears Ears is more than 1,000 years old, says Chuipka, who calls it "a three-dimensional data trove". Archaeologists estimate that just 10% of the roughly 100,000 sites within the monument have been formally surveyed.

The well-preserved ancient goods found in the area have contributed to important scientific discoveries. Earlier this year, a genetic study of 1,900-year-old maize cobs provided important insights into how tropical maize adapted to temperate growing conditions (K. Swarts *et al. Science* 357, 512–515; 2017).

A team led by Kelly Swarts, a plant geneticist then at Cornell University in Ithaca, New York, sequenced the genomes of 15 cobs of maize. The scientists found that the traits that allowed maize to adapt to cooler climates had always existed in the plant, but it took farmers in what is now the southwest United States 2,000 years to select for them. The findings underscore the vast adaptive capacity of the global crop.

The Trump administration's revisions to the Bears Ears National Monument would fragment it into two units. Two well-known ancient cliff dwellings — Moon House and Doll House — are included as satellites of one of the units. But the new boundaries exclude Cedar Mesa, which hosts the monument's densest concentration of archaeological sites — occupied from 500 BC to the mid-thirteenth century AD.

Chuiipka says that carving up the monument and cherry-picking popular sites for protection undermines a key reason for creating it: the preservation of an interconnected cultural landscape. Together, says Lipe, the sites within Bears Ears record "the whole pattern of the way people lived on, made use of, and built their cultural memories into the landscape over thousands of years".

The five tribes that pushed for the creation of the Bears Ears National Monument filed suit on 4 December in federal court, where the site's ultimate fate is expected to be decided. ■



The unprecedented find of *Hamipterus* eggs offers a window into the early lives of pterosaurs.

#### PALAEONTOLOGY

## Rare pterosaur eggs unearthed in China

*Embryos in some of the hundreds of fossil eggs discovered suggest that hatchlings struggled to fly.*

BY JOHN PICKRELL

A remarkable fossil slab containing hundreds of pterosaur eggs and some embryos has been discovered in China. The find is set to transform palaeontologists' understanding of these enigmatic creatures.

The early lives of pterosaurs — the first vertebrates to evolve powered flight — have been a mystery. It was only in 2004 that scientists confirmed that the creatures laid eggs, and until now, just a handful of eggs had been found. The newly discovered trove, belonging to a species called *Hamipterus tianshanensis* that lived around 120 million years ago, offers clues to the development and anatomy of freshly hatched pterosaurs. It also provides the first solid evidence that, like many dinosaur species, these animals nested in groups.

The fossils, reported in *Science*<sup>1</sup> on 1 December, were discovered in the Turpan-Hami Basin in Xinjiang, northwestern China. From 2006 to 2016, Wang Xiaolin

of the Chinese Academy of Sciences' Institute of Vertebrate Paleontology and Paleoanthropology in Beijing and his colleagues excavated a 3-square-metre sandstone block to reveal at least 215 eggs among jumbled pterosaur bones. The team used computed-tomography scanning to peer inside

**"We hope to find embryos in different stages to have a complete embryological sequence."**

42 eggs, and found 16 that contained the remains of embryos at various stages of development. It's "a crucial advance", writes Charles Deeming, who studies bird and reptile reproduction at the University of Lincoln, UK, in a commentary also published in *Science*<sup>2</sup>. Mark Witton, who researches the reptiles at the University of Portsmouth, UK, says that *Hamipterus* now "has the potential to be one of the most completely known pterosaurs of all".

Although the eggs are not in their original

ZHAO CHUANG

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<sup>3</sup>.

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<sup>1</sup>, 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*<sup>1</sup> 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*)<sup>2</sup> — 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<sup>3</sup>. “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<sup>4,5</sup>, the researchers spent ▶



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<sup>1</sup>.

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



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

NASA

to the Moon. As well as testing how space affects human physiology and technology, researchers will propose ways in which the station could support planetary studies and allow for innovative physics and astronomy experiments, says Carpenter.

#### MOON-BOUND AND BEYOND

The workshop will showcase a host of physics experiments that not only would exploit the environment, but might also become economically viable only by piggybacking off the platform's power and navigation capabilities. These include a meteoroid-environment monitor, which would study the drifting interstellar dust that never reaches Earth owing to the planet's magnetic field. A low-frequency radio observatory could be used to pick up radiation from the Universe's 'dark ages', between 40,000 and 100 million years after the Big Bang — which is hugely challenging on Earth because of interference from human sources and the planet's ionosphere, says Mark Bentum, a physicist at the University of

Twente in Enschede, the Netherlands.

A space station near the Moon would afford lunar scientists regular access to its surface, says Mahesh Anand, a planetary scientist at the Open University in Milton Keynes, UK. Water has been confirmed on the Moon in the past decade, but scientists still know little about where it is, how much there is and how feasible it would be to extract. Crew aboard an orbiting laboratory would also be able to control lunar rovers in real time, and could study Moon rock without the need to return samples to Earth.

Others are seeking to develop technology for deep-space travel. Armin Götzhäuser, a physical chemist at Bielefeld University in Germany, wants to test the potential of nanometre-thick carbon nanomembranes, made from fused aromatic molecules, for potential use as long-lasting, thin and efficient filters that could

recycle wastewater or air. Meanwhile, biochemist Katharina Brinkert at the California Institute of Technology in Pasadena and her colleagues have designed a device to boost the solar-assisted production of hydrogen and oxygen, optimized for use in microgravity.

Political interest in the platform is growing. In September, NASA signed a joint agreement with Roscosmos, its Russian counterpart, which outlined such a platform as part of the agencies' "common vision for human exploration". The Japanese and Canadian space agencies are also involved. Both NASA and ESA have already contracted with industry partners to undertake preliminary work.

But if and when the project moves forward will depend largely on NASA's new administrator. James Bridenstine, a Republican member of the US Congress from Oklahoma, has been nominated for the role but has yet to be confirmed for the post. If the Deep Space Gateway is to launch as planned in the mid-2020s, key decisions need to be made by the end of 2019, says Parker. ■

#### PUBLISHING

# German row with Elsevier threatens journal access

*Negotiations to reduce journal prices and promote open access are progressing slowly.*

BY QUIRIN SCHIERMEIER

**A**round 200 German universities will lose their subscriptions to Elsevier journals within weeks, because negotiations have failed to end a long-term contract dispute.

The conflict between Elsevier, the world's biggest publisher of scientific journals, and Germany's entire university system has dragged on since 2015. Academics in the country lost access to Elsevier content briefly early this year, but it was later restored while contract talks resumed.

Advocates of open-access publishing

worldwide say that victory for the German universities would be a major blow to conventional models of scientific publishing based on subscription fees. Germany's firm stand in the battle to reduce subscription prices and promote immediate open access could herald profound changes to the global landscape of scholarly publishing, they say.

"There is no doubt that what the German universities are asking for is the direction of travel for scholarly publishing," says Paul Ayris, pro-vice-provost of library services at University College London. "If Germany achieves this with Elsevier, other

countries will want to follow suit."

Negotiators with 'Project DEAL', a consortium of university libraries and research institutes, have been in talks with Elsevier for more than two years. They want a deal that would give most scientists in Germany full online access to 2,500 or so Elsevier journals, at about half the price that individual libraries have paid in the past. Open access is proving to be the sticking point in the talks: under the deal sought, all corresponding authors affiliated with German institutions would be allowed to make their papers free to read and share by anyone in the world at no extra cost. ►



**MORE  
ONLINE**

#### IMAGES OF THE MONTH



Lions, beetles and bones — November's images of the month  
[go.nature.com/2znpkaa](http://go.nature.com/2znpkaa)

#### TOP NEWS

- Universe's baby picture wins US\$3 million [go.nature.com/2ax4img](http://go.nature.com/2ax4img)
- Gravity signals could speedily warn of big quakes and save lives [go.nature.com/2jseet9](http://go.nature.com/2jseet9)
- Rise in malaria cases sparks fears of a resurgence [go.nature.com/2a6cm4h](http://go.nature.com/2a6cm4h)

#### NATURE PODCAST



Exoplanet geology, and a duck-like, dual-terrain dinosaur  
[nature.com/nature/podcast](http://nature.com/nature/podcast)

► “Publishers’ old business models aren’t up to date any more,” says Horst Hippler, president of the German Rectors’ Conference and a spokesman for Project DEAL. “Results of scientific research must be open to the public, and the costs of open access must be affordable.”

Research institutions and funders worldwide are adopting open-access policies. An analysis published in August, led by information scientists Heather Piwowar at the University of Pittsburgh in Pennsylvania, and Jason Priem, who runs an online service that promotes open science, found that 28% of the global scholarly literature is freely available in some form, including in university repositories (H. Piwowar *et al.*

*PeerJ* 5, e3119v1; 2017). The growth rate of open-access articles is much higher than that of articles behind paywalls (J. P. Tennant *et al.* *F1000Research* 5, 632; 2016).

#### INTERNATIONAL TALKS

In September, a Finnish university consortium that sought a nationwide contract with Elsevier reached a preliminary understanding with the company, after lengthy negotiations and a



The Free University of Berlin is part of a consortium negotiating with Elsevier.

temporary strike by peer reviewers. Details of the agreement have yet to be disclosed, but sources say that it will include both reduced journal prices and permission for some articles by Finnish authors to be made freely available at no charge.

Gerard Meijer, a Dutch physicist now at the Max Planck Society’s Fritz Haber Institute in Berlin, was involved in negotiating open-access deals with Elsevier in the Netherlands in

2015. One deal allows scientists at 14 Dutch universities to make 30% of papers in selected journals open access without extra costs. “This was the maximum we were able to achieve at the time,” he says. “With hindsight, I think we should have pushed harder.”

Some 19% of research articles published in 2016 that included a German author were published in an Elsevier journal, says Hannfried von Hindenburg, a spokesman for Elsevier. “We recognize the urgency of achieving 100% gold open access, and we are happy to support that goal as much as we can,” he says. The challenge is to make the transition sustainable for all parties. Asking national consortia to pay for subscription fees

and for open-access publication “can be quite expensive for countries like Germany with a large research output”, says von Hindenburg.

Germany is also negotiating an open-access deal with Springer Nature, Nature’s publisher. (*Nature’s* news team is editorially independent of its publisher.) To buy more time, both sides agreed in October to a one-year extension of all existing contracts that are due to end on 31 December. ■

HANNIBAL HANSCHKE/REUTERS