and very little of it's actually paid. The wider academic system — and this includes publishing — relies on goodwill and on people doing things that are outside their contracts.

There's no particular reason why an academic has to peer review a paper for a journal; it's not in their contract to do so. The reason we do so is because universities are about the exchange of information and knowledge. But when you keep cutting people's pay and pensions, that goodwill begins to dissipate.

Richard Harris is a geographer at the University of Bristol.

Interviews by Miryam Naddaf.
These interviews have been edited for length and clarity.

ANCIENT SKULL UNCOVERED IN CHINA COULD BE *HOMO ERECTUS*

Fieldwork is under way to excavate a rare, well-preserved specimen in central China.

By Dyani Lewis

Researchers are heralding the discovery of an ancient human skull in central China. As excavation of the remarkably intact fossil continues, archaeologists and palaeoanthropologists anticipate that the skull could give a fuller picture of the diverse family tree of archaic humans living throughout Eurasia in prehistoric times.

The skull was discovered on 18 May at an excavation site 20 kilometres west of Yunyang — formerly known as Yunxian — in central China's Hubei province. It lies 35 metres from where two skulls — dubbed the Yunxian Man skulls — were unearthed in 1989 and 1990 (ref. 1), and probably belongs to the same species of ancient people, say researchers.

"It's a wonderful discovery," says palaeoanthropologist Amélie Vialet at the National Museum of Natural History in Paris, who has worked on the first two skulls, commonly referred to as Yunxian 1 and 2. Unlike those earlier discoveries, which were crushed and distorted after millennia underground, the third skull, Yunxian 3, seems to be in good condition.

PASCAL GOETGHELUCK/SPL

A 3D reconstruction of a skull previously discovered at the same site as Yunxian 3.

In 2010, Vialet and her colleagues created digital reconstructions of the Yunxian 2 skull, and confirmed that it was probably a member of the archaic human species *Homo erectus*[2]. Dating of sediment and animal fossils from the site suggest that the Yunxian humans lived between 1.1 million and 800,000 years ago.

Is Yunxian Man *Homo erectus*?

Homo erectus was first described from fossils found on the Indonesian island of Java in the late nineteenth century. Javanese fossils dating to 1.5 million years ago suggest that members of the species might have been the first early humans to have ventured out of Africa.

Homo erectus was widespread and existed for a long time. Remains have been found in eastern Africa, eastern Asia and possibly Europe, and they span a period from 1.9 million to 250,000 years ago. Because of this, there is a great deal of variability in the species' fossil record, and the precise relationships between populations are a matter of debate.

The Yunxian 3 skull is half-buried in an upright position. Researchers have uncovered the forehead, including the brow ridge and eye sockets, as well as the top, back and left cheekbone of the skull. It is not yet known whether teeth or a lower jawbone are attached to the skull, says Gao Xing at the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, who is leading the excavation.

Vialet says that the Yunxian 1 and 2 skulls share some features with older Javanese fossils, and others with younger *H. erectus* fossils from mainland Asia. Like the Javanese fossils, they are large skulls with big braincases. But she says that they are less heavily built, a characteristic that usually indicates a more modern individual.

Researchers have found *H. erectus* remains at more than a dozen sites across China. Vialet says that the ancient humans at Yunxian could be the ancestors of some of these populations, but their skulls bear distinct features that set them apart.

For example, fossils from around 700,000 years ago that were discovered in the Zhoukoudian cave system in suburban Beijing — known as the Peking Man Site — have a prominent sagittal keel, a crest that runs along the midline of the skull for the attachment of strong jaw muscles. The Yunxian skulls all seem to lack this feature, says Vialet.

Variable fossils

Yameng Zhang, a palaeoanthropologist at Shandong University, says that the *H. erectus* fossils found in China are highly variable and researchers don't know why. It could be that each population evolved independently in Asia. Or they could have been the result of multiple waves of expansion out of Africa, he says. "More complete Chinese *H. erectus* like Yunxian 3 are crucial to answer this question."

Vialet says that the Yunxian 3 skull should be compared with Chinese as well as European hominin fossils, such as the 1.4-million-year-old face from the Sima del Elefante cave in Atapuerca, Spain, discovered in July. She is currently comparing Yunxian 2 with European hominin fossils, and says that the Yunxian people could be more similar to European populations from the middle Pleistocene epoch than they are to later specimens from China.

If the Yunxian 3 skull has teeth, especially molars, they could be useful for discerning evolutionary relationships with other early humans, says Clément Zanolli at the University of Bordeaux in France.

Once the Yunxian 3 skull is excavated, probably in the next few months, dating it will be an important task. Several techniques have been used to estimate the age of Yunxian 1 and Yunxian 2.

Hominin fossils in China are often more difficult to date than fossils in Africa, because China lacks volcanic sediments that can be reliably dated by measuring the amounts of radioactive isotopes in the rock, says Wei Wang, a geochronologist at Shandong University.

Jean-Jacques Bahain at the National Museum of Natural History in Paris dated sediments collected from the Yunxian site using electron spin resonance and uranium-series dating[3]. This requires a close comparison between values taken from the fossil and the quartz in the sediment. But he says that the samples he measured weren't collected at the same time and location as the Yunxian 1 and 2 skulls.

"More complete Chinese *Homo erectus* like Yunxian 3 are crucial to answer questions."

The discovery of Yunxian 3 is an opportunity to collect sediment samples from the ground that the skull sits in, he says.

Small animal fossils surrounding the Yunxian 3 skull are slowing the extraction process, according to Gao. Bahain says that such specimens could help to pinpoint the age of the Yunxian 3 skull, and connect it to early human remains elsewhere in China.

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2. Vialet, A. *et al. Comptes Rendus Palevol.* **9**, 331–339 (2010).
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DID PHYSICISTS CREATE A WORMHOLE IN A QUANTUM COMPUTER?

An unusual teleportation experiment was inspired by tunnels in an exotic 'toy' universe.

By Davide Castelvecchi

Physicists have used a quantum computer to perform a new kind of quantum teleportation, the ability to transport quantum states between distant places, as though information could travel instantly. Although teleportation is an established technique in quantum technology, the purpose of the latest experiment was to simulate the behaviour of a passage called a wormhole through a virtual universe.

The researchers behind the experiment, described in *Nature* on 30 November (D. Jafferis *et al. Nature* **612**, 51–55; 2022), say that it is a step towards using ordinary quantum physics to explore ideas about abstract universes in which gravity and quantum mechanics seem to work harmoniously together. Quantum computers could help to develop a quantum theory of gravity in these 'toy' universes. (Developing a quantum theory of gravity for our own Universe is one of the biggest open problems in physics.)

"It's a test of quantum-gravity ideas on a real lab experimental test bed," says Maria Spiropulu, a particle physicist at the California Institute of Technology in Pasadena who led the study.

Tunnels in space-time

Physicists Albert Einstein and Nathan Rosen proposed the idea of wormholes – passages through space-time that could connect the centres of black holes – in 1935. They calculated that, in principle, wormholes were allowed by Einstein's general theory of relativity, which explains gravity as an effect of the curvature of space-time. (Physicists soon realized that even if wormholes exist, they are unlikely to allow anything like the interstellar travel that features in science fiction.)

Because the latest teleportation experiment used an exotic toy universe, it didn't simulate anything resembling the kind of wormhole that could conceivably exist in our Universe, as suggested by Einstein and Rosen. But it can be interpreted as analogous to a wormhole in the researchers' virtual system – quantum information fed into one side of the 'wormhole' reappeared on the other side.

"The surprise is not that the message made it across in some form, but that it made it across unscrambled," write the authors of an accompanying News and Views article (A. R. Brown and L. Susskind *Nature* **612**, 41–42; 2022). "However, this is easily understood from the gravitational description: the message arrives unscrambled on the other side because it has traversed the wormhole."

Exotic physics

The experiment was inspired by earlier research linking the physics of exotic universes and their own versions of gravity to more standard – but still virtual – quantum systems. The main idea is that some abstract versions of space-time emerge from the collective behaviour of ordinary quantum particles living in a sort of 'shadow world' – similar to how a 2D hologram can create the illusion of a 3D image. That 'holographic' behaviour dictates how the emergent space-times curve on themselves, producing the effects of gravity.

Although physicists do not yet know how to write quantum theories of gravity for emergent universes directly, they know that such phenomena should be fully encapsulated in the physics of the shadow world. This means that gravitational phenomena such as black holes – which still pose riddles to theoretical physicists – or wormholes must be compatible with quantum theory.

The latest experiment follows a scheme that co-author Daniel Jafferis, a theoretical physicist at Harvard University in Cambridge, Massachusetts, and his collaborators proposed in 2017 (P. Gao *et al. J. High Energy Phys.* **2017**, 151; 2017). That work focused on the simplest such holographic correspondence, known as SYK after the initials of its creators. In this toy model universe, space has only one dimension, rather than three.

In the latest study, Jafferis, Spiropulu and their colleagues simulated an even more stripped-down version of such a hologram using the quantum bits, or qubits, of Google's Sycamore processor. They expected their simulated quantum particles to reproduce some behaviours of gravity in the virtual universe – but the models were limited by the capabilities of current quantum computers. "We had to find a model that kind of preserves the gravity properties and that we can code on a quantum processor that has a limited amount of qubits," says Spiropulu. "We shrunk it down to a baby model, and we checked that it preserves gravitational dynamics."