the same way as other groups.

The study hints at "the really diverse ways in which populations move and don't move, and how ideas can spread with, but also through, populations", says co-author Christina Warinner, a molecular archaeologist at Harvard University in Boston, Massachusetts.

The finding demonstrates that cultural exchange doesn't always go hand in hand with genetic ties, says Michael Frachetti, an archaeologist at Washington University in St. Louis, Missouri. "Just because those people are trading, doesn't necessarily mean that they are marrying one another or having children," he says.

Perfect preservation environment

Starting in the early twentieth century, the mummies were found in cemeteries belonging to the so-called Xiaohe culture, which are scattered across the Taklamakan Desert in the Xinjiang region of China. The desert "is one of the most hostile places on Earth", says Alison Betts, an archaeologist at the University of Sydney in Australia.

Here, bodies had been buried in boat-shaped coffins wrapped in cattle hide. The hot, arid and salty environment of the desert naturally preserved them, keeping everything from hair to clothing perfectly intact. Before the latest study, "we knew an awful lot about these people, physically, but we knew nothing about who they were and why they were there", says Betts.

The mummies — which were buried over a period of 2,000 years or more — date to a significant time in Xinjiang's history, when ancient communities were shifting from being hunter-gatherers to farming, she adds.

Some of the later mummies were buried with woollen fabrics and clothing similar to those of cultures found to the west. The graves also contained millet, wheat, animal bones and dairy products — evidence of agricultural and pastoral technologies characteristic of cultures in other regions of Eurasia, which led researchers to hypothesize that these people were originally migrants from the west, who had passed through Siberia, Afghanistan or Central Asia.

The researchers behind the latest study — based in China, South Korea, Germany and the United States — took DNA from the mummies to test these ideas, but found no evidence to support them.

They sequenced the genomes of 13 individuals who lived between 4,100 and 3,700 years ago and whose bodies were found in the lowest layers of the Tarim Basin cemeteries in southern Xinjiang. They also sequenced the genomes of another 5 mummies from hundreds of kilometres away in northern Xinjiang, who lived between 5,000 and 4,800 years ago.

They then compared the genetic profiles of these people with previously sequenced genomes from more than 100 ancient groups of people, and those of more than 200 modern populations, from around the world.

The harsh desert conditions preserved the bodies as natural mummies.

WENYING LI, XINJIANG INSTIT. CULTURAL RELICS AND ARCHAEOLOGY

They found that the northern Xinjiang individuals shared some parts of their genomes with Bronze Age migrants from the Altai Mountains of Central Asia who lived about 5,000 years ago — supporting an earlier hypothesis about their origins.

But the 13 people from the Tarim Basin did not share this ancestry. They seem to be solely related to hunter-gatherers who lived in southern Siberia and what is now northern Kazakhstan some 9,000 years ago, says co-author Choongwon Jeong, a population and evolutionary geneticist at Seoul National University. The northern Xinjiang individuals also shared some of this ancestry.

Evidence of dairy products was found alongside the youngest mummies from the upper layers of cemeteries in the Tarim Basin, so the researchers analysed calcified dental plaque on the teeth of some of the older mummies to see how far back dairy farming went. In the plaque, they found milk proteins from cattle, sheep and goats, suggesting that even the earliest settlers here consumed dairy products. "This founding population had already incorporated dairy pastoralism into their way of life," says Warinner.

But the study raises many more questions about how the people of the Xiaohe culture got these technologies, from where and from whom, says Betts. "That's the next thing we need to try and resolve."

MYSTERIOUS 'ALIEN BEACON' WAS FALSE ALARM

A signal that seemed to come from the star Proxima Centauri will refine the search for extraterrestrial life.

By Alexandra Witze

A radio signal detected by an Australian telescope in 2019, which seemed to be coming from the star closest to the Sun, was not from aliens, researchers reported last week in two papers published in *Nature Astronomy*[1,2].

"It is human-made radio interference from some technology, probably on the surface of the Earth," says Sofia Sheikh, an astronomer at the University of California (UC), Berkeley, and a co-author of both papers.

But the disturbance, detected by Breakthrough Listen — an ambitious and privately funded US$100-million effort to search for extraterrestrial intelligence (SETI) — looked intriguing enough at first that it sent astronomers on a nearly one-year-long quest to understand its origins.

It was the first time that data from Breakthrough Listen triggered a detailed search, and the experience puts scientists in a better position to study future candidate detections.

"It's really valuable for us to have these dry runs," says Jason Wright, an astronomer at Pennsylvania State University in University Park. "We need these candidate signals so we can learn how we will deal with them — how to prove they are extraterrestrial or human-made."

Mysterious blips

Since 2016, Breakthrough Listen has used telescopes around the world to listen for possible broadcasts from alien civilizations. The programme has picked up millions of radio blips of unknown origin, nearly all of which could be swiftly classified as coming from radio interference on Earth — from sources such as mobile-phone towers or aircraft radar.

The 2019 signal was different. It was detected by the 64-metre Parkes Murriyang radio telescope in southeastern Australia and came from the direction of Proxima Centauri — the nearest star to the Sun, just 1.3 parsecs

(4.2 light years) away. Proxima Centauri is of intense interest to SETI researchers, not just because it is nearby. The star has at least two planets, one of which orbits at the right distance for liquid water to be present on its surface – a prerequisite for life as it exists on Earth[3]. A sibling initiative to Breakthrough Listen, known as Breakthrough Starshot, aims to send a tiny spacecraft to this planet in the future to look for life there.

The mysterious signal was first spotted last year by Shane Smith, an undergraduate student at Hillsdale College in Michigan, who was working as a research intern with Breakthrough Listen. Smith was combing through data that Parkes collected in April and May the previous year. The telescope had been making observations in the direction of Proxima Centauri for 26 hours over a 6-day period. It was not hunting specifically for aliens at the time, but was instead monitoring flares on the star's surface, phenomena that could hurt the chances for life to arise on nearby planets.

The data included more than 4 million signals from the vicinity of the star, but Smith noted one signal near 982 megahertz that seemed to originate from the star itself and lasted for about 5 hours. "I was excited to find a signal that matched all the criteria I was looking for, but I immediately remained sceptical of it,' Smith says. "I did not ever think the signal would cause such excitement."

Smith shared the information with his supervisor, Danny Price, who posted it on a Breakthrough Listen channel on the online collaboration platform Slack, and the team started investigating in earnest. "My first thought was that it must be interference, which I guess is a healthy attitude – to be sceptical," says Price, an astronomer at UC Berkeley and the Breakthrough Listen project scientist in Australia. "But after a while I started thinking, this is exactly the kind of signal we're looking for."

The signal, named BLC1 for 'Breakthrough Listen candidate 1', was the first to pass all of the programme's initial screening tests to rule out obvious sources of interference. "It definitely had me wondering 'what if?' for a bit," says Sheikh.

"I immediately remained sceptical of it. I did not ever think the signal would cause such excitement."

She, Price and a large group of colleagues began working through possible explanations, from uncatalogued satellites to transmissions from planetary spacecraft. In Australia, the radio-frequency band around 982 megahertz is primarily reserved for aircraft, but the scientists could not identify any aeroplanes that had been in the area and that could account for the signal – certainly not one lasting 5 hours.

In November 2020, and in January and April this year, the researchers pointed the Parkes telescope at Proxima Centauri to see if they could pick up the signal again. They could not.

Eventually, the team spotted other signals in the original data that looked a lot like the 982-megahertz signal but were at different frequencies. These signals had been tossed out by the team's automated analysis as being earthly interference. Further analysis showed that BLC1 and these 'lookalike' signals were all interference from an unknown source. The signals had modulated and muddied one another, much as a guitar amplifier modulates and distorts a guitar note, which is what made it so difficult to identify BLC1 as interference.

Earthly origins

Because the signal didn't reappear in the 2020 and 2021 observations, it might have been coming from malfunctioning electronic equipment that got shut down or fixed, says Sheikh. The team suspects the equipment was relatively close to Parkes, perhaps less than a few hundred kilometres away. The frequency of the signal drifts in a way that is consistent with inexpensive crystal oscillators such as those commonly used in computers, phones and radios, says Dan Werthimer, a SETI astronomer at UC Berkeley who specializes in signal processing.

Working with another student, Sheikh is now using machine-learning algorithms to tease out what frequency the interfering equipment was transmitting at, which might help to track down its source. One lingering mystery is why the signal seemed to appear only when the telescope was pointed at Proxima Centauri. That might just be an unfortunate coincidence, if the cadence of the interference mimicked the cadence of the telescope's observations of the star.

Radio interference has bedevilled other astronomical searches before, such as when flickering signals picked up at Parkes turned out to be the result of people microwaving their lunches[4]. The famous 'Wow!' signal, detected in 1977 by a radio telescope in Ohio, was a powerful blip so intriguing that the observing scientist scribbled "Wow!" in the margins of the computer printout – but its origin could never be traced.

Alien searches have become much more sophisticated since then, Sheikh notes. "Many groups assumed that if you had a detection that only showed up when you were pointed at the source, that was it, break out the champagne, you're done," she says. "As technology changes, the way we vet signals also has to change – and that hadn't come together until BLC1."

"The Universe gives us a haystack," says Ravi Kopparapu, a planetary scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "It is our need to find the needle in it, and make sure that it is actually a needle that we found."

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The 64-metre Parkes Murriyang telescope in New South Wales, Australia.

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