

<https://bit.ly/3CBrBOe>

Supersaurus might be the longest dinosaur that ever lived

This dino-mite champ was at least 128 feet long.

By [Laura Geggel](#)

The gold medal for the longest dinosaur in the world might go to the aptly named *Supersaurus*, now that scientists have fixed a fossil mix-up and analyzed new bones excavated from the long-necked dinosaur's final resting spot.

Like other exceedingly long [dinosaurs](#), *Supersaurus* is a diplodocid — a long-necked sauropod whose whip-like tail went on for days. *Supersaurus* has always been viewed as one of longest dinosaurs, but research now shows that "this is the longest dinosaur based on a decent skeleton," as other dinosaur remains are fragmentary, and it's challenging to accurately estimate their lengths, Brian Curtice, a paleontologist at the Arizona Museum of Natural History who is spearheading the research, told Live Science

When *Supersaurus* was alive about 150 million years ago during the [Jurassic period](#), it exceeded 128 feet (39 meters) and possibly even reached 137 feet (42 m) from snout to tail, Curtice's new research found. Even its "shorter" size is record-breaking; at 128 feet, the dinosaur would have been longer than another contender — [Diplodocus](#), which could reach lengths of 108 feet (33 m), according to a 2006 study of a specimen known as *Seismosaurus* in the [New Mexico Museum of Natural History and Science Bulletin](#).

The research, which is not yet published in a peer-reviewed journal, was presented online Nov. 5 at the Society of Vertebrate Paleontology's annual conference.

The new finding is nearly 50 years in the making; the first *Supersaurus* specimen was uncovered in 1972 in a chock-full bonebed, in what was basically a "bone salad," Curtice said. So, it wasn't immediately clear which bones belonged to the beast.

That bone salad was excavated by dinosaur field worker Jim Jensen, who collected and prepared fossils for Brigham Young University in Utah, in Dry Mesa Dinosaur Quarry in Colorado. Jensen discovered an 8-foot-long (2.4 m) scapulocoracoid — two fused bones that make up the shoulder girdle in adult dinosaurs and other reptiles. The quarry also contained additional bones that Jensen thought belonged to two other sauropod dinosaurs, which years later he named *Ultrasauros* and *Dystylosaurus*.

News of the beastly bones made headlines. The public was intrigued that a dinosaur larger than [Brachiosaurus](#), then considered the longest dinosaur, existed, according to the blog [Sauropod Vertebra Picture of the Week \(SV-POW\)](#), run by paleontologists Michael Taylor and Mathew Wedel. A journalist incidentally named the biggest beast *Supersaurus* in the frenzy following its discovery.

In 1985, Jensen published a study in the journal [Great Basin Naturalist](#) announcing the discovery of three new sauropod dinosaurs from the quarry. However, Jensen wasn't a trained paleontologist, and he made some mistakes with his analysis. Over the years, paleontologists have debated whether *Ultrasauros* and *Dystylosaurus* are valid genera, or whether — as Curtice believes — their bones were misidentified and actually all belong to a single *Supersaurus*.

The case for Supersaurus

This reclassification of three dinosaurs as one provides a more complete *Supersaurus* specimen for scientists to study, which is useful for estimating its length.

So how can three dinosaurs become one? By uncovering the mistakes of years' past. For instance, one of the scapulocoracoids at the quarry is about 10 inches (25 centimeters) longer than the other, which led many scientists to believe that it belonged to another genus of dinosaur. But when Curtice inspected it, he found that the

longer bone was actually distorted because of cracks. "If you push all the cracks together, [the scapulocoracoids are] basically the same size," he said.



The meat-eating dinosaur Allosaurus, which also lived during the late Jurassic period, was a pipsqueak compared with Supersaurus. (Image credit: Supersaurus by Sean Fox; Allosaurus by Gustavo Monroy/Fossil Crates)

He also found deformities, made by environmental forces, in bones attributed to *Dystylosaurus* and other genera, and he showed that these bones, in fact, belonged to *Supersaurus*.

In addition, no other excessively large sauropod bones were found nearby. Rather, all of the large, diplodocid-looking bones were found in one pocket of the quarry, and there weren't any duplicated bones (meaning there's just one left scapulocoracoid and one right scapulocoracoid, for example), Curtice said. And all of the massive dinosaur bones are roughly the same size, so they likely all belong to one individual: the *Supersaurus*, Curtice said.

Since the original finding, other paleontologists have discovered partial skeletons thought to be *Supersaurus* — including [one nicknamed "Jimbo"](#) and another dubbed "Goliath" — in Wyoming. However, researchers have yet to formally identify Goliath as a *Supersaurus* in a peer-reviewed journal.

How long are you?

Previous *Supersaurus* length estimates put it at the upper echelon of long dinosaurs, including a 2008 estimate of [108 to 111 feet](#) (33 to 34 m), but those were based on incomplete data, Curtice said.

When the Dry Mesa Dinosaur Quarry was excavated, researchers removed large blocks of rocks and fossils and wrapped them up in plaster jackets. But preparing the fossils from these jackets is time intensive and tedious, so, even today, there are still several unopened kitchen table-size jackets from the quarry, Curtice said. Over the years, Curtice has dived into some of these unstudied bones and identified five new neck vertebrae, one new back vertebra, two new tail vertebrae and a left pubis. Previously, Curtice had mistakenly attributed some of these tail vertebrae to the diplodocid dinosaur *Apatosaurus*, until [other research](#) clued him into the fact that *Supersaurus*' tail looked like a mix of the *Apatosaurus* and *Barosaurus* dinosaurs' tails. These newly identified bones helped Curtice get a more accurate estimate of the new lengths for *Supersaurus*, including that its neck was longer than 50 feet (15 m) and its tail was upward of 60 feet (18 m) long.

What's more, the size and shape of the newly identified bones support the idea that all of the colossal bones found at Dry Mesa belong to *Supersaurus*, rather than three different large dinosaurs, Curtice said.

Based on the placement of one nearly 4.5-foot-long (1.3 m) neck vertebra, *Supersaurus* is either 128 feet or 137 feet long. "That is a crazy length — longer than three yellow school buses nose to tail," Curtice said in an SVP video. "And considering we never find the largest individual in the fossil record, how much longer could these animals have gotten?"

The conclusions drawn from the new research "seem reasonable" Matt Lamanna, a vertebrate paleontologist at the Carnegie Museum of Natural History in Pittsburgh, who was not involved with the research, told Live Science. "I can't really weigh in on the exact length estimate, but it's clear that there is a very, very large diplodocid sauropod in that quarry."

The research would be strengthened if the dinosaur nicknamed

Goliath were to be formally identified as a *Supersaurus*, especially because Curtice is using it to inform his analysis, Lamanna said. "I think the final verdict will come when this Goliath specimen is published, when this additional material from Dry Mesa is published. I want to see it go through formal peer review."

"I think it will be pretty exciting when he does," Lamanna added. "I think he's very probably correct."

Of note, *Supersaurus* may be the longest dinosaur on record, but it's not the heaviest. That honor likely goes to the superheavy titanosaur *Argentinosaurus*, which weighed upward of 90 tons (82 metric tons) and came close to weighing twice as much as *Supersaurus* did, Curtice said. Meanwhile, the longest animal on record isn't even a dinosaur. That title goes to a 150-foot-long (45 m) siphonophore — a translucent, stringy creature that, like coral, is made up of smaller beasties — that lives in a submarine canyon off the coast of Australia, [Live Science previously reported](#).

<https://bit.ly/30DyrpN>

In Extremely Rare Case, a Woman With HIV Has 'Cleared' The Virus Without Treatment

An anonymous woman from Argentina has become only the second person known to ever show no detectable traces of an [HIV infection](#) without receiving a [stem cell transplantation treatment](#) to cure it.

[Peter Dockrill](#)

The so-called 'Esperanza patient', named after her hometown in Argentina, was first diagnosed with HIV-1 in 2013 – but after eight years of follow-up checks and a total of 10 commercial viral load tests, there appears to be no sign of active viral infection in her body, nor any evidence of HIV-1-associated disease.

While the woman's case recalls some other famous patients who made headlines for seemingly beating the infection – notably [the 'Berlin patient'](#) (aka Timothy Ray Brown, diagnosed in 1995) and

[the 'London patient'](#) (diagnosed [in 2003](#)) – both those cases involved stem cell transplants to treat different kinds of [cancer](#).

In [the case of the Berlin patient](#), his transplant unexpectedly 'cured him' of the virus – or rather, put the virus into such a level of sustained remission that it could no longer be detected, even in the absence of antiretroviral (ART) drugs.

Several years later, the [London patient's experience shared many similarities](#), suggesting that Brown's case was not entirely unique, and that stem cell transplants could provide an effective, albeit rare form of sterilization of the virus.

Since those discoveries, scientists have progressively been learning more about how some people's bodies seem to sometimes find natural ways of countering the virus, including the [extremely rare 'elite controllers'](#), who appear to somehow tame the virus without the aid of drugs or transplants.

Amongst this elite, the Esperanza patient is particularly notable, because even 'elite controllers' sometimes show detectable signs of the virus, depending on how hard you go looking for it.

"In a small subgroup of persons living with HIV-1 who are frequently termed 'elite controllers' or 'natural suppressors', HIV-1 plasma viremia remains durably undetectable by commercial polymerase chain reaction (PCR) assays in the absence of antiretroviral therapy," an international team of [researchers explains in a new study](#), led by co-first authors Gabriela Turk and Kyra Seiger.

"However, genome-intact proviral DNA and replication-competent [viruses](#) can readily be isolated in these persons by using in vitro laboratory assays, indicating that drug-free viral control in these persons results from host-dependent inhibition of viral replication and does not reflect elimination of all virally infected cells."

Whatever's going on with the Esperanza patient is on a different level, the researchers say, with the woman appearing to have

achieved "complete clearance of all replication-competent HIV-1 proviruses during natural infection".

During the patient's eight years of follow-up after her initial March 2013 diagnosis, she only took antiretroviral drugs (ART) for one point (when she was pregnant in between 2019–2020).

After delivering her healthy (and HIV-1-negative) baby, she stopped ART, and a comprehensive round of tests showed no signs of active virus.

"What distinguishes her from all other described elite controllers and post-treatment controllers is the absence of detectable intact HIV-1 proviruses and replication-competent HIV-1 viral particles in large numbers of cells," [the researchers write](#).

A similar case has been identified before, in a [Californian patient called Loreen Willenberg](#), who has shown decades of drug-free remission, and no signs of intact virus in peripheral blood mononuclear cells (PBMCs) analysis.

Despite the remarkable and hugely promising leads these case studies demonstrate in terms of HIV research, however, the scientists are very careful to distinguish what they are (and are not) claiming here.

"Does this imply that our patient has developed a sterilizing cure during natural infection? We believe this is likely, but it cannot be proved," [the researchers explain](#).

"Scientific concepts can never be proved through empirical data collection; they can only be disproved. In the context of HIV-1 research, this means that it will be impossible to empirically prove that anybody has achieved a sterilizing cure."

Despite not being able to call this seemingly natural phenomenon a 'proof', though, our inability to detect any sign of ongoing intact viral infection – despite comprehensive searching – is a huge win, and it's something that could help us to reframe the boundaries of HIV research.

"Collectively, our results raise the possibility that a sterilizing cure of HIV-1 infection, defined by the absence of detectable intact HIV-1 proviruses, is an extremely rare but possible clinical outcome," [the team writes](#).

"It means there must be more people like this out there," senior author and HIV researcher Natalia Laufer from Universidad de Buenos Aires [told the media](#) when initial results of the case were shared earlier in the year.

"This is a significant leap forward in the world of HIV cure research. Upon diagnosis, her tests surprised us all. Her HIV [antibody](#) test showed she was HIV positive, but the level of virus was undetectable and continued so, over time. This is highly unusual." The findings are reported in [Annals of Internal Medicine](#).

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Study: Coffee and Tea Consumption Lowers Stroke and Dementia Risk

The combination of coffee and tea seemed to correlate with lower risk of stroke and dementia compared to coffee or tea separately

In a [large prospective cohort study](#) published today in the journal *PLoS Medicine*, a team of researchers from Tianjin Medical University and Yale University found that: (i) the separate and combined intake of tea and coffee were associated with lower risk of stroke, ischemic stroke, dementia, and vascular dementia; (ii) participants who reported drinking 2 to 3 cups of coffee with 2 to 3 cups of tea per day were associated with about 30% lower risk of stroke and dementia; (iii) the combination of coffee and tea seemed to correlate with lower risk of stroke and dementia compared to coffee or tea separately; and (iv) intake of coffee alone or in combination with tea was associated with lower risk of post-stroke dementia.

"Coffee and tea are among the most widely consumed beverages, both in the UK and worldwide," said Dr. Yuan Zhang from the

School of Public Health at Tianjin Medical University and colleagues. "Coffee contains caffeine and is a rich source of antioxidants and other bioactive compounds."

"Tea containing caffeine, catechin polyphenols, and flavonoids has been reported to play neuroprotective roles, such as antioxidative stress, anti-inflammation, inhibition of amyloid-beta aggregation, and an antiapoptotic effect."

"Little is known about the association between the combination of coffee and tea and the risk of stroke, dementia, and post-stroke dementia," they added. "Therefore, we aimed to investigate the associations of coffee and tea separately and in combination with the risk of developing stroke and dementia."

The study included 365,682 participants (50 to 74 years old) from the UK Biobank. Participants joined the study from 2006 to 2010 and were followed up until 2020.

At the outset participants self-reported their coffee and tea intake. Over the study period, 5,079 participants developed dementia and 10,053 experienced at least one stroke. People who drank 2-3 cups of coffee or 3-5 cups of tea per day, or a combination of 4-6 cups of coffee and tea had the lowest incidence of stroke or dementia.

Individuals who drank 2-3 cups of coffee and 2-3 cups of tea daily had a 32% lower risk of stroke and a 28% lower risk of dementia compared with those who drank neither coffee nor tea.

Intake of coffee alone or in combination with tea was also associated with lower risk of post-stroke dementia.

"We found that drinking coffee and tea separately or in combination were associated with lower risk of stroke and dementia," the scientists said. "Moreover, drinking coffee alone or in combination with tea was associated with lower risk of poststroke dementia."

"Our findings support an association between moderate coffee and tea consumption and risk of stroke and dementia."

"However, whether the provision of such information can improve stroke and dementia outcomes remains to be determined."

Y. Zhang et al. 2021. Consumption of coffee and tea and risk of developing stroke, dementia, and poststroke dementia: A cohort study in the UK Biobank. PLoS Med 18 (11): e1003830; doi: 10.1371/journal.pmed.1003830

<https://bit.ly/3FxfhB2>

Alien Worlds Hold Minerals Like Nothing in Our Solar System, Scientists Say

There's a lot we don't know about planets outside the Solar System.

[Michelle Starr](#)

They are small, dim, and distant, which means that we don't have a lot of detailed information about what they're made of. This is especially true for rocky exoplanets, like Earth, [Venus](#), and [Mars](#), of which we can't currently see the surfaces.

There is, however, one way we can peer into the guts of rocky worlds – and it suggests that some of the minerals they're made of are nothing like the minerals in the Solar System. So alien are these minerals, in fact, that scientists had to invent new terms to classify them.

The method for doing this is analyzing the atmospheres of white dwarf stars, which can become 'polluted' with minerals from planets and asteroids that have fallen into the stars. The study of these destroyed exoplanets is called [necroplanetology](#).

"Polluted white dwarfs reveal greater planetary variety in our solar neighborhood than currently appreciated, with consequently unique planetary accretion and differentiation paths that have no direct counterparts in our Solar System," [the researchers write in their paper](#).

"These require new rock classification schemes."

White dwarfs are what happens to a star like the Sun when it reaches the end of its main-sequence lifespan, causing its core to

collapse into an ultra-dense object shining brightly with residual heat. Meanwhile, its outer skin expands across its solar system as a vast bubble of hot gases.

Astonishingly, exoplanets [can survive this process](#) – but their orbits can change, becoming unstable, resulting in tidal disruption (that's when the gravitational field of the star pulls the exoplanet apart) and accretion (when the debris from the shredded exoplanet falls onto the star).

When this occurs, the elements in the exoplanets are incorporated into the star, changing the light the star emits. Planetary scientists can then analyze this light, looking for elements that wouldn't normally be found in a white dwarf's atmosphere, to work out what the rocky bodies were made of. This is the science of necroplanetology.

Geologist Keith Putirka of California State University and astronomer Siyi Xu of the National Science Foundation's NOIRLab ran such analyses on 23 white dwarfs, all within 650 light-years of the Sun. For each of these stars, previous observations showed the presence of elements such as calcium, silicon, magnesium, and iron. Because white dwarfs are so dense, heavier elements like these shouldn't be present in the atmosphere, but drawn into the star's interior, where they would not be detectable. Their presence suggests relatively recent accretion of rocky material.

Putirka and Xu analyzed the abundances of these elements in the white dwarf atmospheres to try and reconstruct the mineral composition of the rocky parent bodies. What they found was surprising.

"While some exoplanets that once orbited polluted white dwarfs appear similar to Earth, most have rock types that are exotic to our Solar System," [says Xu](#). "They have no direct counterparts in the Solar System."

The researchers devised a number of new terms to classify these

rocks and their exotic compositions, including quartz pyroxenites, quartz orthopyroxenites, periclase dunites, periclase wehrlites, and periclase clinopyroxenites.

These rocks might be able to tell us a lot about the sorts of exoplanets they came from, and their evolution, the researchers say. And this information could have implications for assessing exoplanet habitability, too.

"Some of the rock types that we see from the white dwarf data would dissolve more water than rocks on Earth and might impact how oceans are developed," [Putirka says](#).

"Some rock types might melt at much lower temperatures and produce thicker crust than Earth rocks, and some rock types might be weaker, which might facilitate the development of plate tectonics."

In addition, learning more about rocky exoplanet compositions via necroplanetology could help us answer some existential questions about our own place in the Universe. For example, we might find that some regions of the galaxy are more likely to form Earth-like planets than other regions.

"Exoplanet studies also force us to face still unresolved questions of why Earth is so utterly different from its immediate planetary neighbors, and whether such contrasts are typical or inevitable," [the researchers explain](#).

The research has been published in [Nature Communications](#).

<https://bit.ly/30Htgoo>

**A hope for Lyme disease? New vaccine targets ticks
mRNA vaccine could prevent other tickborne illnesses, promising
animal study suggests**

By [Meredith Wadman](#)

Erol Fikrig had spent 10 years pursuing a vaccine that would take a new approach to protecting people from Lyme disease, a growing bane in the United States: He wanted to target not the pathogen, but

the tick that transmits it. Then, at a June 2019 meeting in Killarney, Ireland, he heard immunologist Drew Weissman of the University of Pennsylvania describe what was then a little-known technology: messenger RNA (mRNA) vaccines. In a flash, Fikrig saw a way forward. The Yale School of Medicine infectious disease physician collared Weissman and asked whether the technology might work against the deer tick that transmits Lyme disease in the United States. “I’d like to pursue that,” Fikrig recalls Weissman saying.

MRNA technology is now famous for delivering vaccines against COVID-19, and this week it achieved another distinction with an experimental Lyme preventive announced by the collaboration launched in Ireland. “It’s the first vaccine [intended for humans] against an infectious disease that does not target the pathogen,” Fikrig says. The mRNA vaccine, administered to guinea pigs, turned tick bites red and inflamed. The ticks fed poorly, fell off early, and often [failed to transmit the Lyme-causing bacterium](#). Researchers hope the vaccine will one day work the same way in humans.

It’s “a beautiful study,” says Ruth Montgomery, a cellular immunologist at Yale who was not involved with the work. “Potentially a mechanism like this could be very important in a number of tick-borne diseases.”

Others are impressed by the team’s technological feat. The researchers packed 19 distinct mRNA snippets, each encoding a protein, or antigen, from deer tick saliva, into a single vaccine; COVID-19 mRNA vaccines deliver just one. “The mRNA vaccine saved us from COVID for sure,” says microbiologist Jorge Benach of Stony Brook University, who co-discovered *Borrelia burgdorferi*, the tick-borne spirochete that causes Lyme disease. “Now [Fikrig] is using stunning technology ... with more than one antigen simultaneously. ... I think it will be very very useful for future vaccines.”

In the United States, Lyme disease is the most common infection transmitted from animals to people, with up to [476,000 cases](#) each year. *B. burgdorferi* triggers a flulike illness and trademark skin rash, and can also invade the brain, nerves, heart, and joints, sometimes leading to permanent nerve damage and arthritis.

“For some people Lyme disease can cause major problems,” says Adriana Marques, who runs Lyme disease trials at the National Institute of Allergy and Infectious Diseases. Antibiotics can treat

Lyme disease in its early stages, but a growing number of people—[at least 1.6 million in 2020](#), according to one estimate—now suffer chronic consequences. No human vaccine is currently available, although one is in human trials.



Tick bites became red and inflamed in vaccinated guinea pigs (left) versus unvaccinated animals (right.)Sajid et al./Science Translational Medicine

That vaccine targets *B. burgdorferi* itself, but Fikrig thought a vaccine aimed at targeting the deer tick (*Ixodes scapularis*) might stymie the bacteria. Tick saliva secretes agents that help transmit the pathogen, but those proteins are “difficult to make in the lab,” Fikrig says. “The beauty of the mRNA vaccine is ... you don’t need to make the protein—the body does that for you.”

In many people, tick bites go unnoticed, allowing ticks to feed uninterrupted. The new vaccine, with its multiple mRNA snippets that order host cells to make important tick salivary proteins, primed the guinea pigs’ immune systems to react to a tick bite. Within 18 hours after the ticks attached, most bites were transformed into red, inflamed, and likely itchy wounds, according to work published today in *Science Translational Medicine*.

That’s important because *B. burgdorferi* is rarely transmitted from

tick to host before 36 hours into a tick meal that often lasts 4 days or more. And when scientists pulled ticks off soon after the bite site became inflamed—as a human might do—the transmission of *B. burgdorferi* was blocked.

“Everybody should look at these as very, very promising results,” says epidemiologist Sam Telford of Tufts University.

Still, much of the protection will probably hinge on whether people notice an itchy, red, tick bite and manage to pull the tick off early. When three infected ticks were attached and allowed to feed on guinea pigs until they were sated, 60% of vaccinated animals became infected, almost as many as control animals. And whether vaccinated people will react to the ticks as the guinea pigs do remains an open question. “Responding to the bite is really, really a cool thing,” says Uğur Şahin, CEO of BioNTech, which with Pfizer developed an mRNA vaccine against COVID-19. “We have to see if it holds true when translated into the human situation.”

Scientists note that a successful human vaccine, which would need a pharmaceutical company sponsor, could also protect people from other, rarer pathogens also transmitted by the deer tick, such as [babesiosis](#). A vaccine might also induce a reaction to other tick species, such as those that transmit Lyme disease [in Europe](#).

Benach thinks the new vaccine might also have to be loaded with mRNA that targets the pathogen. “I would like to see it supplemented with pathogen [mRNA] because it’s the pathogen that ... makes you ill,” he says.

Telford, who has spent years working in communities with high Lyme disease burdens, hopes the vaccine will offer one solution to a growing problem: “People are fed up with tick bites. People are fed up with Lyme disease. They want something done.”

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<https://bit.ly/3x7FSkU>

Deadly and massive 'Megaspider' found in Australia has fangs that can puncture a fingernail

Funnel-web spiders are typically half the Megaspider's size.

By [Mindy Weisberger](#)

What has eight legs and fangs powerful enough to bite through a human fingernail? "Megaspider," an enormous [funnel-web spider](#) that was recently captured in Australia.

The Australian Reptile Park (ARP) in New South Wales is a public zoo that also houses a collection of funnel-web spiders; keepers milk the spiders for their venom, which is then processed to create anti-venom. This particular [spider](#) was donated by an anonymous benefactor and arrived last week at the park in a plastic tub as part of a weekly collection from spider drop-off points near Sydney, the Central Coast and Newcastle, ARP representatives said on Nov. 11 in a statement.

Even seasoned spider keepers were astonished by the spider's size, according to the statement. The giant arachnid measured just over 3 inches (8 centimeters) from foot to foot — most funnel-web spiders are typically between 0.4 and 2 inches (1 and 5 cm) wide — and its curved fangs were 0.8 inches (2 cm) long.

"In my 30+ years at the Park, I have never seen a funnel web spider this big," Michael Tate, an ARP education officer, said in the statement. Park keepers promptly named the sizable arachnid female "Megaspider," but they don't know where she was found or who captured her; she had been boxed up in a Tupperware container without any labels or information about her captor, and there were no clues to connect her to any of the drop-off sites along the route, according to the statement.

"We are really keen to find out where she came from in hopes to find more massive spiders like her," Tate said.

Funnel-web spiders — which comprise about 40 species in the genera *Hadronyche* and *Atrax* — live in eastern Australia, and some species deliver a [bite](#) so toxic that it can kill an adult human within 15 minutes, [according to the Australian Museum](#). All funnel-web spider species have glossy, nearly hairless bodies that vary in color from brown to deep black, and they have eight eyes arranged in two rows of four eyes each. The spiders are active year-round and live in burrows in moist, cool habitats, surrounding their tunnel openings with a network of silk strands.

When a passing insect or other animal touches the silk, the vibrations alert the spider in the burrow, according to the Australian Museum.



The aptly named Megaspider will join the park's spider-milking program, which creates lifesaving anti-venom. ([Image credit: Australian Reptile Park](#))

ARP is Australia's only source of raw funnel-web spider venom for anti-venom serum production, according to the park statement. Keepers milk the spiders weekly and then ship the venom to a lab in Melbourne that produces the anti-venom by injecting very small doses into rabbits, so that the animals develop antibodies. These antibodies in the rabbits' blood can then be processed into a serum that neutralizes the venom's toxins in humans, [according to NPS MedicineWise](#), an Australian nonprofit funded by the national Department of Health.

Since the ARP program began in the 1950s, its anti-venom is estimated to have saved 25,000 Australians who were bitten by funnel-web spiders, and the antidote still saves approximately 300 lives each year.

Recent rainy weather and intense humidity in eastern Australia has created highly favorable conditions for the continent's funnel-web spiders, according to the statement. Members of the public who wish to safely collect spiders for the anti-venom program are

advised to exercise extreme caution, by using glass jars (which the spiders can't climb or jump out of once they've been captured) and wearing protective clothing, such as gardening gloves and long pants, [according to the New South Wales Department of Planning, Industry and Environment](#).

The park is especially interested in supersize arachnids like Megaspider, which have bigger reservoirs of venom for the milking program, Tate said. "If we can get the public to hand in more spiders like her, it will only result in more lives being saved due to the huge amount of venom they can produce," he said.

<https://bit.ly/3qYircu>

Cosmic Dust May Be Key Source of Phosphorus for Life on Earth

When tiny particles enter Earth's atmosphere, a newly described series of chemical reactions may lead to production of phosphorus-containing molecules that are essential for biological processes.

by [Sarah Stanley](#)

When Earth formed 4.5 billion years ago, any phosphorus that was present likely sank into the molten core because of the element's distinct chemical properties. However, phosphorus is essential for life; it is found in DNA, RNA, and other important biological molecules. So it is probable that the phosphorus that made life possible was delivered to Earth's surface from extraterrestrial origins, and previous studies have suggested meteorites as potential sources.

Now, [Plane et al.](#) present a new analysis suggesting that much smaller extraterrestrial particles known as [cosmic dust](#) may deliver phosphorus to Earth's atmosphere, where a series of chemical reactions repackage the element into biologically useful forms—namely, metal phosphites and phosphates—that eventually settle onto Earth's surface.

Upon entry into the atmosphere, air friction causes cosmic dust to undergo a process of vaporization and melting known as ablation. The new research builds on [earlier work](#) in which cosmic dust-sized meteoric fragments were [flash heated](#) to simulate ablation and the release of phosphorus-containing molecules was detected. [Computational modeling](#) of this process provided further support for cosmic dust as a significant source of phosphorus on Earth's surface.

The researchers constructed a network of chemical reactions that outline the specific process by which cosmic dust ablation could produce biologically useful phosphorus molecules. To do so, they combined real-world results from [laboratory studies](#) of chemical reactions with theoretical predictions for reactions that have not yet been studied in the lab. Then the researchers incorporated the reaction network into a [global climate model](#).

The reaction network and the model simulations provide new support for the ablation of cosmic dust and subsequent chemical reactions as a source of biologically useful forms of phosphorus. These molecules are incorporated into tiny "meteoric smoke" particles that settle onto Earth's surface. The authors suggest the particles could be a significant and continuous supply of phosphorus for life on Earth.

In addition, the researchers predict which regions, per year, might receive the greatest amount of phosphorus delivered by cosmic dust, in particular, the northern Rockies, the Himalayas, and the southern Andes. They also predict that a narrow atmospheric layer of OPO—a phosphorus-containing molecule—might encircle Earth 90 kilometers above its surface.

Future research could confirm the existence of the predicted layer. Researchers could also explore the possible role of cosmic dust-delivered phosphorus during the rise of life on Earth, when limited amounts of phosphorus could have constrained biological activity.

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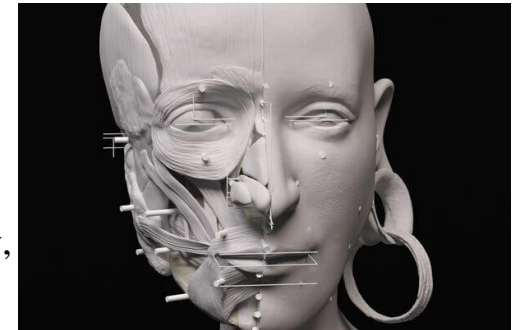
<https://nyti.ms/30S7w99>

You Should See Her in a Crown. Now You Can See Her Face.

New research is solving mysteries linked to the La Almoloya burial site and revealing a genetic history of an ancient European people.

By Jennifer Pinkowski

This year, archaeologists announced the discovery of a [remarkable, 3,700-year-old double burial](#) in Murcia, Spain. Skeletons of a man and a woman were draped in silver — earrings, bracelets, rings and, most notably, a silver diadem that had once gleamed on the woman's head.

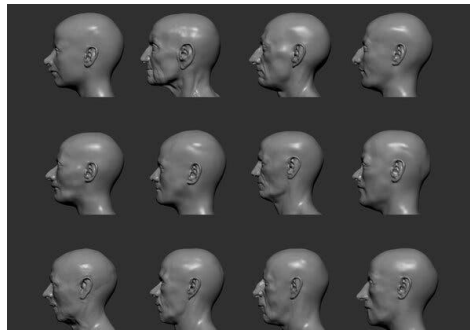


A facial reconstruction in progress of a person buried in Spain 3,700 years ago. Credit...Joana Bruno/ASOME/Autonomous University of Barcelona

The burial site, and particularly the crown and other fineries interred with the woman, hinted at a premodern European culture in which women might have held considerable power. The skeletons were [unearthed](#) in a large ovoid jar in La Almoloya, a key settlement of the El Argar culture, which is one of the earliest examples of a society in Europe with a ruling bureaucracy, geopolitical boundaries and other hallmarks of an advanced state. Although the gender politics of El Argar continue to be debated, a pair of complementary research projects are solving mysteries at this burial site. One has given faces to the woman, the man and others buried at La Almoloya, while the other is filling out an intriguing genetic history for the El Argar people.

Joana Bruno, a doctoral student at the Autonomous University of Barcelona, created digital facial representations of 36 people buried at La Almoloya. At the burial site, she said, “we not only have most of the facial portion of the skulls complete, but we also have the mandible, which is a very important portion of what constitutes the lower contour of the face.” The research is part of her dissertation, and the findings have not yet been published in a peer-reviewed journal.

Using a combination of facial reconstruction methods, anatomical knowledge and computer software, Ms. Bruno created a series of faces that are gray-toned and rendered in profile, their distinctive noses and ears made more prominent by their lack of hair. The reconstructions have intentionally neutral facial expressions to enable comparisons.



Twelve reconstructed faces from the La Almoloya burial site. The man at lower left, with the regressed chin, is known as AY38/2. Credit...Joana Bruno/ASOME/Autonomous University of Barcelona

“We are trying to use these faces to see if the resemblance between certain traits could point us towards a shared genetic relationship” among the bodies, Ms. Bruno said.

The silver-rich woman died around 1,700 B.C. during the last phase of the El Argar culture. The upper portion of her skull didn’t survive the millenniums, but [a short video](#) by Ms. Bruno depicts her with a long narrow nose and thick silver earlobe plugs. Digital facial reconstruction of the man buried beside her (known as AY38/2) shows he had a recessed jaw, or retrognathism. A girl buried nearby (AY30/2) had the same trait.

Ms. Bruno proposed that the two were related — and genomic analysis proved her right. The man was the girl’s father.

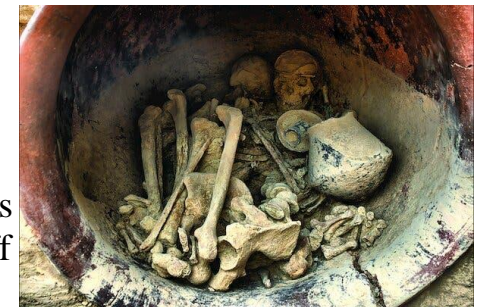
“The fact that AY38/2 is the father of AY30/2 gives further support to retrognathism as a relevant marker of Argaric populations,” said Cristina Rihuete-Herrada, a professor of prehistory at the Autonomous University of Barcelona and one of the discoverers of the burial site.

Ms. Bruno also modeled the face of a boy found at the burial site. As she digitally fleshed him out, his unusually wide-set eyes emerged. The condition, hypertelorism, can be caused by a number of genetic disorders.

Understanding the genetic relationships of the Almoloya bodies to others across the Iberian Peninsula was the goal of another [study](#), published on Wednesday in *Science Advances*. Researchers analyzed the genomes of 67 people buried at La Almoloya, including the silver-crowned woman, and another 33 buried at the Argaric site of La Bastida. The researchers then compared them with the genomes of nearly 200 people found across what are now Spain and Portugal, spanning the years 3,300 B.C. to 1,000 B.C.

This period includes the transition from the Copper Age to the Bronze Age around 2,200 B.C. It was a time of social upheaval across China, the Near East, Egypt and Europe that may have been incited by a century of intense climate change, during which environments became much drier.

On the lower Iberian Peninsula, the delineation between the two ages is especially sharp. Copper Age sites contain monumental funerary structures, fortified mega-settlements and artifacts that originated in far-off places.



The silver-crowned woman’s grave at La Almoloya. Credit...ASOME/Autonomous University of Barcelona

But this lifestyle was largely abandoned in the early Bronze Age.

The El Argar favored large hilltop settlements like La Almoloya, and their burials were more intimate, with just a person or two interred. Their pottery, specialized weapons and bronze, silver and gold artifacts were distinctly different.

The researchers found that Argaric genetics reflected this turnover. Based on DNA extracted from teeth and cranial bones, they discovered that after the transition from the Copper Age to the Bronze Age, the El Argar had genetic links to a population in Central Europe known as the steppe people.

The researchers also found a surprising gender divide across the Argaric sites. Based on their mitochondrial DNA, passed from mother to child, the women and girls were mostly descended from local people. Yet the men and boys were overwhelmingly related to the steppe people, and had virtually no genetic inheritance from the local people. The men and boys, tracked through their Y chromosomes, belonged to a genetic population now among the most common in Western Europe, but which was relatively new to the Iberian Peninsula 4,200 years ago. About a century after their arrival, these steppe-descended men replaced the local Iberian men entirely — and had many children with the local women.

As researchers studied these genomes, another gender difference emerged as well. “Males have many relatives at the site, whereas the females have less,” said Vanessa Villalba-Mouco, a postdoctoral researcher at the Max Planck Institute for the Science of Human History in Germany and an author of the study.

Of the 30 adult female genomes that researchers sequenced at La Almoloya, not one woman was related to any other woman. They had children — such as the infant daughter of the silver-crowned woman — but they were seemingly otherwise on their own.

The site contains no evidence of colonization or violence, but it also contains no easy explanation for these genetic relationships.

“We don’t know if that is the result of men becoming widows and

having sequential spouses or, much the contrary, polygamic practices,” Dr. Rihuete-Herrada, a co-author of the genetic study, said. But the researchers don’t think the genetic discovery contradicts the idea that women held some power in El Argar. One possibility, Dr. Rihuete-Herrada said, is that women in different settlements sent “their daughters as an alliance with other groups that are run equally along female lines.”

The only other Argaric silver diadems were found with women.

[David Reich](#), an expert in ancient DNA at Harvard Medical School, said that such a nearly complete Y chromosome turnover could have happened when powerful local women formed alliances with foreign men.

“Maybe they say, ‘Oh, there’s these elite foreign men who have culture or religion or some degree of military power or lands.’ And so there’s a complete or partial rejection of the local male population,” said Dr. Reich, whose data in a 2019 [study](#) on the genomic history of the Iberian Peninsula was used in the current research.

While the study focuses on population genetics at a regional scale, there are details about a few individuals in the data, too. Phenotype analysis suggests that most of them had brown eyes, brown or black hair and generally medium-toned skin. A few were redheads.

And researchers also found evidence of genetic disorders. One infant girl was found to have Trisomy X, or three X chromosomes, which is linked to a number of disorders. Their burials, however, were typical for La Almoloya. The woman with the silver crown, for instance, had the richest tomb as well as a shortened, fused spine and a stunted left thumb. “What is important here is that people potentially impaired were not treated differently and certainly not excluded,” Dr. Rihuete-Herrada said.

The next step in their research is to try to establish family links between the people at La Almoloya based on their locations,

housing environments and burials, which will inform their understanding of the Argaric social structure, including whether it was patrilineal or matrilineal, Dr. Rihuete-Herrada said.

Volker Heyd, a professor of prehistoric archaeology at the University of Helsinki, said genetically based kinship studies like these signaled a “clear revolution” in our understanding of human connections.

“So far, kinship could only have been assessed with ethnographic research or a little bit of historical records,” said Dr. Heyd, who was not involved in the study. But now, he said, scientists can study “patterns sometimes going back over thousands of years that are still visible.”

Dr. Villalba-Mouco is also sending the phenotype data from her study to Ms. Bruno, so she can add eye, skin and hair color to her gray reconstructions.

Ms. Bruno said she felt “quite privileged to be the first person to see their faces emerging from the skulls after so many years.”

<https://bit.ly/3lm7HRR>

Antibody Breakthrough in Mice Could Lead to a Vaccine For Alzheimer's Disease

Method for treatment has been shown to successfully immunize mice against animal models of AD

[Carly Cassella](#)

[Alzheimer's](#) disease (AD) is the [most common cause of dementia](#), impacting roughly 44 million people worldwide.

In some nations, [those numbers could triple in the next fifty years](#), and scientists are desperately trying to find ways to protect our aging populations.

Now, a novel method for treatment has been shown to successfully immunize mice against animal models of AD.

We still don't know if the approach can be used to vaccinate humans against the disease, but the results look promising

compared to other attempts. The authors are now calling for commercial partners to help them take the research further.

"While the science is currently still at an early stage, if these results were to be replicated in human [clinical trials](#), then it could be transformative," [says](#) drug researcher Mark Carr from the University of Leicester in the UK.

"It opens up the possibility to not only treat Alzheimer's once symptoms are detected, but also to potentially vaccinate against the disease before symptoms appear."

One of the hallmarks of Alzheimer's disease are the plaques of amyloid beta proteins (A β) that can be found in the brains of [roughly two-thirds of clinically diagnosed patients post-mortem](#).

Amyloid beta proteins on their own aren't necessarily bad for cognition – their presence may actually be important for brain health – but when some truncated forms appear and clump together, research suggests they can grow toxic, leading to neurodegeneration. Other AD treatments that target amyloid beta proteins indiscriminately have been shown to have adverse impacts, but this new immunization approach only targets the toxic truncated proteins.

Researchers had identified a family of [antibodies](#) called TAP01 in mice that could neutralize the truncated proteins while leaving healthy full-length ones alone. These antibodies could therefore be a useful way to stop the truncated proteins from binding with each other.

To make sure these antibodies work for humans, too, the authors created a version of the antibody for our own species, called TAP01_04.

Using X-ray crystallography to peer closer at the action of the TAP01_04 antibody in the brain of a transgenic 'humanized' mouse, the team noticed it was binding to a region of the truncated proteins that looked sort of like a hairpin.

The result not only reduced plaque load in the mouse brain, it also rescued glucose metabolism, memory deficits, and neuron loss.

By engineering a similar hairpin-shaped protein, researchers then created a more direct 'vaccine', called TAPAS. By mimicking the truncated proteins, this vaccine triggered the mouse immune system to produce TAP01 type antibodies of its own accord.

When this vaccine was given to two mouse models of preclinical AD, it showed similar results to the antibodies on their own.

That's really exciting news, but while amyloid beta plaques are associated with many forms of Alzheimer's, this vaccine might not be able to prevent all forms of the disease.

Emerging evidence suggests AD is more than just one thing and may include [multiple subtypes](#). In about a third of patients with clinical diagnoses, for instance, amyloid beta plaques are missing postmortem, which means a vaccine against their forming may not prevent brain degeneration.

Nevertheless, if this potential new vaccine can make it through human clinical trials, it might just bolster the brain health of millions. Let's hope the researchers find a commercial partner to team up with soon.

"The results so far are very exciting and testament to the scientific expertise of the team," [says](#) biochemist Preeti Bakrania from the medical research charity LifeArc.

"If the treatment does prove successful, it could transform the lives of many patients."

The study was published in [Molecular Psychiatry](#).

<https://bit.ly/3DEXSW2>

The Most Common Pain Relief Drug in The World Induces Risky Behavior, Study Finds

Acetaminophen also increases risk-taking

[Peter Dockrill](#)

One of the most consumed drugs in the US – and the [most](#)

[commonly taken analgesic worldwide](#) – could be doing a lot more than simply taking the edge off your headache, according to scientists.

Acetaminophen, also known as paracetamol and sold widely under the brand names Tylenol and Panadol, also increases risk-taking, according to a study published in 2020 that measured changes in people's behavior when under the influence of the common over-the-counter medication.

"Acetaminophen seems to make people feel less negative emotion when they consider risky activities – they just don't feel as scared," neuroscientist Baldwin Way from The Ohio State University [explained last year](#).

"With nearly 25 percent of the population in the US taking acetaminophen each week, reduced risk perceptions and increased risk-taking could have important effects on society."

The findings add to a recent body of research suggesting that acetaminophen's effects on pain reduction also extend to various psychological processes, lowering people's [receptivity to hurt feelings](#), experiencing [reduced empathy](#), and even [blunting cognitive functions](#).

Similarly, Way's study suggests people's affective ability to perceive and evaluate risks can be impaired when they take acetaminophen. While the effects might be slight, they're definitely worth noting, given acetaminophen is the [most common drug ingredient in America](#), found in over 600 different kinds of over-the-counter and prescription medicines.

In a series of experiments involving over 500 university students as participants, Way and his team measured how a single 1,000 mg dose of acetaminophen (the recommended maximum adult single dosage) randomly assigned to participants affected their risk-taking behavior, compared against placebos randomly given to a control group.

In each of the experiments, participants had to pump up an uninflated balloon on a computer screen, with each single pump earning imaginary money. Their instructions were to earn as much imaginary money as possible by pumping the balloon as much as possible, but to make sure not to pop the balloon, in which case they would lose the money.

The results showed that the students who took acetaminophen engaged in significantly more risk-taking during the exercise, relative to the more cautious and conservative placebo group. On the whole, those on acetaminophen pumped (and burst) their balloons more than the controls.

"If you're risk-averse, you may pump a few times and then decide to cash out because you don't want the balloon to burst and lose your money," [Way said](#).

"But for those who are on acetaminophen, as the balloon gets bigger, we believe they have less anxiety and less negative emotion about how big the balloon is getting and the possibility of it bursting."

In addition to the balloon simulation, participants also filled out surveys during two of the experiments, rating the level of risk they perceived in various hypothetical scenarios, such as betting a day's income on a sporting event, bungee jumping off a tall bridge, or driving a car without a seatbelt.

In one of the surveys, acetaminophen consumption did appear to reduce perceived risk compared to the control group, although in another similar survey, the same effect wasn't observed.

Overall, however, based on an average of results across the various tests, the team concludes that there is a significant relationship between taking acetaminophen and choosing more risk, even if the observed effect can be slight.

That said, they acknowledge the drug's apparent effects on risk-taking behavior could also be interpreted via other kinds of

psychological processes, such as reduced anxiety, perhaps.

"It may be that as the balloon increases in size, those on placebo feel increasing amounts of anxiety about a potential burst," [the researchers explained](#).

"When the anxiety becomes too much, they end the trial. Acetaminophen may reduce this anxiety, thus leading to greater risk taking."

Exploring such psychological alternative explanations for this phenomenon – as well as investigating the biological mechanisms responsible for acetaminophen's effects on people's choices in situations like this – should be addressed in future research, the team said.

While they're at it, scientists no doubt will also have future opportunities to further investigate the role and efficacy of acetaminophen in pain relief more broadly, after [studies in recent years](#) found that in many medical scenarios, the drug can be ineffective at pain relief, and sometimes is no better than a placebo, in addition to inviting other kinds of health problems.

Despite the seriousness of those findings, acetaminophen nonetheless remains one of the most used medications in the world, considered an [essential medicine by the World Health Organization](#), and [recommended by the CDC](#) for pain relief at home in suspected cases of [COVID-19](#).

In light of what we're finding out about acetaminophen, however, we might want to rethink some of that advice, Way said.

"Perhaps someone with mild COVID-19 symptoms may not think it is as risky to leave their house and meet with people if they're taking acetaminophen," [Way said](#).

"We really need more research on the effects of acetaminophen and other over-the-counter drugs on the choices and risks we take."

The findings are reported in [Social Cognitive and Affective Neuroscience](#).

<https://bit.ly/3HNGv87>

New COVID Threat: Rodents Could Be Asymptomatic Carriers of SARS-Like Coronaviruses

Ancestral rodents likely had repeated infections with SARS-like coronaviruses, leading them to acquire tolerance or resistance

Some ancestral rodents likely had repeated infections with SARS-like coronaviruses, leading them to acquire tolerance or resistance to the pathogens, according to new research publishing today (November 18th, 2021) in *PLOS Computational Biology* by Sean King and Mona Singh of Princeton University, US. This raises the possibility that modern rodents may be reservoirs of SARS-like viruses, the researchers say.

SARS-CoV-2, the virus that causes COVID-19 infection, is of zoonotic origin—it jumped from a non-human animal to humans. Previous research has shown that Chinese Horseshoe bats are a host of numerous SARS-like viruses and tolerate these viruses without extreme symptoms. Identifying other animals that have adapted tolerance mechanisms to coronaviruses is important for awareness of potential viral reservoirs that can spread new pathogens to humans.

In the new research, King and Singh performed an evolutionary analysis, across mammalian species, of the ACE2 receptors, used by SARS viruses to gain entry into mammalian cells. Primates had highly conserved sequences of amino acids in the sites of the ACE2 receptor known to bind SARS viruses. Rodents, however, had a greater diversity — and an accelerated rate of evolution — in these spots. Overall, the results indicated that SARS-like infections have not been evolutionary drivers in primate history, but that some rodent species have likely been exposed to repeated SARS-like coronavirus infections for a considerable evolutionary period.

“Our study suggests that ancestral rodents may have had repeated infections with SARS-like coronaviruses and have acquired some

form of tolerance or resistance to SARS-like coronaviruses as a result of these infections,” the authors add. “This raises the tantalizing possibility that some modern rodent species may be asymptomatic carriers of SARS-like coronaviruses, including those that may not have been discovered yet.”

Reference: “Comparative genomic analysis reveals varying levels of mammalian adaptation to coronavirus infections” by King SB, Singh M, 18 November 2021, PLOS Computational Biology. DOI: 10.1371/journal.pcbi.1009560

Funding: This work has been supported in part by the National Institutes of Health (NIH) R01-GM076275 (to M.S.) and 5T32GM007388 (to Princeton University Department of Molecular Biology). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

<https://wb.md/3FKJ88V>

Hospitals' COVID Strain Tied to Subsequent Spike in Excess Deaths

Surges in COVID-19 cases in hospitals can directly and indirectly result in an increase in deaths from all causes 2, 4, and 6 weeks later, [according to a report released Thursday](#).

Marcia Frellick

The modeling study, led by Geoffrey French, MA, with the Cybersecurity and Infrastructure Security Agency (CISA), studied the effect of hospital strain — measured by intensive care unit use — on excess deaths (expected vs observed) from July 2020-July 2021. It was published in the Centers for Disease Control and Prevention's (CDC) *Morbidity and Mortality Weekly Report*.

Researchers found that the conditions of hospital strain in that period, which included the onslaught of the Delta variant, predicted that nationwide ICU bed use at 75% capacity is linked with an estimated additional 12,000 excess deaths in the ensuing 2 weeks ($P < .01$).

When ICU bed use exceeds 100% capacity, the authors write, 80,000 excess deaths would be expected within the ensuing 2 weeks ($P < .01$).

As of October 25, the report notes, according to the US Department of Health and Human Services, capacity in adult ICUs nationwide had exceeded 75% for at least 12 weeks. As of Thursday, [capacity nationally](#) was at 78%.

"This means that the United States continues to experience the high and sustained levels of hospital strain that, according to the model's results, are associated with significant subsequent increases in excess deaths," the authors write.

ICU Capacity a Marker

The CISA COVID Task Force used the data to assess the potential effect of COVID-19 surges on hospital systems and other critical infrastructure sectors and national critical functions. The CDC provided data on deaths from all causes.

The authors write that the data highlight the importance of controlling case growth and hospitalizations for COVID before severe strain.

"State, local, tribal, and territorial leaders could evaluate ways to reduce strain on public health and health care infrastructures, including implementing interventions to reduce overall disease prevalence such as vaccination and other prevention strategies, as well as ways to expand or enhance capacity during times of high disease prevalence," they write.

Conditions in the pandemic may help explain contributors to the excess deaths. The authors point out that lack of hospital space, staffing, and supplies have pushed some healthcare facilities to adopt crisis standards of care, the most extreme operating condition for hospitals.

Under those standards, decision-making shifts from achieving the best outcome for each patient to addressing the immediate needs of large groups. Additionally, many preventive and elective procedures were suspended, leading to progression of serious diseases.

Emergency department visits for serious conditions also declined. From March to May 2020, ED visits declined by 23% for heart attacks, 20% for strokes, and 10% for diabetic emergencies.

Although pandemic surges in ICU bed use are not a direct cause of excess deaths, the authors write, "high ICU capacity is a marker of broader issues that can contribute to excess deaths, such as curtailed services, stressed operations, and public reluctance to seek services."

<https://bit.ly/3DO3duf>

Moonshot: Japan recruits first new astronauts in 13 years

Successful applicants will be trained as astronauts by JAXA.

It's one small step for Japan, but one giant opportunity for would-be space cadets: the country is recruiting new astronauts for the first time in over a decade and applicants no longer have to hold a science degree.

Women are strongly encouraged to put themselves forward for the job, the Japan Aerospace Exploration Agency (JAXA) said, as all seven of the nation's current astronauts are men.

Successful applicants, who must be Japanese, will be trained and sent on missions—potentially to the Moon, the Lunar Gateway or the International Space Station.

"We want to establish a (recruiting) system that matches the current [time](#)," JAXA's Kazuyoshi Kawasaki said at a media briefing.

"Previously we limited candidates to those with a natural [science degree](#), but many of us agreed to make it not a requirement."

However, written exams will include university-level questions on science, technology, engineering and maths, with the applicants' English ability also tested.

JAXA said it will accept applications between December 20 and March 4—the first time it has offered positions for rookie astronauts in 13 years.

This time around, they are looking to recruit "a few" [astronauts](#) with at least three years of workplace experience.

There is no age requirement or [gender quotas](#) and the agency has lowered its height requirement to 149.5 centimetres (4.9 feet).

One of Japan's current crew is Akihiko Hoshide, 52, who returned to Earth from the International Space Station earlier this month in a SpaceX craft.

<https://lat.ms/3oR8ICi>

Fresh look at earliest COVID cases points to live-animal market as most likely source

A new report traces more than half of the earliest cases of the disease that became known as COVID-19 to the market.

By [Melissa Healy](#)

Conspiracy theorists need little more than suspicion, some cherry-picked facts and vibrant imaginations to spin tales about the origins of the COVID-19 pandemic. But for the scientists working to establish the facts, the path to the truth is much more plodding.

Their search will take them through a trove of medical records whose quotidian details will be important guideposts to the time and circumstances of the coronavirus' birth as a human pathogen. Patients' recall of their whereabouts and contacts will matter too.

But even if the Chinese government were willing to open all its patient files to international investigators — it currently is not — symptom reports and patients' memories can be fallible and confusing. Researchers need to check every fact as they ferret out the story, piece by piece.

University of Arizona evolutionary biologist [Michael Worobey](#) offers a down payment on such sleuthing in this week's edition of the journal Science. Drawn from medical journal articles, the work of World Health Organization investigators, media reports and online accounts, Worobey's [reconstruction](#) leaves many questions unanswered. But it provides a road map for further investigation.

Worobey has played an influential role. He was one of 18 scientists whose objections to a WHO report on the coronavirus' origins reignited investigation into the possibility that it might have leaked from the Wuhan Institute of Virology.

Their [letter](#) was published in Science after [the WHO declared it "likely to very likely"](#) that the virus jumped to humans from animals, and "extremely unlikely" that it escaped from the government lab. Noting that the two theories "were not given balanced consideration," the group called for "a proper investigation" to resolve the issue.

Worobey [said at the time](#) that "both" explanations "remain on the table for me." But his new work leans heavily to the "animal spillover" explanation.

Worobey's effort is meeting with mixed reviews.

"I don't think this advances in a major way our collective understanding of what really happened," said [Dr. David Relman](#), the Stanford microbiologist who organized the Science letter. Since Worobey's new narrative is constructed mainly of "third- and fourth-hand information," it is fragmentary, inconsistent and potentially unreliable, Relman said.

But Scripps Institution microbiologist [Kristian Andersen](#), who has long argued that an animal spillover was more likely than a lab leak, lauded Worobey's research for "uncovering several new key insights."

The collective evidence "clearly points to the Huanan Market as a very likely source of the origin of the COVID-19 pandemic," Andersen said.

Worobey's account calls into question the date and location of the earliest reported case of the mysterious type of pneumonia that was later recognized as COVID-19. His research suggests it was not — as has been widely reported — a 41-year-old accountant with no connection to the Huanan Market, but a seafood vendor who

worked there. (A Chinese investigative reporter would discover that the accountant's Dec. 8 fever was due to an infection after dental surgery to remove retained baby teeth. The accountant would go on to develop another fever eight days later that was a sign of COVID-19.)

A full 11 days before Chinese authorities focused their attention on the Huanan Market as the common link in the mysterious infections, doctors at two Wuhan hospitals had already identified 14 cases of the unexplained pneumonia. Eight of those patients had spent time at the market, where live raccoon dogs, a species known to carry SARS-like coronaviruses, were sold.

The significance of such minute details would not be evident to casual followers of the origin debate. But they matter enormously.

Those arguing that China has covered up an accidental lab leak or the intentional release of an engineered pathogen have seized upon this finding in the WHO report: Only 33% of 168 patients who developed the unexplained pneumonia early in the outbreak had a direct link to the Huanan Market. They add that even that number is likely inflated by doctors who went looking for links to the market after Chinese authorities designated the site as the likely source.

They've also made much of the now-disputed report that the earliest known patient (the 41-year-old accountant) lived nearly 20 miles south of the Huanan Market and had never been there, yet he showed up sick in a hospital close to the Wuhan Institute of Virology.

[Dr. Marc Suchard](#), a UCLA researcher who uses genetic sequences to study the spread of disease, said Worobey's reconstruction makes clear that "most early cases occur near the market, identifying it as an early epicenter." Suchard said he expects to work with Worobey on the next phase of this research.

China insists the SARS-CoV-2 virus arose from a spillover event. Authorities there said they responded promptly to reports of an

unexplained illness in Wuhan, quickly tracing it to the Huanan Market and activating a national warning system.

They dismiss the possibility that the virus escaped from the Wuhan virology lab. But they've been unwilling to share their records with WHO investigators. And because the government has covered up missteps in past disasters, skepticism of its claims has been widespread.

Worobey did not acknowledge the politically charged debate over the virus' origins. But he made clear his reconstruction of events points strongly toward a spillover explanation.

For instance, by his accounting, 10 of the 19 earliest cases identified — 53% — had a link to the market. That number could not have been inflated by doctors' following the government's lead, he said, because they were all identified before authorities made any announcement.

"There was a genuine preponderance of early COVID-19 cases associated with Huanan Market," Worobey wrote.

He also wrote that, given what is now known about the SARS-CoV-2 virus, it should be no surprise that many of the early patients had no connection to the Huanan Market. The virus is easily spread by people with few or no symptoms. It takes close to two weeks for an infection to progress to severe illness, and no more than 7% of those infected end up hospitalized.

That means by the time people began to land in Wuhan's hospitals, the virus had probably been circulating locally for weeks — and at least 93% of infected people were out and about, able to spread it in a city of 11 million.

Among patients with no direct link to the market, most lived close by. That "is notable and provides compelling evidence that community transmission started at the market," Worobey wrote.

Those facts also suggest that the pandemic's "patient zero" will likely never be found.

Sometime in late November or early December, that person might have been eating lunch next to infected raccoon dogs in their cages at the Huanan Market. He or she might have been one of the nearly 50% of people who don't feel very sick but are still quite effective at passing SARS-CoV-2 on.

The animal that incubated the virus is even less likely to be found. Chinese researchers [told](#) WHO investigators they took samples from 188 animals from 18 species at the market, and all tested negative. And since the market was closed and disinfected on Jan. 1, 2020, there's no way to look further.

So researchers will have to keep collecting epidemiological data and sorting through the telling details to create the fullest picture possible of the virus' birth.

[Genetic sequencing data](#) can also help, Worobey said. As the virus moves from person to person, [its genetic signature changes](#) just enough to reveal the order in which infections occurred. When epidemiologists and geneticists pool their data, they're better able to create a family tree of infections.

As they cross-check genetic signatures with patients' accounts of their contacts and whereabouts, they may be able to time-stamp some infections and discern the spatial patterns of the virus's earliest transmissions. That should get them closer to the root of the family tree — maybe not patient zero, but close.

“Conclusive evidence of a Huanan Market origin from infected wildlife may nonetheless be obtainable,” Worobey wrote.

“Preventing future pandemics depends on this effort.”

<https://bit.ly/3CHZN1b>

Researchers Think They've Finally Figured Out How Herpes Invades Our Nervous System

Could potentially point the way to new ways to treat or even prevent this disease

[Mike Mcrae](#)

Herpes simplex is the criminal genius of [viruses](#), breaking into the cells lining our more delicate body parts before finding their way into our nervous system, where it hides itself in our DNA. Precisely how they carry out this complicated hijacking sequence is only partially understood.

Now a study led by researchers from the Northwestern University Feinberg School of Medicine in the US has uncovered a vital piece of the puzzle, one that could potentially point the way to new ways to treat or even prevent this incredibly common disease.

Herpes is an all-too-familiar infection to most of the world's population, whether they know it or not. Found in [more than two thirds](#) of all humans as the type-1 oral variety (HSV-1) or the sexually-transmitted type-2 (HSV-2) form, it's been an intimate companion for our species for as long as we've been human. [Maybe even longer](#).

Though usually silent, the virus is capable of producing some downright uncomfortable and even destructive symptoms, from the ubiquitous cold-sore blisters to the rare but devastating effect it can have [when it invades the eye](#).

In some of the most tragic cases, passing the infection from mother to child can be fatal for a newborn. Shockingly, [more than a thousand infant deaths](#) in the US have been attributed to the disease over the past two decades alone. It's even been implicated as a cause, or at least contributing factor, [in cases of dementia](#).

Getting our hands on a reliable treatment, if not a vaccine, would bring a lot of relief and safety to people around the globe.

Unfortunately, the herpes virus is a wily one, exposing itself to our immune system for the briefest period before inserting its DNA into the genetic library of our peripheral nerve cells. There it remains, a recipe for disaster begging to be translated into a new generation of infectious particles the moment the heat dies down.

"It reprograms the cell to become a virus factory," [says](#)

Northwestern Medicine immunologist Gregory Smith.

"The big question is how does it get to the nucleus of a neuron?"

A clue lies in a protein encoded by the virus, called pUL36. [Previous research](#) revealed the protein can lock onto molecules of [dynein](#) – tiny biological motors that click-clack their way along the web of stiff strings that help give a cell its shape.

To put it another way, herpes seems to make its way around the inside of any cell it invades by hitching a ride on the cell's own rail network, care of its own tiny grappling hook.

Observations on various other cells revealed there had to be more to the story, however. In some tissues, the rail journey wasn't random, or even in a single direction. The virus was able to take a trip to the cell's periphery, a journey that couldn't be explained by a dynein ride alone. Yet the herpes virus didn't seem to make anything else that could help it navigate the network.

Now the researchers have shown that the virus simply steals a tool from the original cells it breaks into. This additional molecular device, a motor protein called kinesin, literally walks along the strings of microtubules that support the cell.

Using both dynein and kinesin to move around inside a cell [isn't necessarily unusual for a virus](#). What is clever is that herpes takes one half of this set from one cell type and uses it in another in order to move more efficiently.

Further examination showed how this theft helped the virus make its way to the nucleus of a nerve cell. Once it entered the neuron's body it was able to take an express straight to DNA central without risking the added delay of randomly zig-zagging back and forth.

A nerve cell might not seem big to us, but for a virus ratcheting its way along weaving strands of cellular webbing is a lengthy one.

"It's a long way to go," [says](#) Smith. "It probably takes eight hours for it to travel from the end of the neuron to the hub."

It's the first time a virus has been seen repurposing a protein to help

it continue its infection, a discovery that could help us better understand our relationship with this ancient pathogen and maybe even find a way to lock it out of our DNA.

"By learning how the virus is achieving this incredible feat to get into our nervous system, we can now think about how to take away that ability," [says](#) Smith. "If you can stop it from assimilating kinesin, you would have a virus that couldn't infect the nervous system. And then you have a candidate for a preventive vaccine."

This research was published in [Nature](#).

<https://wb.md/3CGCq1B>

A COVID Head-Scratcher: Why Lice Lurk Despite Physical Distancing

Pediculus humanus capitis, the much-scorned head louse, has returned

Rae Ellen Bichell

PARKER, Colo. — The Marker family opened their door on a recent evening to a woman dressed in purple, with a military attitude to cleanliness.

Linda Holmes, who has worked as a technician with LiceDoctors for five years, came straight from her day job at a hospital after she got the call from a dispatcher that the Marker family needed her ASAP.

According to those in the world of professional nitpicking, *Pediculus humanus capitis*, the much-scorned head louse, has returned.

"It's definitely back," said Kelli Boswell, owner of Lice & Easy, a boutique where people in the Denver area can get deloused, a process that can range from minutes to hours depending on the method and the infestation. "It's a sign that things are coming back to normal."

Colds and more serious bugs like respiratory syncytial virus, better known by the shorthand RSV, are also back. That may leave some

to wonder: With all the covid prevention measures in place, how are kids sharing these things?

Like the coronavirus, all these bugs depend on human sociability. Unfortunately, the measures that many reopened schools have taken to prevent the transmission of covid-19 — masks, hand-washing, vaccination — do little to deter the spread of the head louse. However, physical distancing, such as spacing desks 3 feet apart, should be helping, if it's actually happening.

Lice are, in theory, harder to spread than the SARS-CoV-2 virus because proximity alone isn't enough: They usually need head-to-head contact. If a kid gets lice, odds are it means that kid spent some quality time close enough to another kid for the parasite to make its move. (Researchers [tend to agree](#) that transmission via inanimate objects like combs and hats is minimal.)

The head louse is not known for its fortitude or athletic prowess. It's basically the couch potato of pests. Adults can't survive more than [a day or two](#) without snacking on blood. Their eggs can't hatch without the warmth of a human head, and will die within about a week if not in those cozy conditions. The bugs can't jump or fly — only crawl. The one thing going for the head louse is its highly specialized claws, evolved to grasp human hair.

Unlike the [body louse](#), the head louse isn't known to spread disease. An infestation doesn't indicate anything about a person's hygiene. (In fact, the lore of delousers says that the bugs prefer clean hair because it's more grabbable.) And despite common misconceptions, they can colonize people of all ages, races and ethnicities.

Covid lockdowns were not great from a louse-world-domination standpoint. But the critters have been bonding with us [for tens of thousands of years](#). A little lockdown wasn't going to end the romance.

Federico Galassi, a researcher with Argentina's Pest and Insecticide Research Center, [found that](#) strict early covid lockdowns did,

indeed, lead to a decline in head lice among kids in Buenos Aires, but the bugs came nowhere close to being eliminated. His study found prevalence dropped from about 70% to about 44%.

And one thing is clear: When people shut their doors and hunkered down in early lockdowns, the lice were right there hunkered down with us. When SaLeah Snelling reopened the doors of her Lice Clinics of America salon in Boise, Idaho, in May, she said, "the cases of head lice were heavier than we've ever seen." And it wasn't just one or two people in the household with lice, but the entire household.

Now, Galassi and American louse workers say, infestation rates are back to pre-lockdown norms, despite school covid protections.

Nix, a brand of anti-lice products, [publishes a map](#) that claims lice are bad right now in Houston, most of Alabama and New Mexico, plus Tulsa, Oklahoma. The map directs people to locations that carry its products since many parents use a DIY approach once they spy the critter on a child's head.

Richard Pollack, chief scientific officer with pro-bono pest-identification service [IdentifyUS](#), said most claims about louse prevalence are "marketing nonsense" from a largely unregulated industry focused on apparent infestations that often turn out to be just dandruff, glitter, hair spray, grass-dwelling [springtail insects](#), innocuous fungus or even cookie crumbs.

It's possible that the recent increase in business for professional nitpickery suggests that people are now comfortable seeking help outside the home rather than its being a sign of a surge in the bugs.

While little research exists to confirm whether there is a rise in lice, Boswell, Pollack and even the National Association of School Nurses agree: The bugs [aren't likely spreading in the classroom](#) because in-school louse transmission is considered rare. Instead, Boswell said, it's more likely that as other activities resumed — sleepovers, play dates, summer camp, family gatherings — the bugs

prospered once more.

Pollack once wrote in a presentation slide, "Head lice indicate that the child has friends." Preschoolers tend to get the infestations the most "because they're more cuddly," said Julia Wilson, co-owner of Rocky Mountain Lice Removal in Lafayette, Colorado. But she has also noticed a rise among teenagers, which she ascribes to taking selfies with pals.

"You say to them, 'Have you touched heads?' and the teenager's like, 'No, never,'" said Wilson. "And then all of a sudden, they're literally taking a selfie photo with their friends."

The Marker family isn't sure where third grader Huntley's lice originated. Perhaps a close friend or her dance team? The Markers spent more than \$200 to get the four-person household checked — eyebrows and Dad's beard included. Her dad and her preschool-aged brother were free of nits. But Holmes did find a couple of nits on Huntley's mom, Paris.

"You can just burn my whole head right now," said Paris.

After combing each head carefully, Holmes ended the session by hugging her customers goodbye, proof that she trusts her work.

<https://bit.ly/3nKhAKF>

Replacing Carbon Fuel With Nitrogen: Chemists Discover New Way To Harness Energy From Ammonia

A research team at the University of Wisconsin–Madison has identified a new way to convert ammonia to nitrogen gas through a process that could be a step toward ammonia replacing carbon-based fuels.

The discovery of this technique, which uses a metal catalyst and releases, rather than requires, energy, was reported on November 8, 2021, in *Nature Chemistry* and has received a provisional patent from the Wisconsin Alumni Research Foundation.

"The world currently runs on a carbon fuel economy," explains Christian Wallen, an author of the paper and a former postdoctoral

researcher in the lab of UW–Madison chemist John Berry. "It's not a great economy because we burn hydrocarbons, which release carbon dioxide into the atmosphere. We don't have a way to close the loop for a true carbon cycle, where we could transform carbon dioxide back into a useful fuel."

To move toward the United Nations' goal for the world to become carbon-neutral by 2050, scientists must consider environmentally responsible ways to create energy from elements other than carbon, and the UW–Madison team is proposing a nitrogen energy economy based on interconversions of nitrogen and ammonia.

The scientists were excited to find that the addition of ammonia to a metal catalyst containing the platinum-like element ruthenium spontaneously produced nitrogen, which means that no added energy was required. Instead, this process can be harnessed to produce electricity, with protons and nitrogen gas as byproducts. In addition, the metal complex can be recycled through exposure to oxygen and used repeatedly, all a much cleaner process than using carbon-based fuels.

"We figured out that, not only are we making nitrogen, we are making it under conditions that are completely unprecedented," says Berry, who is the Lester McNall Professor of Chemistry and focuses his research efforts on transition metal chemistry. "To be able to complete the ammonia-to-nitrogen reaction under ambient conditions — and get energy — is a pretty big deal."

Ammonia has been burned as a fuel source for many years. During World War II, it was used in automobiles, and scientists today are considering ways to burn it in engines as a replacement for gasoline, particularly in the maritime industry. However, burning ammonia releases toxic nitrogen oxide gases.

The new reaction avoids those toxic byproducts. If the reaction were housed in a fuel cell where ammonia and ruthenium react at an electrode surface, it could cleanly produce electricity without the

need for a catalytic converter.

“For a fuel cell, we want an electrical output, not input,” Wallen says. “We discovered chemical compounds that catalyze the conversion of ammonia to nitrogen at room temperature, without any applied voltage or added chemicals. This is the first process, as far as we know, to do that.”

“We have an established infrastructure for distribution of ammonia, which is already mass produced from nitrogen and hydrogen in the Haber-Bosch process,” says Michael Trenerry, a graduate student and author on the paper. “This technology could enable a carbon-free fuel economy, but it’s one half of the puzzle. One of the drawbacks of ammonia synthesis is that the hydrogen we use to make ammonia comes from natural gas and fossil fuels.”

This trend is changing, however, as ammonia producers attempt to produce “green” ammonia, in which the hydrogen atoms are supplied by carbon-neutral water electrolysis instead of the energy-intensive Haber-Bosch process.

As the ammonia synthesis challenges are met, according to Berry, there will be many benefits to using ammonia as a common energy source or fuel. It’s compressible, like propane, easy to transport and easy to store. Though some ammonia fuel cells already exist, they, unlike this new process, require added energy, for example, by first splitting ammonia into nitrogen and hydrogen.

The group’s next steps include figuring out how to engineer a fuel cell that takes advantage of the new discovery and considering environmentally friendly ways to create the needed starting materials.

“One of the next challenges I would like to think about is how to generate ammonia from water, instead of hydrogen gas,” Trenerry says. “The dream is to put in water, air and sunlight to create a fuel.”

Reference: “Spontaneous N₂ formation by a diruthenium complex enables electrocatalytic

and aerobic oxidation of ammonia” by Michael J. Trenerry, Christian M. Wallen, Tristan R. Brown, Sungho V. Park and John F. Berry, 8 November 2021, Nature Chemistry. DOI: 10.1038/s41557-021-00797-w

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<https://wb.md/3kYLpVK>

Can Cupping Improve COVID Vaccine Delivery?

Cupping, rooted in a practice used for centuries in China and the Middle East

Tara Haelle

Until mRNA vaccines against COVID-19 emerged, RNA or DNA vaccines had not been used at a large scale even though the technology had existed for years. Now researchers are seeking ways to deliver these vaccines more efficiently, and they've found one: cupping, which is rooted in a practice used for centuries in China and the Middle East.

The tradition typically involves placing heated cups on a person's skin. As the air inside the cup cools, the air pressure under the cup drops. Practitioners believe that the resulting suction of the skin promotes healing, although evidence for its effectiveness is limited. But scientists suspected that the process might stimulate skin cells to soak up injected DNA as a vaccine or gene therapy.

In the body, injected RNA usually degrades quickly if it's unprotected. In the mRNA COVID vaccines, an oily droplet surrounds the mRNA, protecting it long enough to reach cells. DNA is less vulnerable to breakdown but faces a different problem: getting enough cells to take it up. Current methods to get DNA into cells include using an electric pulse to open an entry point for the DNA. But the side effects include muscle contractions, pain, and tissue damage, and the method isn't usable in people with [pacemakers](#) or other electrical device implants.

In a new study published in Science Advances, researchers tried out vaccination plus cupping on rats. They injected one or two doses of a DNA-only COVID vaccine, immediately followed by cupping

suction where the shot was given. Even if only one dose of vaccine was used, the immune response with cupping was about 100 times greater than without cupping.

Scientists aren't certain why the suction helps, but they suspect that it strains the skin layers, stretching the cells so that they take up more of the DNA. This method of enhancing DNA uptake is less painful than other methods and has fewer side effects, including no tissue damage.

DNA vaccines don't require cold storage, making them an encouraging option in areas where maintaining low temperatures during vaccine transport can be difficult. A successful delivery system for DNA vaccines that doesn't involve the side effects of other methods could add another advantage. The company that developed this method, GeneOne Life Science, has already begun clinical trials with a DNA vaccine against COVID-19.

Source

Science Advances: "[Novel suction-based in vivo cutaneous DNA transfection platform.](#)"