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Discover
SPECIAL ISSUE

STRANGE SCIENCE

Fall 2018

52 AMAZING TRUE STORIES

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1

Ancient Nightmare Spider Sports a Tail Preserved in Amber

There's a new kid in town — in Creepycrawly Town, to be exact. But there's much more to this leggy fella than nightmarishly good looks. A pair of papers recently detailed how this 100 million-year-old discovery, preserved in amber, fits into the spider evolution story … and the ways it doesn't.

Known from four specimens, the ancient arachnid's formal name is *Chimerarachne yingi*. Its genus name, from the mythic Greek chimera, is a nod to its unusual mix of features. There's that one feature you've probably noticed already that you might not expect in a spider: a long, segmented, whiplike tail that resembles the telson found in scorpions.

All four of the specimens were preserved in amber from what's now Myanmar (formerly Burma). One of the papers describes the holotype, or exemplar, of the species, as well as a second specimen. The other study details

two additional individuals.

Fun fact: The combination of primitive and advanced traits in *C. yingi* is so unusual that the two teams of researchers behind the dueling studies disagree on what the animal is, evolutionarily speaking.

WHIP IT GOOD

For starters, in addition to fairly standard spider traits such as fangs and multisegmented spinnerets that produce silk, there's that tail. No modern spider has a similar feature. Its body is only about 2.5 millimeters, but the tail is about 3 mm, making it less than a quarter of an inch in total.

Researchers believe that the whiplike tail was probably used to sense the environment, perhaps similar to the way a cat uses its whiskers to gauge the dimensions of openings or even detect movements that stir the air.

Researchers believe that the whiplike tail was probably used to sense the environment, perhaps similar to the way a cat uses its whiskers to gauge the dimensions of openings.

Because of the animal's blend of early and later traits, one team of researchers does not consider *C. yingi* to be a spider. Spider relatives that are nearly three and four times as old also had tails but no spinnerets. *C. yingi*'s mix of traits places it as a late version, say the researchers, within Uraraneida, an earlier order of arachnids. Even then, it's still exciting: Uraraneida was thought to have gone extinct near the end of the Permian, about 252 million years ago. Finding these little guys tells us that the uraraneids may have survived at least another 150 million years.

EIGHT ARMS TO HOLD YOU

But the team describing the holotype of *C. yingi* places it within the arachnid family tree as an early true spider, citing the presence of both those spinnerets and modified male pedipalps, which assist with sperm transfer. (FYI, while the animal could likely produce silk, there's no evidence to suggest that *C. yingi* wove webs. Spiders use silk for a variety of reasons, including augmenting their living space and protecting their eggs.)

The formal description of *C. yingi* appears in *Nature Ecology & Evolution*, which also published the related paper on the two additional specimens and alternate spot on the arachnid family tree. — **GEMMA TARLACH**

CLOCKWISE FROM TOP LEFT: DINGHUA YANG (2); UNIVERSITY OF KANSAS

2

Global Warming Researchers Heat Ocean Themselves

A perennial problem for climate science is that much of it lies in the realm of abstraction. Various models and forecasts compete for relevance, based on arcane statistical formulas that look like gibberish to science reporters and readers alike.

Well, rest easy, weary travelers. Here's a climate study that leaves the ponderous math behind in favor of a real-world simulation of warming Antarctic waters. Researchers from the British Antarctic Survey decided to see the effects of a small change in water temperature in the most straightforward way possible: They went and warmed the water up themselves.

DIY WARMING

The scientists took plastic slabs threaded through with heating coils and left them on the seabed near the Rothera Research Station on Adelaide Island in

Scientists placed warming panels directly on the seabed.

Antarctica for nine months. The experiments, published in *Current Biology,* included panels calibrated to warm the water nearby by 1 and 2 degrees Celsius, as well as controls that produced no heating. Those temperature changes mirror predictions within 50 and 100 years, respectively, and the researchers checked back every month or so to see what was happening.

After just two months, noticeable differences already became apparent. The 1-degree panels were dominated by a single species of bryozoan, a tiny, filter-feeding invertebrate, pushing out most other species. On the panels that served as controls, the ecosystem was much more balanced, mirroring the normal conditions in Antarctic waters. The 2-degree panels were also more favorable to the bryozoans, but the makeup was a bit more diverse. Still evident, however, was a loss of biodiversity as some species began to take over.

The results highlight the fact that global warming won't necessarily kill off all the wildlife in the oceans, but it will cause striking shifts in the ecology.

The time of year also seemed to play into how changing temperatures affected the marine ecosystem. Some species that had been doing well in the summer months began to drop off as fall approached, while others did even better.

The results highlight the fact that global warming won't necessarily kill off all the wildlife in the oceans, but it will cause striking shifts in the ecology. In the Antarctic, it appears the bryozoans have a rosy future. Other animals, perhaps not so much.

"I was quite surprised," says Gail Ashton of the British Antarctic Survey and Smithsonian Environmental Research Center in a news release. "I have spent most of my career working in temperate climates where communities experience much greater temperature fluctuations and wasn't expecting such a response to just 1 degree C of change."

So, climate change likely won't turn the Antarctic into a barren wasteland; plants and animals will still be there. But without the complex, diverse environment that has been built up over the course of millions of years, the Antarctic will have lost something crucial to any ecosystem: resilience.

— NATHANIEL SCHARPING

OPPOSITE: TERRI SOUSTER. THIS PAGE: LLOYD PECK

3

Formula for Happiness Gets Complicated

In 2014, *Discover* reported on an equation that purported to lay out key variables that determine how happy we are. It said, in a nutshell: Lower your expectations if you want to be happier.

But the pursuit of happiness is far more complicated than simply expecting nothing, so it's no surprise that the "happiness equation" has since grown. Now, on top of lowering your expectations, you might want to avoid scrolling through your Facebook newsfeed comparing yourself with other smiling faces. It turns out other people's happiness is now part of that equation.

IT'S ALL ABOUT EXPECTATIONS

To write the original equation, researchers from the University College London tracked participants' happiness levels as they played a simple gambling game. They could either win $2 or get nothing. In another version of the game, they could either lose $2 or get nothing. They found that people who succeeded in not losing $2 were much happier than people who failed to win $2, even though

they all ended up with nothing. Their experiment showed that context matters a lot, and if results exceeded participants' expectations, they were much happier than when they fell short.

The researchers' updated equation takes into account how other people's fortunes affect our relative happiness. The researchers performed two experiments: In the first, they told participants that they would be receiving a small reward and asked them how much, if any, they would like to give to a stranger. In the second experiment, they had the same people play a gambling experiment, much like their first study, but this time they could see how much another person won or lost. Again, participants were asked how happy they were throughout the experiment. The team published their findings in *Nature Communications*.

The researchers' updated equation takes into account how other people's fortunes affect our relative happiness.

YOU WIN, I WIN, AND WE ALL SMILE

Although winning made everyone happy, the researchers found that people achieved the most happiness when their partner also won. If their partner lost, there was a noticeable dip in happiness levels. Similarly, people were less grumpy about losing when their partner also lost — schadenfreude, perhaps.

The researchers identified two primary emotions at work here: guilt and envy. Guilt emerged when one person won but their partner lost, while envy came into play in the same situation, but for the loser. The researchers say their findings show that inequality is a universal bummer. Misery *and* delight love company.

$$\text{Happiness}(t) = w_0 + w_1 \sum_{j=1}^{t} \gamma^{t-j}\,\text{CR}_j + w_2 \sum_{j=1}^{t} \gamma^{t-j}\,\text{EV}_j + w_3 \sum_{j=1}^{t} \gamma^{t-j}\,\text{RPE}_j + w_4 \sum_{j=1}^{t} \gamma^{t-j} \max(\text{R}_j - \text{O}_j, 0) + w_5 \sum_{j=1}^{t} \gamma^{t-j} \max(\text{O}_j - \text{R}_j, 0)$$

Scientists have devised an official formula for happiness — and then made it more complicated.

The purpose of the study wasn't necessarily to lay out all the factors that determine what makes people happy, but to instead find out how happiness can be affected by others. It would be nearly impossible to account for all the things that bring us happiness, but expectations and how much we compare our standing in society relative to others may underlie the reason we're in a good or bad mood. — **NATHANIEL SCHARPING**

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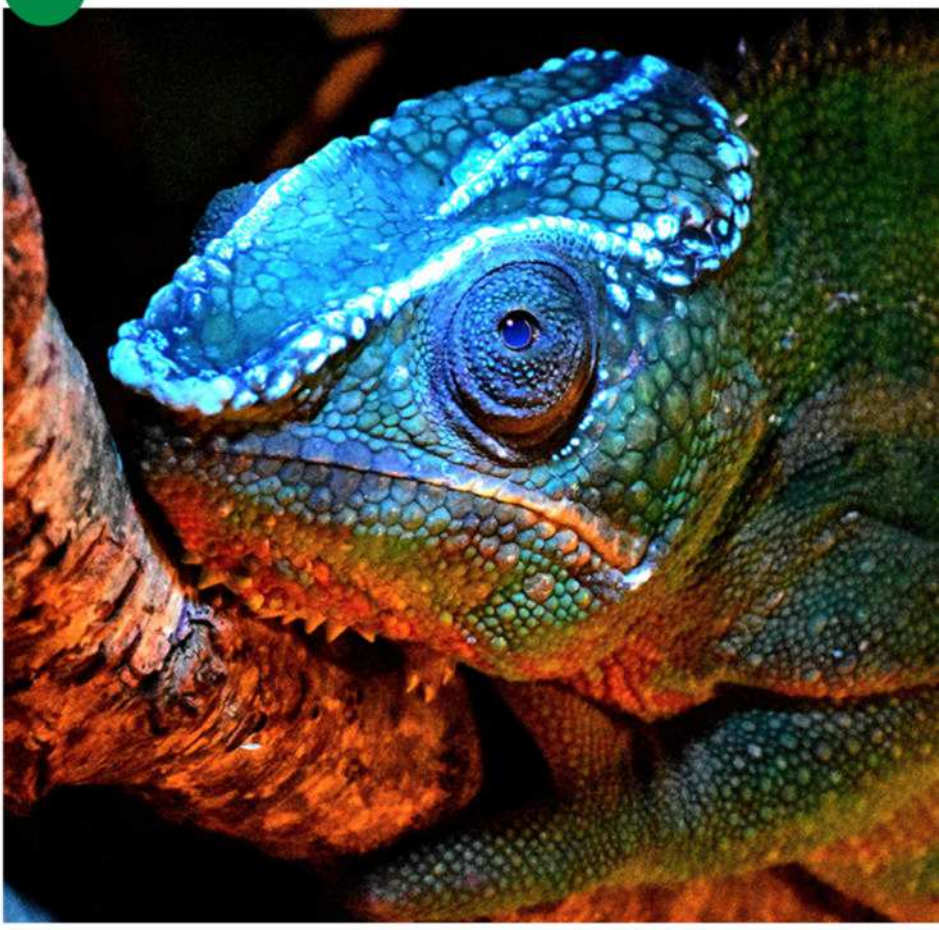

Chameleon Bones Glow in the Dark

Shine an ultraviolet light on a chameleon in the dark, and it will light up with an eerie blue glow. It's not color-changing skin at play here, though: It's the bones.

We've long known that bones fluoresce under ultraviolet light — some researchers have even used the property to find fossils — but our bones

are usually all covered up. Chameleons have evolved rows of small, bony outgrowths along their skeletons that sit just beneath the skin, making it thin enough for the glow to shine through, say German scientists in a paper published in *Nature Scientific Reports*.

It's the first time researchers have noticed the ability among chameleons, and they think it's useful for communication and sexual selection. The lizards can see UV light, and it could function as a kind of secret communication in the rainforest. The trait shows up around the eyes and temporal regions most frequently, both areas commonly associated with communication in chameleons, the researchers say. Males seem to have more of the bony bumps that cause the glow, indicating that it probably plays a role in mating as well.

The electric blue would show up visibly against the dull greens and browns of the rainforest, helping chameleons to stand out to their friends.

Not every chameleon has the ability, though. The trait seems to be most dominant in species that live in rainforests, as opposed to open grasslands, and the researchers suggest this is because forests are typically darker, and the glow is easier to see. The electric blue would show up visibly against the dull greens and browns of the rainforest, helping chameleons to stand out to their friends. And their skin might help make the color even more distinct, acting as an optical filter to highlight blue wavelengths of light.

The team suggests that UV fluorescence might actually be more common than we think, especially in reptiles. Plants, insects and many sea creatures already use bioluminescence, and the ability could be widespread in the animal kingdom as well. Scorpions, for example, glow bright green under a UV light. To find more, all we might have to do is look. — **NATHANIEL SCHARPING**

DAVID PRÖTZEL/ZSM/LMU (2)

5

This Wood Won't Float, but It's Stronger Than Steel

The question of how much wood a woodchuck can chuck may need to be re-evaluated. Research published in *Nature* reveals a process that can create wood with a strength-to-weight ratio stronger than most metals.

HARDER, BETTER, STRONGER

Many of today's high-performance structural materials have at least one major drawback. Metals like steel may be strong, but they are also heavy and environmentally damaging. Composites and polymer-based materials work around these drawbacks, but they are complex and expensive to produce.

Despite all of our technological innovation, wood remains one of our best options for building. It's abundant, inexpensive and lightweight. However,

it's not remarkably strong or durable. In an attempt to boost wood's mechanical capabilities, researchers have developed various methods to treat the material.

Treating wood to improve its mechanical performance is nothing new, with simple versions of the process dating back to the 1700s. Wood can be treated with steam, heat or ammonia to make it stronger, but none of these capitalizes on its full potential — not to mention wood often re-expands and loses strength over time.

The new method involves a two-step process: Wood is chemically treated and then hot-pressed at over 200 degrees Fahrenheit.

When the natural wood is boiled in a mixture of sodium hydroxide and sodium sulfite, the chemicals break down something called the lignin. Lignin is the polymer, present in cell walls of many rigid plants, that keeps plants stiff. When some, but not all, of the lignin is broken down, the wood is easily compressed into its tougher, stronger self: densified wood.

This alter-ego wood is over 11 times stronger than natural wood, the researchers say, though it no longer floats in water.

TOUGH ENOUGH?

This alter-ego wood is over 11 times stronger than natural wood, the researchers say, though it no longer floats in water. Still, the compacted variety is only about three times denser than normal wood — much lighter than most building materials.

In terms of practical applications, the main focus of the research is the potential use for densified wood in construction. Natural wood simply can't compete with metal alloys and plastics in terms of strength when it comes to complex engineering projects. Densified wood could represent a happy medium between strength and weight.

The study cites another use: "low-cost armor and ballistic energy absorption." In ballistics tests of a laminated version of densified wood, the researchers found that it absorbed 10 times more energy than natural wood.

But densified wood is not the perfect material … yet. One of the concerns when removing lignin from a natural plant material is bacteria and fungus. In living plants, the rigidity of lignin helps to fend off these attacks. It remains to be seen whether a densified wood structure would be more susceptible to bacterial and fungal issues.

Nevertheless, it's a reminder that nature, with a little help, is still the greatest engineer of all. — **LEAH FROATS**

NATALIIA K/SHUTTERSTOCK

6

Spinach: A Bomb-Detecting Superfood

To detect explosive compounds, researchers have designed plants that communicate with us.

Scientists from MIT added carbon nanotubes to spinach plant leaves, causing the plants to emit infrared light when they're near nitroaromatics, compounds often used in explosives. Researchers believe their augmented plants represent early successes in an emerging field called plant nanobionics, which could fundamentally change the way we detect bombs, droughts, toxins and more.

GIVING PLANTS SUPERPOWERS

The same team debuted this technology a few years ago when it used nanoparticles embedded in plant leaves to detect nitric oxide, a hallmark of pollution. Since then, these scientists have developed polymers that bind to a variety of molecules, including hydrogen peroxide, TNT and sarin, a potent nerve toxin. They wrap their custom polymers around carbon nanotubes and apply

them as a solution to the undersides of leaves. The nanotubes are then absorbed into the mesophyll, a part of the plant involved in photosynthesis, where they are exposed to all the chemicals flowing through the plant. The researchers used spinach plants, but the same technology could work on any plant, they say.

Plants have a highly developed vascular system that distributes water and nutrients from the roots to the tip of the stem. They also are highly sensitive to minute environmental changes, necessary for responding to impending catastrophes such as droughts.

Everything the plant absorbs cycles through its system, and molecules absorbed by the roots or leaves will eventually make their way to the nanotubes sitting in the spinach plants' leaves. In this iteration of the project, when nitroaromatics were present, they attached to the nanotube. This caused the structure to fluoresce differently when a laser was trained on it, emitting near-infrared radiation picked up by a nearby camera. A computer attached to the camera registered the presence of a dangerous compound and sent out an email alert warning of a possible threat.

"This is a novel demonstration of how we have overcome the plant/human communication barrier," Michael Strano, a professor of chemical engineering at MIT and co-author of the study, says in a news release. The team published its research in *Nature Materials*.

Scientists from MIT added carbon nanotubes to spinach plant leaves, causing the plants to emit infrared light when they're near nitroaromatics, compounds often used in explosives.

STILL IN EARLY STAGES

There are still a few kinks to work out. The team didn't conduct trials using solely airborne compounds, which presumably would be how most commercial applications of this technology would need to operate. The researchers also didn't reveal the minimum concentration of nitroaromatic compounds needed to trigger a detection, so it's unclear how sensitive their plants are.

The researchers say their system takes about 10 minutes to detect the presence of nitroaromatics when they are added to the roots, and the infrared sensor works from up to a meter away, although they hope to boost that range in the future. They have also increased the detector's reliability by adding in separate nanotubes that constantly fluoresce, which they say helps avoid false-positive detections. — **NATHANIEL SCHARPING**

JUN WAT/SHUTTERSTOCK

7

Suspense Is in the Air

When someone says, "Suspense is in the air," they're being more literal than they realize.

A recent study shows that we exhale a unique mix of chemicals when experiencing certain strong emotions, such as fear or excitement. These invisible signatures can be monitored to track how an individual or crowd is feeling. The experiment took place in a movie theater, where suspense, terror and laughter abound.

The fact that our bodies emit different chemicals depending on our physiology was already known; it's how a Breathalyzer works, for example. Strong feelings, such as fear, produce aromatic signatures revealed by chemicals seeping through our sweat glands — it gave rise to the notion of "smelling fear." But getting a glimpse at the full range of emotions, as documented by our exhalations, hadn't been successfully tested.

A recent study shows that we exhale a unique mix of chemicals when experiencing certain strong emotions, such as fear or excitement. These invisible signatures can be monitored to track how an individual or crowd is feeling.

EXHALING SUSPENSE

In the controlled environment of a movie theater, scientists from the Max Planck Institute for Chemistry and the Johannes Gutenberg University in Mainz, Germany, were guaranteed some thrills.

In total, they gathered data from 9,500 people watching 108 screenings of 16 different movies at a movie theater in Mainz. They hooked up a mass spectrometer to an outgoing air duct and measured the chemicals in the air every 30 seconds. To get a range of reactions, the team used a range of film types, from comedy to horror, including *The Hunger Games: Catching Fire, Carrie, The Hobbit: The Desolation of Smaug* and *The Secret Life of Walter Mitty.*

The researchers primarily focused on carbon dioxide levels in their analysis, as a higher rate of exhalation — a result of fear or laughter — will produce more of the molecule. (They also noticed that levels of another of our body's

MARK POKORNY/WARNER BROS. PICTURES/EVERETT COLLECTION

natural chemicals, isoprene, spiked during exciting situations, but that could just be another result of increased exhalation.)

Ultimately, the team members realized they could predict when an exciting event was occurring just by looking at sharp increases in the concentration of the chemical. For example, across four separate screenings of *Catching Fire*, a scene where the heroine's dress bursts into flames reliably caused spikes in levels of telltale chemicals. Their findings appeared in the journal *Scientific Reports*.

Dramatic scenes alter the air composition within a movie theater.

While the team found that both suspense and humor produced clear signals, other emotions were more muddled. Researchers believe this is because both suspense and humor produce physiological responses that alter the chemistry of exhaled air. Suspenseful scenes, for example, will cause our hearts to beat faster and speed up our metabolism; both responses quicken breathing and set off unique chemical reactions in our bodies.

Maybe you can lie, but your breath will always tell the truth.

— NATHANIEL SCHARPING

8

If We Start Geoengineering, There's No Going Back

When it comes to climate change, speed kills.

The temperature changes that are causing heat waves, intense storms and other climate aberrations are dangerous today because they're happening so fast. Indeed, the climate has been this warm, and even warmer, in the past, but it reached those temperatures over the course of thousands or millions of years — long enough for the changes to occur gradually. This time around, the climate is being altered too fast for much animal and plant life to adapt.

A suggested fix for climate change could make the problem even worse.

FIXING THE CLIMATE

A paper in *Nature Ecology & Evolution* looks at how geoengineering — artificially manipulating the atmosphere to counteract the effects of climate change — would affect biodiversity on Earth. The results are a bit mixed, but the paper's real warning comes from an analysis of suddenly halting geoengineering efforts. If we begin to alter the climate and then abruptly stop, the consequences would be much worse than if we had never begun in the first place, the researchers say.

For their analysis, a team from the University of Maryland, Annapolis, Yale University and Rutgers University assume that humankind decides to begin geoengineering in the year 2020. Governments and scientists in this fictional (though plausible) alternate universe begin injecting sulfur aerosols into the climate at the equator, to the tune of 5 trillion grams per year.

This kind of geoengineering, called stratospheric aerosol injection, is one of the most commonly proposed scenarios for geoengineering. Whereas carbon dioxide holds onto heat, making the planet warmer, sulfur helps to reflect the sun's energy, meaning less of it enters our atmosphere and the planet gets cooler.

For evidence that this works, just look at volcanic eruptions, which pump millions of tons of sulfur dioxide into the atmosphere. There are noticeable dips in average global temperature after large-scale eruptions.

For evidence that this works, just look at volcanic eruptions, which pump millions of tons of sulfur dioxide into the atmosphere. There are noticeable dips in average global temperature after large-scale eruptions, and one of the most recent occurred in 1991 when Mount Pinatubo erupted in the Philippines. Large parts of the planet experienced temperature decreases of almost a full degree Fahrenheit after the eruption.

Five trillion grams is about a quarter of the amount of sulfur that Mount Pinatubo ejected, so placing that much into the atmosphere every year could cool the climate appreciably. The results would be beneficial overall, at least

LEFT: AALTAIR/SHUTTERSTOCK. ABOVE: HOA-QUI/SCIENCE SOURCE

as far as we can tell, though this kind of geoengineering might skew rainfall in harmful ways.

DON'T STOP

However, the gravest danger geoengineering poses is that it only masks the real problem. We might spray sulfur into the atmosphere, but there would still be too much carbon dioxide in the atmosphere. Therefore, if we were to stop geoengineering, the climate would snap back to where it was before, and likely get even worse, assuming we didn't stop emitting carbon dioxide.

That shift wouldn't happen on a scale of thousands of years, or even decades as is currently happening. If geoengineering were to suddenly stop after 50 years in 2070, the researchers' analysis shows the climate would warm by more than a full degree on land in just 10 years — an incredible level of volatility.

Possible consequences for plants and animals could be severe. In the researchers' scenario, temperature changes would occur roughly three times faster than if climate change had occurred at the predicted rate.

The consequences for plants and animals could be severe. In the researchers' scenario, temperature changes would occur roughly three times faster than if climate change had occurred at the predicted rate. That's a temperature change greater than in any other decade in the historical record, the researchers say, and more than any predicted under the climate forecast they use.

It's also much faster than most plants and animals can adapt. Regions that harbor some of the greatest biodiversity on Earth — such as tropical oceans, the Amazon basin, Africa and Eurasia — would be most affected, they say.

Ramping down geoengineering slowly would help to mitigate these problems, but that may not be an option. A geoengineering program would most likely be run by the government or a coalition of governments, and would thus be subject to changes in political will. And when it comes to international cooperative agreements, nothing is ever guaranteed.

The best solution, the researchers say, is to cut greenhouse gas emissions the old-fashioned ways. To keep temperature increases within the bounds proposed by the Paris Agreement, that means emissions will need to peak by 2020. — **NATHANIEL SCHARPING**

9

Meet *Caihong Juji*, the Show-Off Dino

Ooh, shiny! One of the newer dinosaurs on the paleo scene is more than a little eye-catching: Researchers believe the duck-sized *Caihong juji* rocked iridescent feathers on its head, wings and tail. If it was indeed so fancy, it's the earliest example in the fossil record of such shimmering finery.

C. juji was discovered in northeastern China, home to many feathered dinosaur finds. Its name translates from Mandarin as "rainbow with a big crest," and they're not kidding.

C. juji had a bony crest on top of its head and long, streamerlike feathers, some of which were preserved when the animal was fossilized. And what researchers saw when they took a good look at those feathers got them excited.

Melanosomes, the cellular structures that hold pigment, come in various shapes, which affect how the actual color of the feather is perceived. Pancake-shaped melanosomes are found in iridescent feathers such as those of hummingbirds and other fancy sorts.

Based on the imprints of melanosomes in the *C. juji* fossil, it appears the animal's head and wings, and parts of its tail, had iridescent feathers. If so, that would make *C. juji*, which lived 161 million years ago, the oldest known animal with iridescent feathers. By comparing the melanosome imprints in the fossil with those of modern birds, the researchers reconstructed not only the shimmy and shine of *C. juji's* feathers, but also the specific colors it may have produced. In a word: rainbow.

C. juji is also neat because it appears to have had the oldest known example of asymmetrical feathers, which modern dinosaurs (aka birds) use to steer in flight. *C. juji* was grounded, however. The feathers were on its tail, not its wings as they are for birds. But the discovery leads to all kinds of intriguing questions about how and why the feathers evolved and what purpose they served.

As for the purpose of *C. juji*'s fantastic fashion, the researchers suspect that, like many birds, its plumage was the equivalent of a "hey, baby" and attracted potential mates. I know I always like a fella with a big crest and rainbow flair.

The research appeared in *Nature Communications*. — **GEMMA TARLACH**

VELIZAR SIMEONOVSKI/THE FIELD MUSEUM

10

Are You Sapiosexual?

What turns you on? When responding to the question, most people turn to physical attributes, and we can probably all guess what the answers might be.

But for some, sexual attraction stems not from the assemblage of flesh and bone that carries us through life, but from what resides within. No, it's not the soul — it's the mind.

Or so they say. So-called sapiosexuals claim to be attracted to intellect, and many say that it overrules the physical characteristics that underpin sexuality for most people. The term has caught on recently: The dating website OkCupid now allows users to identify as sapiosexual, and an entire dating app, Sapio, is devoted to helping sapiosexuals meet.

A crucial point to make here is that for sapiosexuals, intellect isn't just nice to have — it's a legitimate turn-on. It's not a stretch to say that most people value intelligence in a long-term partner; a host of studies backs that up, and it usually ranks second just behind "kindness and understanding" as a desirable trait. But sapiosexuals claim that their preferences go beyond that. They react to intelligence the same way others might to, say, chiseled abs.

Perhaps it's inevitable that a sexual identity that prizes intelligence above all has been met with both ridicule and criticism from those who see the concept as pretentious, or who worry that it disadvantages people with disabilities. Some doubt that sapiosexuality is even a legitimate phenomenon. It could simply be a manifestation of an attraction to other characteristics, or perhaps simply an identity adopted by those who wish to see themselves a certain way.

SMART AND SEXY

Gilles Gignac, a psychology researcher at the University of Western Australia, investigated sapiosexuality further. He conducted a survey of both undergraduate students in Australia and online participants. He and his co-authors had them complete a questionnaire that asked whether they found

high levels of intelligence attractive, in addition to more general questions about intelligence. Examples included "Listening to someone speak very intelligently arouses me sexually," and "A very high level of intelligence alone is enough for me to be attracted to someone sexually."

Gignac also asked them directly whether they would find people with varying levels of intelligence attractive, ranging from well below the 50th percentile to the very top end of the intelligence spectrum. His study was published in the journal *Intelligence*.

Tallying the data revealed that for most people, intelligence isn't a significant factor in deciding whether someone's hot or not. While it wasn't totally insignificant, it's likely that other characteristics override brains for most people. For a select few, however, it appears that a prodigious intellect did indeed serve to stir desire. Eight percent of the participants scored a 4 out of 5 on Gignac's test, meaning they responded strongly in the positive to most questions that asked whether they were turned on by intelligence. Gignac interprets this as evidence of sapiosexuality among a small subset of people.

Interestingly, it seems there's a limit to how much intelligence people can handle. When asked to rate what level of intelligence they found attractive, most people stopped at an IQ of 120, which corresponds roughly to the 90th percentile of intelligence. Gignac isn't sure about why this is so, though he suggests that portrayals of extremely intelligent people as socially awkward, as well as fears of compatibility problems, could come into play.

In addition, the participant's own level of intelligence, as measured by a few common cognitive tests, didn't seem to make them more attracted to smart people. In other words, even the non-brilliant can be sapiosexuals.

LET'S BE INTELLIGENT ABOUT IT

It's not time yet to rush to any conclusions about this study. First off, there are the general shortcomings of self-reported studies, which don't always reflect what people really think about themselves. At worst, it means that Gignac's study just found some people who want to be sapiosexuals; at best, it means that more work is needed. Future research looking at whether intelligence actually correlates to greater success at dating or finding sex partners could be helpful, as well as deeper studies into those who claim to be sapiosexual.

Why humans might be attracted to intelligence is certainly a question for future studies to answer. It's not a stretch to imagine that brains — like the bulging muscles and full lips that connote physical strength and reproductive health — could also confer evolutionary benefits.

But, as is also apparent to most any adult, sexuality is a fascinatingly complex subject. Getting to the roots of what turns us on is no easy task, whatever the IQs involved. — **NATHANIEL SCHARPING**

INNERVISIONPRO/SHUTTERSTOCK

11

Why This Fungus Has Over 20,000 Sexes

Gender isn't really a fungal construct.

While we have two traditionally recognized genders, man and woman, some species of fungi can have thousands. It sounds confusing, but it's actually helpful — with so many variations, the fungi can mate with nearly every individual of their species they meet. It must make for a wild singles night.

SEXY FUN GUYS

One species, *Schizophyllum commune*, shines when it comes to gender diversity. The white, fan-shaped mushroom has more than 23,000 different sexual identities, a result of widespread differentiation in the genetic locations that govern its sexual behavior. For humans — and all animals, really — this would never fly because we've evolved a very specific method of reproduction that involves specialized sexual organs to do the mating with, and sex cells to carry the genetic information.

Fungi, by contrast, keep it casual. To mate, all a fungus has to do is bump up against another member of its species and let their cells fuse together.

S. commune uses a special kind of structure called a clamp connection to do this, and it allows them to exchange their cells' nuclei, along with the genetic information inside. This keeps reproduction simple and means that a potentially huge number of sexes are possible — other fungi species have dozens or more, though *S. commune* is certainly an outlier.

BERNARD SPRAGG VIA WIKIMEDIA

One species, *Schizophyllum commune*, shines when it comes to gender diversity. The white, fan-shaped mushroom has more than 23,000 different sexual identities, a result of widespread differentiation in the genetic locations that govern its sexual behavior.

IT'S NOT WHAT YOU THINK

The "sexes" don't really involve physical differences, either, as we might think of when the word *sex* comes to mind. The variations are all in the genome, at two separate loci, or locations, each of which has two alleles, or alternate forms. The loci are called A and B, and the alleles are termed "alpha" and "beta." That makes four possible sexes, but there's another twist. Every A-alpha/beta and B-alpha/beta can have many different variants, called specificities. It amounts to more than 339 specificities for A and 64 for B. Putting all that together yields thousands of possible unique sexes.

The fungus can mate with any specificity as long as it's different somewhere on both A and B. So, two prospective mates could both have the same A-beta and B-alpha, but have different A-alphas and B-betas, and they'd be fine to hook up. If they shared A-alpha and A-beta, though, their pheromones wouldn't be compatible, meaning that they couldn't carry out the reproductive process. That leaves a ton of options for mating, though, and it essentially means that anyone a fungus meets is fair game for sexy time.

It also really helps spread genetic diversity because there are so many options. Something to consider next time you're looking for a date.

— NATHANIEL SCHARPING

12

Storms Generate Thunder, Lightning and . . . Antimatter?

Scientists have detected lightning triggering nuclear reactions in the skies above Japan. These new findings are clear evidence that thunderstorms are a natural source of radioactive isotopes on Earth.

Thunderstorms are natural particle accelerators, capable of hurling electrons outward at nearly the speed of light. When these electrons strike atoms, they can generate gamma rays, the highest-energy form of light.

Previous research suggested that gamma rays from lightning can have a variety of extraordinary effects, such as creating matter and antimatter. Per Einstein's famous equation $E = mc^2$, mass can get converted into energy and vice versa. Prior work found that gamma rays from lightning can generate pairs

of electrons and their positively charged antimatter counterparts, known as positrons. If any of these positrons smack into electrons, they will mutually annihilate each other, emitting gamma rays.

Scientists also had conjectured that gamma rays from lightning could trigger photonuclear reactions that can break atoms apart. For example, stable nitrogen-14 atoms could, in theory, absorb gamma rays and spit out neutrons to become unstable nitrogen-13 atoms. These could, in turn, give off positrons and neutrinos and radioactively decay to become more stable carbon-13 atoms.

Researchers in Japan say they have the first proof that gamma rays from lightning can trigger such photonuclear reactions. "We provided clear and conclusive evidence for both neutrons and positrons from a single event that can be only explained by photonuclear reactions from lightning," says study lead author Teruaki Enoto, a high-energy astrophysicist at Kyoto University. The scientists detailed their findings in the journal *Nature*.

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They analyzed data from radiation detectors at the Kashiwazaki-Kariwa nuclear power station in Niigata. They hunted for gamma rays from powerful winter thunderstorms along the coast of the Sea of Japan.

During a winter storm, the researchers detected an intense gamma-ray flash immediately after lightning. The flash, which lasted less than a millisecond, was quickly followed by a gamma-ray afterglow lasting several dozen milliseconds. About 35 seconds later, the scientists detected a roughly minute-long interval of gamma-ray emission.

The wavelengths of the gamma rays from the milliseconds-long afterglow were as expected from atomic nuclei that captured neutrons. In addition, the gamma rays in the minute-long interval after the afterglow had the exact amounts of energy one would see from annihilated positrons.

If the lightning had directly generated pairs of electrons and positrons, then gamma rays from annihilated positrons would be detected immediately after the lightning, not 35 seconds afterward, Enoto says. Instead, the annihilated positrons the researchers saw likely came from lightning-triggered nuclear reactions.

These findings suggest lightning can generate radioactive isotopes of carbon, nitrogen and oxygen in Earth's atmosphere. "It would be interesting to know what fraction of isotopes in the atmosphere are generated by lightning discharges," Enoto says. — **CHARLES CHOI**

KRISTINA KOKHANOVA/SHUTTERSTOCK

13

A kelp bed near Crook Point on the Oregon coast is rich in nutrients.

Did First Americans Arrive Via a Kelp Highway?

The average person's idea of how — and when — the first people arrived in the Americas needs a serious revision, say researchers: The First Americans arrived significantly earlier and via a different route than most of us learned in school. There's something fishy about the whole thing.

Open most middle school textbooks to the chapter on how our species migrated to the Americas, and you'll likely see an image of people in furs trekking over taiga and tundra, the lost world of Beringia. The land bridge, now submerged, once linked Siberia with North America. For years, the standard story was that hunter-gatherers from Siberia crossed it on foot when the glaciers

retreated enough at the end of the last ice age to open an ice-free corridor.

And people did cover Beringia on foot when such a route opened up. But they probably weren't the First Americans. Think of them as … Second Americans, perhaps.

Thanks to a growing body of archaeological and genetic evidence, researchers publishing in *Science* say it's increasingly likely that the first humans to arrive in the Americas followed a coastal route, making the most of marine resources on a "kelp highway" that spanned the edge of the north Pacific from Asia to North America. And they made this journey well before glaciers retreated to open the traditional Beringia overland route.

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SURF OR TURF?

To be clear, the kelp highway hypothesis is not new. It's a 21st-century tweak of a coastal migration theory that was around — and discounted — for much of the preceding century. In 2007, archaeologist Jon Erlandson and colleagues, including marine ecologists, fleshed out the earlier idea of coastal migration by reconstructing the environment these early travelers would have encountered.

About 16,000 years ago, someone traveling along the northern Pacific Ocean coastline eastward from Siberia would have encountered an essentially unobstructed route at sea level, with plenty of fish, shellfish, kelp, seabirds and other resources — and no dangerous open ocean. The specificity of the hypothesis, together with subsequent archaeological discoveries that defy the Beringia timeline, led more and more researchers to rethink whether they wanted to stay in the overland migration camp.

What's new about the kelp highway hypothesis, according to authors of the recent commentary, is that we've passed a tipping point, and that most of the field now believes the First Americans followed this Pacific Rim buffet all the way from Siberia to the North American coastline and beyond. As these earliest of Americans moved south into Central America, the marine ecosystem would have changed — no more kelp forests, but instead mangrove habitats, which offered different sustaining fare. — **GEMMA TARLACH**

ROY W. LOWE/U.S. FISH AND WILDLIFE SERVICE

14

Motherese Is a Universal Language

Hang around any mom with a young child, and eventually she'll break out her baby voice. You know the one: She gets high-pitched, and her words are simple and exaggerated.

It's sometimes referred to as motherese, but researchers call it infant-directed speech. Whatever you want to call it, it's pretty vital to little ones' development. It "helps babies to segment this huge stream of words into the building blocks of language," says Elise Piazza, a neuroscientist at Princeton University.

Researchers have known that mothers change the more basic aspects of their speech, such as pitch (how high or low a tone sounds) and word choice, when

talking to their infants. But now, Piazza and her team have pinpointed a more subtle change, to something called timbre.

"We use timbre descriptors all the time," Piazza explains. "For instance, the nasality of Gilbert Gottfried's voice or the velvety tone of Pavarotti — we can discriminate these two speakers, even though they might be speaking in the same pitches. We also use timbre descriptors when talking about music. So we might have the reedy woodwinds or the buzzy brass. These have nothing to do with pitch or rhythm; they're timbre descriptors."

To find out if moms adjust this vocal characteristic, Piazza and her colleagues recorded two scenarios: 12 English-speaking women talking to their 7- to 12- month-old children and then talking to another adult. Next, using audio clips from these sessions, they calculated the mathematical profile of each woman's vocal spectrum — essentially, they found the fingerprint of each mom's timbre.

When they compared the timbre fingerprints from when moms were talking to their babies with those from when they were just talking to adults, the team found a distinct difference. That difference is apparent even in non-English speaking mothers, too. After seeing the results from the first group, the researchers tested 12 non-native English speakers in the same scenarios. Except, this time, the moms cooed at their babes in their native tongue. The results were the same.

The findings add to the literature on motherese, and knowing that moms are changing even complex vocal characteristics like timbre could help experts fine-tune things like speech recognition software. "It could tease apart how much speech is really being directed at [babies], consciously targeting their own needs, versus overheard conversation," Piazza says. "And to be able to do that instantaneously across many languages could get into some interesting cross-cultural questions in a variety of environments around the world." — **LACY SCHLEY**

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MONKEY BUSINESS IMAGES/SHUTTERSTOCK

15

Naked Mole Rats Defy Mortality Math

The Romantic Movement of the early 1800s was marked by a morbid fascination with mortality and death. Poets, novelists and other artists tackled the eternal void head on, rather than sweeping such dark topics under the proverbial rug.

With death in vogue, even mathematicians took a stab on the beauty of ceasing to be. In 1825, British autodidact Benjamin Gompertz found the risk of death increases exponentially with age. After age 30, his depressing model shows, the risk of dying on any given day churns upward at a constant clip. When you crunch the numbers, a human's risk of death doubles every eight years along this mortal coil. But one homely critter laughs in the face of Gompertzian math: the naked mole rat.

AGELESS WONDERS

These adorably ugly creatures challenge what we think we know about aging. There's a strong correlation, for example, between the size of an

animal and its expected life span. A tiny hamster can live three years or so on average, while a lumbering elephant can live well past 50. You would expect the naked mole rat, weighing in at just 35 grams, to live six years or so, similar to a rat. But naked mole rats can live to be 30 years old.

Further, female mole rats show no signs of menopause and remain highly fertile even into their final years. Neurogenesis in naked mole rats continues over two decades, and their hearts and bones don't seem to change significantly over time. They rarely get cancer. They can even live up to 18 minutes without oxygen.

When the world is an ashen wasteland, there's a good chance naked mole rats will still be around to keep the cockroaches company.

BELIZAR/SHUTTERSTOCK

IT DOESN'T GET OLD

At Google's San Francisco biotech company Calico, biologist Rochelle Buffenstein has worked with the animals for more than 30 years, hoping to unlock their secrets of aging. She says naked mole rats aren't subject to Gompertzian logic, and she has over 3,000 data points to back her conclusion.

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After a naked mole rat reached adulthood at 6 months old, its mortality risk remained the same for the rest of its days, her analysis revealed. Its risk of death on any given day, no matter the age, hovered around 1 in 10,000. The mortality risk actually fell a little in old age. In this sense, Buffenstein writes, naked mole rats have established themselves as "a non-aging mammal."

"This life-history trend is unprecedented for mammals," Buffenstein and colleagues wrote in a study published in the journal *eLife*.

Still, it's probably too early to proclaim naked mole rats truly ageless. Scientists will need to study a lot more geriatric mole rats to see if the mortality risk does indeed remain fixed across a larger population.

But for now, we say long live the naked mole rat! — **CARL ENGELKING**

A New Titleholder for Earliest Wine?

What are the roots of the earliest wine? To date, the oldest widely accepted evidence for viniculture came from the Zagros Mountains of Iran.

But now research from the Republic of Georgia — a perennial challenger for the title — suggests people in that Southern Caucasus country were sipping the nectar of the gods even earlier.

Wine (I'm following the European Union's definition of wine as the product of grapes) was all the rage throughout much of the ancient world, but despite widespread use and cultural significance, its origin story has always been a little murky.

Archaeological evidence and, more recently, genetic evidence, have zeroed in on the Near East as the most likely region where winemaking began, but the exact spot has long proven elusive.

It's very possible, of course, that more than one person, seeing wild vines, realized that letting juice from the vines' fruit ferment resulted in a delicious, mind-altering beverage. But it's one thing to take advantage of wild grapes, and quite another to domesticate a crop and develop a method for producing a fermented beverage from it.

Grapes, most of which become wine, are today one of the most valuable crops in the world, and there's prestige in being the cradle of viniculture. Nearly every country in the corner of Asia where grapes were first domesticated (Turkey, Iran, Armenia, Azerbaijan and Georgia) has made a bid for the title of first winemaker.

For more than 20 years, the archaeological site of Hajji Firuz Tepe in Iran arguably had the best case for earliest evidence of winemaking. A roughly 7,000-year-old shard from a large vessel had tested positive for tartaric acid, a key residue distinct to the winemaking process, as well as a potential wine preservative derived from tree resin.

The Republic of Georgia, however, had staked its own claim for the earliest wine based on similar residues on pottery shards that were about 8,000 years old, but the evidence was uncertain.

But the Georgians (and a few non-Georgian colleagues) came back with new evidence in the journal *PNAS*.

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WINE IN THE WAY, WAY BACK

New excavations at Shulaveris Gora and Gadachrili Gora, two sites south of the Georgian capital of Tbilisi, yielded more pottery shards, with some pieces as old as 8,000 years.

Chemical analysis showed that several of the shards tested positive for residues associated with winemaking, including tartaric, malic, succinic and citric acids. Not found, however, were any resins, which were commonly used in ancient viniculture. Also not found: pips or any other solids from the grapes themselves, which you should reasonably expect to find from the winemaking process and as contents settled in storage.

Still, the chemical profile of the residues points in one direction, and that direction is wine. — **GEMMA TARLACH**

JANIS PIPARS/ANZENBERGER/REDUX

Eat Less, Age Less?

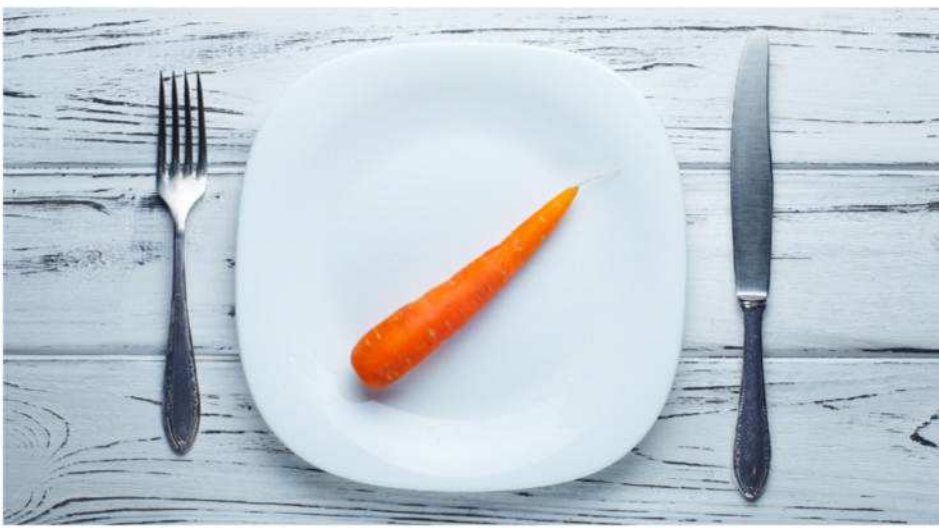
Eating is one of life's great pleasures. But eating too much places people at risk for chronic illnesses and shortens life expectancy. Seven of 10 American adults are overweight or obese, according to the Centers for Disease Control and Prevention.

People generally want to feel healthy and live a long time. But practically speaking, the price may be too high, if it means pushing away that extra plate of food.

Decades of lab animal studies connect health and longevity to dramatic caloric restriction — eating less of everything. Scientists continue to replicate these animal studies in their quest to figure out what causes aging.

One of these scientists is Paolo Sassone-Corsi, director of the Center for Epigenetics and Metabolism at the University of California, Irvine. He's the corresponding author of a paper published in the journal *Cell* that shows how our biological clock affects metabolism.

Corsi and his team say older-lived animals (including humans) are less efficient than younger animals in processing energy — metabolism runs down during life. Apparently, 50 percent of our metabolism is controlled by circadian rhythms, or biological clock, and a host of factors can mess them up. A big one is overeating. Eating too much can "completely reprogram the clock system that normally works



perfectly," Corsi says.

Corsi conducted an experiment in which lab mice underwent a 30 percent reduction in calorie intake. "They lost weight, they were healthy, and they lived longer," Corsi says. "That is the amazing thing."

A low-calorie diet appears to reset circadian rhythms, from which comes health and longevity. But at this point, Corsi doesn't recommend a 30 percent reduction in calories for fit humans, and it likely wouldn't improve their health. Studies have shown benefits with a 10 percent reduction in calorie intake, he says. And it could be that exercise is just as beneficial, though Corsi says moderate eating and regular exercise are the ideal.

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THE "NOISE" OF AGING

Another scientist studying the under-the-hood causes of aging is Jean-Pierre Issa, director of the Fels Institute for Cancer Research and Molecular Biology at Temple University in Philadelphia. He and colleagues published a paper in *Nature Communications* that suggested epigenetic drift is a factor in aging.

Epigenetics is the science of how cells control cellular identity. Humans have a single genome, but hundreds of cell and tissue types. "There must be an added layer of information that says you are a liver cell or a blood cell," Issa says. "That added layer of information is what we call epigenetics."

When body cells aren't working as well as they used to, chronic illnesses and other signs of aging develop. "The overall pattern is that of progressive noise compared to the young," Issa says, "and this is what we call [epigenetic] drift. People who have more drift tend to have more diseases and more cancers and die younger than people of the same age with less drift."

But Issa found something that quiets the noise: calorie restriction. In one experiment, a group of mice was fed 40 percent fewer calories from when they were months old until they were about 3 years old, the typical life span of mice. Compared with the control mice, those on a diet were healthier and lived longer.

For humans, exercise might offer better health results than severe calorie restriction, Issa says. "Someone who is slightly overweight but exercises every day is probably healthier than someone who is lean but never exercises." — **MARK BARNA**

OLEKSII MISHCHENKO/SHUTTERSTOCK

Ingestible sensors could monitor what's going on inside you.

Fart-Sniffing Pill Reveals Secrets of the Gut

Your nose, mouth, skin pores and … other body holes serve unique functions. But most of them double as biological exhaust pipes, spewing gaseous byproducts of the myriad internal chemical reactions keeping you alive.

And just as we measure emissions from our internal-combustion vehicles, advances in medical technology allow doctors to analyze the gases you leak into the atmosphere.

Scientists at RMIT University in Australia developed a pill-sized sensor that measures hydrogen, carbon dioxide and oxygen gases circulating in the gut, and in real time. Temperature and gas sensors, batteries, antennas and a wireless

transmitter are all sealed within a gas-impermeable shell. One end of the device — you might call it the nose — features a small, gas-permeable membrane, which allows the sensor to get a whiff of its surroundings. Every five minutes, the device beams back data about gas concentrations to another device.

"Just as body temperature is an indicator of general health, the concentration of gases produced by the microbiome is an indicator of gut health," wrote Benjamin Terry, a University of Nebraska engineering professor, in a *Nature* commentary about the study. "More valuable still is an understanding of the gas concentration profile along the entire length of the gut."

When researchers tested their device in humans, the gas sensor could detect the moment food started fermenting in the gut. They also used ultrasound to track the device location as it meandered through the digestive tract, to pair gas readings with a particular gut locale. The researchers published their work in the journal *Nature Electronics*.

The device gives doctors and researchers an easier way to measure the activities of the gut microbiome, the vast community of organisms that thrive inside you. Current measurement techniques are a bit unwieldy, according to Terry. Getting a sample of gut gas can require analyzing flatus (farts), insertion of tubes, breath tests and whole-body calorimetry.

The device gives doctors and researchers an easier way to measure the activities of the gut microbiome, the vast community of organisms that thrive inside you.

"The gut microbiome … may play a role in the development of a startling number of diseases, including inflammatory bowel disease, obesity, cardiovascular disease, circulatory disease and even autism," Terry wrote.

Already, the study's lead author, Kourosh Kalantar-Zadeh, says the device showed the stomach releases a slew of oxidizing chemicals that destroy foreign compounds lingering in the stomach for too long. It might be the first observation of a gastric protection system against bodily invaders.

No doubt there's a market for such technology in the doctor's office and research labs. But you know some intrepid programmer could (should?) design an app that monitors concentrations of noxious fumes and sends your smartphone a real-time fart forecast when levels spike. That way you could, perhaps, provide fair warning to yourself, your friends and your family.

I love the smell of science in the morning! — **CARL ENGELKING**

RMIT UNIVERSITY/PETER CLARKE

19

NASA's Curiosity rover has found Mars to be an unforgiving place.

Mars Is More Toxic to Life Than We Think

Is there life on Mars? Depending on when you last checked in with the Red Planet, you could probably be convinced either way. As we discover more and more about the planet's composition and planetary dynamics, we've had cause for elation and disappointment.

The pendulum swung back toward the "no" side recently, with the release of a study examining how a special kind of salt on Mars interacts with ultraviolet radiation there. Martian soil is laced with perchlorates, which are composed of one chlorine and four oxygen atoms and bind to a number of different elements to form various compounds. It's classified as a salt, and it was initially cause for celebration among extraterrestrial hopefuls because it drastically lowers the freezing point of water, meaning liquid water might exist on the Martian surface. It can also be used to produce rocket fuel and oxygen, another plus for future settlers.

THE SALT OF THE MARS

It turns out these perchlorates are highly toxic to life when bathed in the UV radiation that pummels Mars. Researchers from the United Kingdom Centre for Astrobiology at the University of Edinburgh exposed a strain of bacteria commonly found on spacecraft to levels of perchlorates and UV light found on the Red Planet. They found that nearly all the bacteria died within a minute. They tried this with several different kinds of perchlorate and found similar results every time. Incorporating other environmental factors found on Mars — such as low temperatures, additional minerals and a lack of oxygen — failed to keep the bacteria alive.

This surprised the researchers because the strain of bacteria used, *Bacillus subtilis*, belongs to a genus that does fine in the presence of perchlorates, as studies of the microbes in terrestrial environments have confirmed. These findings were initially good news for researchers looking for extraterrestrial life, as they suggested some forms of life could survive in Martian analog conditions. But adding the UV light kills the bacteria in short order.

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The researchers think the UV light breaks apart the perchlorate molecules into more reactive ions that wreak havoc on living cells. Backing this up: Low temperatures, which slow down chemical reactions, extended the life span of the bacteria in the perchlorates, though they still died. If they can't survive there, it significantly lowers our chances of finding life as we know it on Mars. The researchers published their findings in *Nature Scientific Reports*.

While it's a blow to the possibility of finding life on Mars, there is at least one upside to the news: NASA regularly worries about the possibility of contaminating other planets with earthly bacteria, even going so far as to crash probes into Saturn so they don't hit the planet's moons. If Mars is so hostile to bacteria that they can't even make it a minute on the surface, our fears of contamination could be pretty much resolved.

— NATHANIEL SCHARPING

NASA/JPL-CALTECH/MSSS

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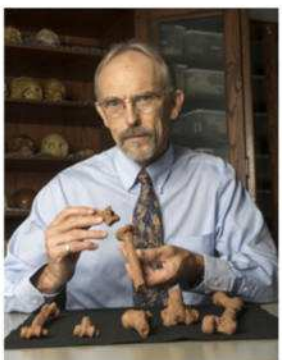
Lucy's Demise: What Killed the Most Famous Fossil?

She's the most famous of our distant ancestral kin, and while it's too late to send flowers, we now know how Lucy died some 3.18 million years ago. The best-known *Australopithecus afarensis* appears to have died of injuries sustained in a fall, according to recent research. But it's not quite case closed: The proposed scenario that led to her death is fanning the flames of an old debate about how the early members of our family tree lived.

When her remains were unearthed in Ethiopia's Afar region in 1974, Lucy kicked off a new era in the understanding of human evolution. At the time, she was the oldest hominin fossil ever found. And instead of the odd jawbone, tooth or partial skull typically found by paleoanthropologists, much of Lucy's skeleton was recovered — enough to see she had traits handy for tree-climbing as well as for walking upright. More than 40 years later, paleoanthropologists still argue over whether she and other members of *A. afarensis* spent most of their time above ground or on it, walking fully upright.



Anthropologist John Kappelman and his team think Lucy fell from a tree.

The findings, published in *Nature*, don't settle the debate. But they do add an intriguing new piece of evidence to the discussion. According to the researchers, the most plausible explanation for the severe injuries Lucy suffered shortly before death is that she fell out of a tree.

A team led by anthropologist John Kappelman of the University of Texas at Austin determined through computed tomographic scans that several of Lucy's bones had been fractured shortly before death. What's more, by comparing the fractures with those seen in hospital ERs, the team was able to reconstruct Lucy's last moments.

Kappelman and company believe she fell from a height of about 40 feet, and researchers know enough about the environment in the immediate vicinity of where she lived to say she must have fallen out of a tree. — **GEMMA TARLACH**

TOP: GARCÍA JUAN/DREAMSTIME. BOTTOM: MARSHA MILLER/UT AUSTIN

Cloudy With a Chance of Viruses

Like a lot of other people, I love rain. What can be nicer than a cool, refreshing burst of liquid precipitation — a sound so soothing, people actually pay to hear it during dry spells? It's good for dirty walkways, good for the plants, good for skydiving viruses … wait, what?

Yes, it turns out that the rains are particularly rife with falling viruses. A study in *The ISME Journal: Multidisciplinary Journal of Microbial Ecology* is a census of the viral invaders falling upon us at all times. It's not pretty.

GONE WITH THE WIND

Specifically, the scientists wrote, "the downward flux of viruses ranged from 0.26×10^9 to $>7\times10^9 m^{-2}$ per day," meaning you'd see more than 7 billion of them per square meter per day in some areas. They apparently hitch a ride from tiny bits of dirt and sea foam swept into the winds, then weather patterns allow the viruses to float around in the atmosphere before eventually coming back down.

Scientists already knew that bacteria can travel this way, but the new research showed viruses are nine to 461 times more numerous. Rain and dust storms are good ways to bring both types of organisms back down to Earth, though viruses were less affected by the rain than bacteria.

LONG DISTANCE TRAVEL

Getting a read on the number of viruses falling from the sky helps answer a decades-old question among virologists. Apparently, they'd been spotting viruses with remarkably similar genetic makeups in different environments all over the world, and they weren't sure how that could be. Perhaps it's just as simple as a virus getting swept up into the atmosphere in one continent and drifting down onto another — along with billions of its closest friends.

The new findings don't really change anything other than our understanding of things. But I, for one, will never look at a rainstorm the same way again.

— BILL ANDREWS

JOHN FOWLER/UNSPLASH

Fireworms Eat Sea Urchins From the Inside Out

Sea urchins living in the Mediterranean have a new enemy: the bearded fireworm. This toothless but determined predator has found a way to devour sea urchins, despite their spines and stony shells. And the worms' appetite for urchins might remake entire ocean ecosystems.

The bearded fireworm, *Hermodice carunculata*, grows up to a foot long and is fuzzy, in the "do not touch" way. It lives in tropical coastal waters along both sides of the Atlantic Ocean, but in recent years it's become more common in the Mediterranean, especially along the coast of Italy. The reason is still unclear, says Roberto Simonini of Università degli Studi di Modena e Reggio Emilia in Italy.

When Simonini and other researchers collected fireworms from the water and brought them back to the lab, the worms regurgitated "huge numbers of spines," says co-author Sara Righi. Other evidence persuaded the researchers to investigate whether the newcomer worms were, somehow, eating sea urchins.

Sea urchins wear impressive armor to protect themselves as they crawl along the seafloor, grazing on plants. They have a hard shell, called a test, and a full-body coat of dense spines on top of that. The animals that prey on sea urchins often have strong claws or teeth that can break through the armor.

So the scientists didn't expect fireworms to pose a threat to urchins. "They have no arms, nails or jaws to manipulate and break open the hard shell," Simonini says. But when the researchers put both animals in a tank together, they learned the truth.

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Five times, the scientists put three *Paracentrotus lividus* sea urchins into a tank with 25 hungry bearded fireworms. When a worm bumped against an urchin, it sprang into action. The other worms soon followed, swarming their spiny victim.

Some worms latched onto the sea urchin's body, turning their throats inside out and gobbling up spines. Other worms worked on flipping the sea urchin over. Once they'd pried the urchin off the floor of the tank, its mouth was exposed. Bad news.

The sea urchin's chewing apparatus is a complex organ called Aristotle's lantern. The scientists watched a worm latch onto this structure and suck it off the urchin's body. The worm then crawled into the hole it made and ate the sea urchin from the inside.

Even if you're Team Fireworm, this is concerning. Sea urchins are important engineers of ocean ecosystems. Righi explains that *P. lividus* feeds on algae that would otherwise grow into tall seaweed forests. When lots of *P. lividus* sea urchins graze in an area, it becomes barren and rocky, allowing different types of algae to grow. The movement of bearded fireworms into the Italian coasts could reduce sea urchin populations and upset the balance between ecosystem types.

Although scientists don't know what's increasing bearded fireworm numbers in the Mediterranean, warming oceans could help extend the worms' range, Righi says. So sea urchins should watch their backs — and their mouths. — **ELIZABETH PRESTON**

R. SIMONINI ET AL./ECOLOGY, OCTOBER 2017

Feel Like You're Being Watched?

You've felt it at one time or another. You're standing on a crowded train platform, or in the park, and suddenly, your alertness spikes: You're being watched.

The hair on the back of your neck stands up. From some unconscious part of your brain, an alarm sounds: "Look over there!" Often, you turn and find your mind was playing tricks on you. But sometimes you turn and meet the eyes of a stranger whose gaze you've sensed without consciously seeing it.

The idea that we can feel another's person's gaze has captured the attention of fringe researchers and parapsychologists for decades, but are we anywhere closer to explaining the roots of this unnerving feeling? Does it really exist?

HIDDEN GAZES

For centuries, people have reported that they could sense when the "evil eye" was on them. Around the world, many cultures created talismans to protect against this evil gaze.

For "proof" of this supernatural evil eye, one simply had to pair that funny feeling with looking up and noting someone really *was* watching from across the room. In fact, the evil eye belief was neatly ported over from traditional folklore to the pseudo-science of parapsychology in the 19th century. It was believed a person could "psychically" affect people by staring at them, and that theory carried on well into the 20th century.

As recently as 1995, British biologist and parapsychologist Rupert Sheldrake performed a series of studies that he claimed demonstrated people could "feel" they were being watched. He sent ripples of incredulity through the scientific community

with this theory of "morphic resonance" — the idea that there are telepathic interconnections between organisms that stem from their collective memory.

Other researchers got decidedly different results. In one creepy experiment, psychologist and skeptic Robert Baker "took up a physical position no closer than 5 feet and no farther away than 20 feet behind 40 individuals" and for between five and 15 minutes, he stared at the back of their heads. Thirty-five out of the 40 subjects reported no sense of being watched at all.

Baker followed up with a more formal experiment, in which volunteers sat in soundproof rooms separated by a one-way mirror. One volunteer stared at the other during certain intervals, while the volunteer on the other side of the mirror noted each time they felt they were being stared at. Not a single subject could guess better than two out of the 50 times they'd been stared at.

Clearly, the feeling of being watched depended on cues that couldn't pass through opaque walls. So what sorts of cues might those be?

UNCONSCIOUS VISION

Social psychologist Ilan Shrira has spent much of his career studying the neurological mechanisms behind the feeling of being watched. He's gathered a large body of data to support the existence of a "gaze detection" system, which we share with many other social animals.

Even if sound can alert us to someone's presence, there's no evidence that auditory cues could tell us whether that person was looking at us. The only conclusive demonstrations of an accurate sense of being watched come from experiments in which the subjects had visual cues to go on.

That doesn't mean, though, that the person who feels watched has to be aware of such cues. They often originate in our peripheral vision.

"We get the initial feeling that someone in our peripheral vision is staring at us by their head and body positions," Shrira explains. At that point, our instinctual alarm bells may go off.

The evolutionary reasons for such a system are clear. Eye contact is important for detecting predators and subtle social signals. The auditory system actually has an equivalent, known as the "cocktail party effect," in which people can easily pick out their own name (or another important word) among the clamor of voices at a party.

In short, the truly spooky thing about the feeling of being watched is that it likely takes place below the level of conscious awareness — as does much of our brain activity.

Still, the feeling of being watched is difficult to test in the lab, so there's no firm explanation for this phenomenon. But when you get that unsettling feeling late at night, all alone in your home, are you going to trust science, or the hair on the back of your neck? — **BEN THOMAS**

ROMMEL CANLAS/SHUTTERSTOCK

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With Just $1,000, Anyone Can Track Your Every Move

By now, most of us are probably used to the idea that large corporations track our preferences and activities every time we go online. It's the price we pay for the custom, convenient experiences we seek on the internet. But tracking your activity online isn't exclusive to the Facebooks and Googles out there. For a modest sum, anyone can use similar tracking tools to essentially spy on another person's activities.

To illustrate the ease of web-based voyeurism, researchers from the University of Washington bought online ads from a common network and used them to track a person's location and behavior, all for the price of about $1,000. So far,

there are no reported instances of this method being applied to nefarious ends in the real world, but it reveals vulnerabilities in the ways technology companies gather, disseminate and monetize personal information.

DSP CONNECTION

The researchers exploited the way ads are shown to us whenever we open an app or visit a website on our phones. Platforms known as demand-side providers (DSPs) buy up ad space on apps and sites and place their clients' promotions there. Most DSPs offer fairly sophisticated targeting options, such as by gender, language, age, interests, location, type of app and more. This allows a potential attacker to target ads at very specific groups of people, such as those who use different kinds of religious apps or dating sites, for example. They could also target a specific app or location.

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To connect their ads to specific people, the researchers relied on the mobile advertising ID (MAID) assigned to every smartphone. It's a code that allows advertisers to track how frequently they serve content to a specific user, and also a convenient means of identifying them. It's quite easy for potential attackers to get a target's MAID, and the researchers detail several ways to do so, from eavesdropping on unsecured WiFi connections to intercepting cellular traffic to simply buying it online. Through the ad service, a MAID and a little snooping, the researchers could connect the dots to an actual person.

For their experiment, the researchers bought ad space through one of these networks and input ads from their university. The tracking tools allowed them to monitor every time their ad got served, as well as where and to whom. And the bits of data were enough to give them potentially damaging information about users.

Setting up an ad-buying profile is both easy and cheap, they say, which means anyone could do it. They presented their work at the Association for Computing Machinery's Workshop on Privacy in the Electronic Society.

HIGYOU/SHUTTERSTOCK

WHAT, WHERE AND WHEN

With this information, researchers could map out the route a study participant took to work. To track physical movement, they simply created a grid of ads tied to a specific location. When the app was opened during the target's morning commute, an ad would get served, and the researchers were notified. Seeing when and where the ads popped up let them piece together the route their subject took.

It wasn't perfect. It took a few minutes for an ad to be served, and the target needed to have the app open for it to work. But stopping for a coffee, waiting at the bus stop or having a brief conversation while also using an app turned out to be enough for the researchers to pin down a person's location.

Advertising DSPs also reveal which app they serve ads on. While using the Facebook app isn't very incriminating, using the gay dating app Grindr, or a Quran app, could be dangerous in certain parts of the world. Targeting ads to certain apps, as most DSPs allow for, could also help attackers ferret out information.

Another way to confuse would-be attackers is to change the MAID on your phone. This is relatively easy to do, and it makes it harder to tie a specific MAID to you.

KEEPING SAFE

Again, there's no evidence that anyone has tried to exploit this vulnerability for nefarious purposes, but you can do a few things to protect yourself regardless. One of the most basic steps is simply to limit your phone use. If you don't open apps that serve ads, you can't be tracked by them. You could also disable location services on your phone, although that means you can't use some apps that rely on it, like Google Maps.

Another way to confuse would-be attackers is to change the MAID on your phone. This is relatively easy to do, and it makes it harder to tie a specific MAID to you. Always using secure WiFi connections and being careful about the information you send over the internet are good rules of thumb as well.

The researchers say their work should be a warning about the potential for abuse that DSP services offer. In the future, watching out for hyperspecific or suspicious-looking ad buys could be a way to find individuals attempting to use them for tracking and targeting, they say. Machine-learning algorithms, somewhat ironically, could also provide a layer of security. — NATHANIEL SCHARPING

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The Sexiest Math

When the news release accompanying a study brings up lap dances and twerking, attention must be paid.

Incredibly, the paper in question, which appeared in *Evolutionary Psychological Science*, actually lived up to the hype — and it's all in the service of mathematically determining just how sexy an arched back is. Hey, who are we to determine which scientific questions are worth asking?

SEX POSTURING

Let's back up a moment. Biologists have long known that many mammals, from ferrets to primates, curve their spines a certain way when they are ready to procreate. That curve, the lordotic posture, also occurs in human women, when their hips pop out a little more and the lower spine curves toward the belly.

Perhaps, wondered study leader Farid Pazhoohi of the University of Minho in Portugal, when women took on the posture, it was a signal that they, too, might be up for some action?

To test this, Pazhoohi's team gathered 82 undergraduate men and women and showed them the upper bodies of six computer-generated women with differing back postures, and each in three viewing angles (front, side, behind). Amusingly, they used a simple sine wave, $y = a*\sin(x)$, to model the back curves on their CG models, keeping the a variable within actually possible body shapes.

Each of the 82 participants (all heterosexuals, the study points out) rated which models were most attractive, using the 1-10 scale, natch. The researchers also tracked subjects' eye movement, which, the paper notes, is "considered a robust method to study human physical attractiveness."

HOT OR NOT?

And what were the results? Pretty much what you'd expect. Curvier backsides did indeed get higher marks. The front side view got the lowest relative scores. Men overall rated everything more highly. The eyeball tracking backed this up mostly, with all participants generally staring longer at the models' backsides, though men seemed to linger on the hips while women focused on the waist.

So yes, basically, everyone apparently finds arched backs more attractive. Pazhoohi and colleagues argue that this is consistent with their hypothesis that a nice curvy back is an indication that a human female is ready for procreation, though they stop short of stating it outright. It looks like the arched backs aren't the only ones ready for a stretch here. — **BILL ANDREWS**

CARLOS CARDETAS/ALAMY STOCK PHOTO

If You Stuck Your Head in a Particle Accelerator …

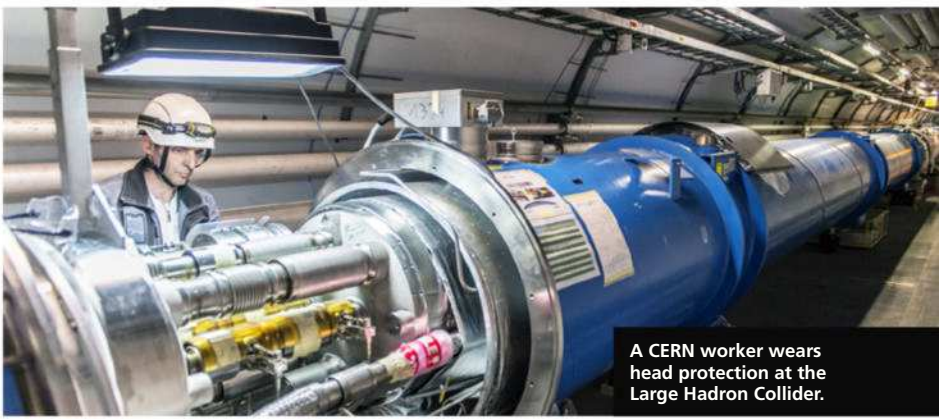
What happens when you stick your head inside a particle accelerator and get hit with a beam of trillions of protons? If you're Anatoli Bugorski, you go on to finish your Ph.D.

Bugorski is the only person known to have been exposed to a particle accelerator beam, the result of an accident that occurred while he was working at the Institute for High Energy Physics in Russia. On July 13, 1978, he leaned into the path of the U-70 synchrotron while it was still on, and a burst of high-energy protons traveled through the back of his head and exited near his nose. He felt no pain but experienced a flash of light "brighter than a thousand suns."

PARTICLE BEAM RAY GUN

The amount of radiation the beam delivered was staggering — 2,000 gray (defined as 1 joule of radiation energy per kilogram of matter) on the way in and, as a result of collisions with particles as it passed through, 3,000 gray by the time it left. A dose of around 5 gray can be lethal to humans.

Bugorski was taken to the hospital and placed under observation. Doctors thought he would surely die, but the case presented a unique opportunity to



A CERN worker wears head protection at the Large Hadron Collider.

study the effects of radiation.

The accelerator Bugorski stuck his head in, and others like it, takes beams of particles and smashes them together at nearly the speed of light. Scientists then observe what happens when tiny particles break apart. The beams are thin, no wider than a pencil, and they are composed of particles so small, it's hard to even fathom. But protons are still very much physical objects, and when you force trillions of them through something as delicate and complex as a human cell, the collisions tend to tear biological structures apart.

It turned out that Bugorski was OK, relatively speaking. The left side of his face ballooned to comical proportions, and his skin blistered and peeled off where the beam had struck, but those symptoms were only temporary. He lost hearing in his left ear, replaced by a form of tinnitus, and the left side of his face gradually became completely paralyzed. In the long term, Bugorski suffered for a time from petit mal and grand mal seizures, and he became mentally fatigued more easily. Nevertheless, he went on to earn his doctorate, and even returned to work at the same facility where his accident occurred.

WAS IT LUCK?

Radiation harms our bodies by breaking apart chemical bonds that hold DNA and other cellular components together. With enough radiation, cells are unable to duplicate and begin to die, leading to organ failure. Common symptoms are nausea, vomiting, dizziness and headaches. Radiation will often cause levels of red and white blood cells to drop precipitously. The skin will usually redden and sometimes blister at the site of the exposure as well.

While Bugorski's blistered and peeled skin is what we would expect from radiation poisoning, what prevented him from experiencing much more damage remains unknown. The beam being narrowly focused likely helped, however. Most radiation exposure affects the whole body, meaning whole organ systems are affected. In Bugorski's case, only his brain received exposure to the radiation, limiting the damage to that area. He may have just been lucky, and the beam missed important areas of his brain, or perhaps proton beams affect the body differently than other sorts of radiation.

Today, proton beams are actually used for therapeutic purposes. Particle accelerators can deliver targeted doses of radiation to cancer patients, a process known as proton beam therapy. Protons are heavier than other particles and can be directed with more precision, targeting tumors to destroy the cells that make them up. Those doses are around 300 times smaller than the one Bugorski sustained, though, and the side effects even for proton beam therapy can be severe.

If this were a comic book, Bugorski would certainly be endowed with fearsome powers in the aftermath of his accident. As it is, he's probably just happy to be alive. — **NATHANIEL SCHARPING**

ANNA PANTELIA/CERN

This Is Not the Yeti You're Looking For

Researchers have taken another crack at hair, bone and other samples allegedly from the yeti of the Himalayas. The analysis was the most sophisticated to date, but — spoiler alert — the results won't thrill cryptozoology fans. The study did reveal, however, an evolutionary plot twist of scientific significance.

The wild man of the snows, the glacier spirit, the abominable snowman … the yeti. A mysterious creature purported to dwell in the mountains of Tibet, Nepal and Bhutan, it has captured human imagination for centuries. Long before Western explorers claimed to have spotted its tracks through deep snow, local residents have revered and sometimes feared the mythic beast.

And occasionally, locals and foreign interlopers alike have collected what they believed to be physical proof of the yeti's existence: a few hairs, a partial bone, a scrap of scalp, even feces.

With the advent of DNA analysis, researchers began testing these alleged yeti bits with mixed results. In 2014, for example, scientists found that samples allegedly from "anomalous primates," aka yetis, were genetically most similar to ancient DNA retrieved from the remains of a 40,000-year-old polar bear. The conclusion stirred up a bit of excitement, leading to the suggestion that the yeti was some sort of archaic bear hybrid or previously unidentified species.

Later that same year, a second team analyzing some of the same material reported it was closest genetically to the Himalayan brown bear (*Ursus arctos isabellinus*), an animal native to the areas in which the samples were collected. In other words, the simplest explanation — it's just a bear — is usually the most likely.

EVIDENCE BROUGHT TO BEAR

But you know how we humans are. We want to believe. So interest in the yeti has persisted both in pop culture and among researchers.

Published in *Proceedings of the Royal Society B: Biological Sciences*, a recent study looked at 24 samples, half collected during a Himalayan brown bear study in Pakistan, three from other bears and nine allegedly from yeti. (Although one of the yeti samples turned out to be from a dog. Woof.)

The team performed a more sophisticated analysis on the bear and "yeti" samples than previous studies did, obtaining complete mitogenomes (from maternally inherited mitochondrial DNA) rather than short sequences.

The results: The "yeti" samples that weren't from a dog were all from bears, specifically Asian black bears, Himalayan brown bears and Tibetan brown bears. No sign of an anomalous primate here, folks.

The wild man of the snows, the glacier spirit, the abominable snowman … the yeti.

EVOLUTIONARY PLOT TWIST

While the results will likely disappoint anyone hoping for proof of a wild man-ape-bear creature roaming the mountainous region, the study does reveal a surprise about the Himalayan brown bear and bear evolution in general, which has been a tricky thing to map out due to hybridization in the wild and a general scarcity of data.

The mitogenomes generated in the study show that the Himalayan brown bear branched off on its own from the rest of the bear family tree much earlier than thought, about 650,000 years ago.

Although the Himalayan brown bear's territory is geographically close to that of the Tibetan brown bear, the two brown bear subspecies are not close genetically. The Tibetan brown bear is actually closer kin to Eurasian and American brown bears.

According to the new research, Himalayan brown bears are a relic population that was likely isolated during a period of glaciation. Cut off from other bear populations, the animals went their own way genetically. Other brown bear populations moved into the Himalayas thousands of years later, but the difficult terrain kept the Himalayan subspecies isolated.

The discovery has important implications for conservation of the Himalayan relic subspecies, which is critically endangered.

It's worth noting, in the interest of full disclosure, that both the controversial 2014 study and this research received funding (and some of the samples) from Icon Film Co., an outfit that has stoked public interest in the yeti with a couple of programs on the topic. — **GEMMA TARLACH**

SPENCER SUTTON/SCIENCE SOURCE

Caterpillars Recruit Friends With Anal Scraping

Newly hatched caterpillars look helpless. They're teensy, soft and juicy, with no parent around for protection. But masked birch caterpillars, at least, are more capable than they seem: They gather in groups to stay safe. And to form those groups, they use a previously undiscovered language of buzzes, vibrations, head banging and butt scraping.

The species, *Drepana arcuata*, passes through five caterpillar life stages, called instars, on its way to becoming a little beige moth with hooked wingtips. As a caterpillar it resides, and munches, on the leaves of birch and alder trees across North America. The older caterpillars live alone. When they encounter each other, they may fight over shelters they've built from silk; during these disputes, they signal to each other by vibrating.

Younger masked birch caterpillars, on the other hand, are friendly. They live in groups during their first and second instars. This is probably so they can work together to build silk shelters, says Jayne Yack, a biology professor at Carleton University in Ottawa, Ontario.

Scientists have also observed young caterpillars making vibration signals. But unlike the older caterpillars, they send out these signals when they're all alone. "It was puzzling to us why early instars signaled at all," Yack says, "and what they were talking about."

Yack, along with graduate student Chanchal Yadav and others, gathered newly hatched caterpillars to learn more. They kept the tiny insects — just 1 to 2 millimeters long — on fresh birch cuttings in glass jars, and conducted a series of experiments on them, gently moving the caterpillars from place to place with a paintbrush.

First, they put one caterpillar onto each of five or six leaves on a birch twig. Over 30 trials, they saw that the insects began to find each other within half an hour. Within five hours, they'd assembled in groups of two to six caterpillars. In another experiment, the researchers cut birch leaves into "Y" shapes. They placed three caterpillars on one arm of the Y, and a solitary caterpillar at the base. Nearly every time, the lone caterpillar walked onto the arm of the leaf where the other caterpillars were.

Clearly the young insects were seeking each other out. To observe the signals they might be using, the researchers made video recordings of the caterpillars. They also measured vibrations using a technique called laser Doppler vibrometry: They stuck a little circle of reflective tape to a leaf that caterpillars were on, shone a laser at the disk, and measured shifts in the frequency of the light bouncing back to detect very small vibrations in the leaf.

The caterpillars used four different tricks to vibrate leaves. Most commonly, they rubbed the leaf's surface with stiff bristles on their back ends, a technique called anal scraping. Sometimes they vibrated their whole bodies while they were anal scraping. At other times, they drummed or scraped their mandibles against the leaf. They made these signals while they were resting, walking, eating or working on building shelters out of silk.

Solitary caterpillars always made vibration signals before being approached by another caterpillar. The approaching caterpillars didn't make as many signals. And the more often a caterpillar signaled, the sooner it was joined by others.

It would be hard for these insects to find each other by sight, the researchers say, given their simple eyes and the long distances — up to 420 times their body lengths — they travel to reach each other. Some caterpillars communicate by leaving chemical trails, but that doesn't seem to be the case here, either.

When the researchers repeated the Y experiment by letting caterpillars crawl all over one arm of the Y and then removing them, the lone caterpillar didn't show any preference for that side of the leaf. So smell probably isn't the secret to forming caterpillar clubs.

Instead, the researchers think caterpillars use vibrations to call out to one another. They may be announcing that there's food and shelter where they are. No one has seen this kind of signaling in caterpillars before. "Discovering that these tiny guys are communicating, and with such complex vibration patterns, was really intriguing," Yack says. — **ELIZABETH PRESTON**

JAYNE YACK

Is It Love at First Sight? Nah

Cynics rejoice: The oft-reported phenomenon of love at first sight is more akin to lust at first sight.

Psychologist Florian Zsok and his European colleagues published a study that found even though people generally do believe they're experiencing love at first sight (LAFS), the event has more to do with physical attraction than actual feelings of love.

Zsok and his team set up various experiments to answer some questions: Is LAFS actually happening in the moment, or is it something people remember only after they've fallen for someone? How does physical attraction affect LAFS? Does LAFS differ from love reported in romantic relationships?

Psychologist Florian Zsok and his European colleagues published a study that found even though people generally do believe they're experiencing love at first sight (LAFS), the event has more to do with physical attraction than actual feelings of love.

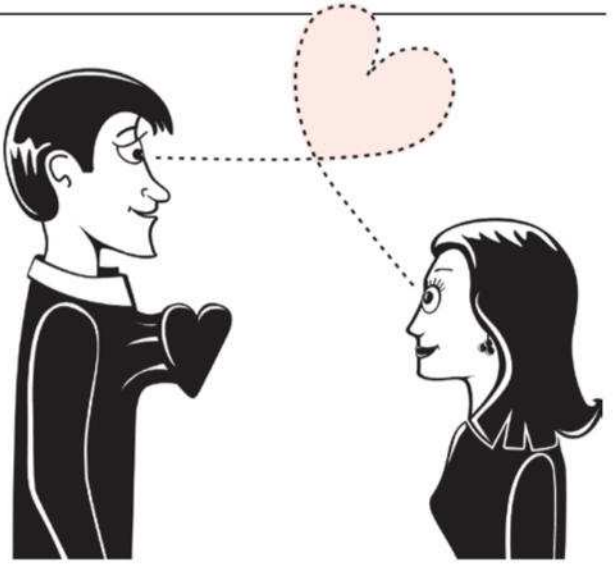
To get answers, the group recruited nearly 400 adults: mostly women, mostly heterosexual and mostly Dutch or German students. One group of volunteers filled out a survey about themselves and how they felt about their current partner, if they had one. Then, those same participants were shown, based on sexual preference, images of strangers and asked to imagine meeting them at a speed-dating event. Afterward, they filled out another questionnaire, but with the people from the images in mind.

This time, participants rated how much they agreed with statements like, "I feel that this person and I were meant for each other," and "I am experiencing love at first sight with this person." It also asked them to rate the attractiveness of each potential partner on a scale of 1 (not at all) to 5 (very much).

The rest of the volunteers, all of whom reported being single, went to face-to-face soirées where they first met each other either in small groups or as part

of a speed-dating event. Again, the participants filled out the questionnaire that probed how they felt about their potential partners.

Ultimately, out of the nearly 500 meetings Zsok and his team studied, 49 of those resulted in someone reporting LAFS, supporting the idea the phenomenon isn't just something people conveniently remember once they're in a relationship. Sadly, in this study, there were no reports of reciprocal LAFS. (Womp, womp.)



There was a common theme, though: People who reported LAFS often rated their date as more physically attractive than the rest of the volunteers. They also tended to score lower on questions measuring love than did people who reported being in a relationship, suggesting there is a difference between the two.

And, interestingly, people in relationships who claimed they'd experienced LAFS with their current partners were more likely to report feelings of passion (I wish I knew how to quit you!) than those who said they didn't experience LAFS with their partners.

In all, this study might burst a lot of people's bubbles. But, as they say, nothing in science is ever proven. So maybe there's still hope out there for the hopeless romantics.

— LACY SCHLEY

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ALEKSANDAR KARANOV/SHUTTERSTOCK

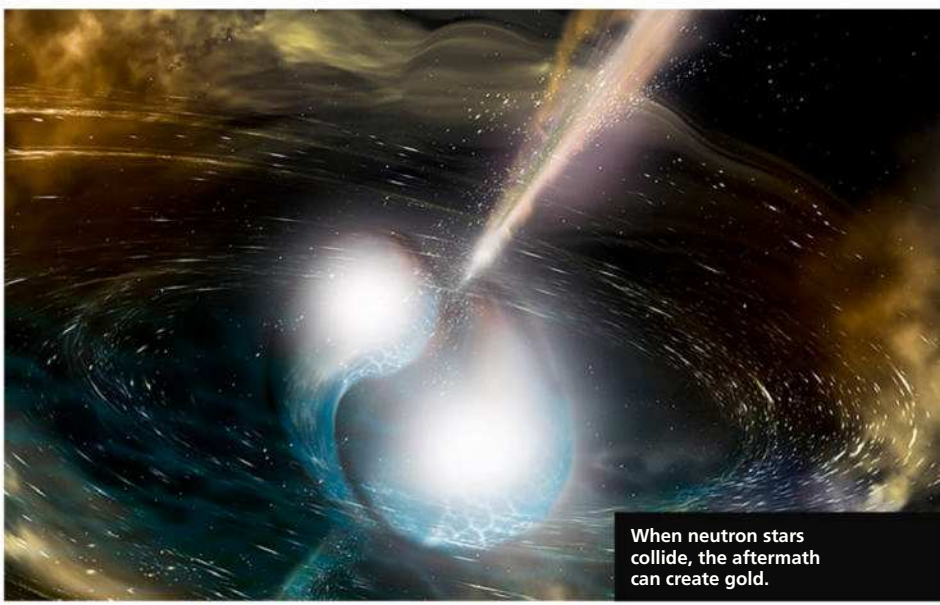
Astronomers Tally All the Gold in Our Galaxy

Before "he went to Jared," two neutron stars collided.

That's what scientists learned from studying the debris fallout after a cosmic stellar explosion called a kilonova — 1,000 times brighter than a standard nova —appeared in earthly skies in August 2017.

For decades, astronomers debated the origins of the heaviest elements, which include precious metals, rare-earth elements and basically everything on the bottom rungs of the periodic table, from platinum to plutonium.

"It's a very violent process," says Columbia University astronomer Brian Metzger, whose team predicted neutron star mergers would create a kilonova. "The two neutron stars are moving almost at the speed of light around each other, and then they slam into each other."



When neutron stars collide, the aftermath can create gold.

WHICH STAR STUFF?

You and I are made from pretty typical stardust — stuff that forms when large stars explode as supernovas. But supernovas make few heavy elements, probably not enough to explain their quantities. So science didn't know for sure how that gold in your wedding ring came to be.

Indirect evidence pointed to crashes between binary neutron stars — the dense cores of dead suns. But they don't happen very often in any particular galaxy, and no one had ever seen such an event before.

"The question was always which one of these wins?" says University of Wisconsin-Milwaukee astronomer David Kaplan, whose team studied the kilonova. "Is it the really common thing that makes a little? Or was it the rare thing that makes a lot?"

The chance to find out finally arrived.

CHEMICAL FINGERPRINTS

On that fateful night, a ripple in space-time — a gravitational wave — stretched and squeezed detectors at the Laser Interferometer Gravitational-wave Observatory, as well as Italy's Virgo instrument. Electromagnetic light arrived seconds later.

Astronomers used the twin Magellan telescopes at Las Campanas Observatory in Chile to capture the chemical fingerprints, or spectra, of this cosmic collision, along with the Hubble Space Telescope. The results, published in the journal *Science*, found signs of precious metals and radioactive waste.

"As the matter expands," Metzger says, "there are nuclear reactions, which turn the neutrons and protons into heavier nuclei, so things like gold and silver and platinum."

ALL THAT GLITTERS

The merger produced somewhere between 10 and 100 Earths' worth of gold, among many other heavy elements. And based on this one observation in the relatively short period of time gravitational wave detectors were capable of seeing it, scientists can extrapolate to guess how often binary neutron stars merge — about once every 10,000 years, Metzger says.

If you multiply those mergers over the Milky Way's entire history, it indicates there should be roughly 100 million Earths' worth of gold in our galaxy.

"It's a number that comes with a factor of five uncertainty in either way," Metzger says. "But that's the ballpark number."

Of course, before you pivot careers to become a space pirate and plunder the galaxy, consider that impressive gold yield is mixed in among hundreds of billions of stars. Something to keep in mind next time you're at Tiffany & Co. — **ERIC BETZ**

NATIONAL SCIENCE FOUNDATION/LIGO/SONOMA STATE UNIVERSITY/A. SIMONNE

31

27 Ways to Die in a Heat Wave

If you want to teach your children the alphabet while mildly traumatizing them, look no further than *The Gashlycrumb Tinies*. In alphabetical order, and with a jaunty rhyme scheme, 26 children meet fates both gruesome and preposterous. But as climate change warms the planet beyond our comfort zone in many regions, a hot new version of the book may come to pass.

There are 27 ways a heat wave can kill you, say researchers from the University of Hawaii. They found that excessive temperatures have deadly effects on seven different major organs in five unique ways. Of the 35 theoretical combinations, they found reports of 27 that actually happened. The team published its work in the journal *Circulation: Cardiovascular Quality and Outcomes*.

The work is morbid, but it drives home how deadly heat waves could be in the

century to come if the climate continues on its current trajectory. In just over 80 years, 3 out every 4 people on this planet will be subject to deadly heat waves more than 20 days out of the year, the researchers say. Some areas near the equator could even become functionally uninhabitable under that scenario.

NO, IT IS THE HEAT

When your body starts to overheat, one of the ways it attempts to compensate is by increasing blood flow near the skin to release more heat into the air. More blood near the skin means less inside our bodies, which can result in ischemia, a condition that can damage our organs, sometimes fatally.

The heat itself can also damage cells, something called heat cytotoxicity, and if enough cells fail, organ damage follows. Our hearts are particularly vulnerable: Heat can break down cardiac muscle while dehydration thickens the blood and makes it that much harder to pump, increasing the risk of heart failure. Both ischemia and heat cytotoxicity have affected six of the seven major organs, the literature showed, and damage to any of them can lead to death if not properly treated.

There are 27 ways a heat wave can kill you, say researchers from the University of Hawaii. They found that excessive temperatures have deadly effects on seven different major organs in five unique ways.

Our digestive systems don't like the heat much, either. If it gets too hot in our abdomens, the mucosal lining of the intestines can break down, spilling a flood of bacteria and endotoxins into the bloodstream and causing widespread inflammation.

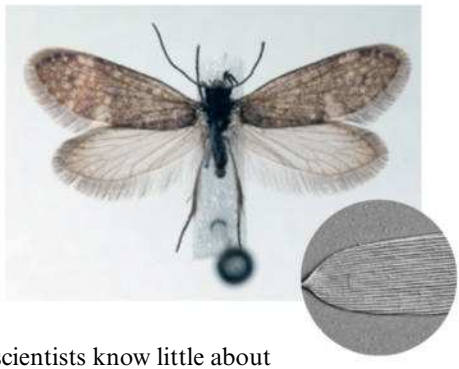
As if bacteria and toxic compounds weren't bad enough, the inflammation can also lead to runaway blood clots as a clotting protein becomes overactive and begins to gum up the circulatory system.

On top of that, ischemia and cytotoxicity can break down our muscles if we exert ourselves too hard in the heat. One of the products of this cellular breakdown is myoglobin, which in large enough concentrations can lead to kidney failure.

This is to say nothing of problems related to high temperatures, like dehydration, and the stressing effect that heat has on our bodies, which can lead to heart attacks and strokes. Heat doesn't always kill directly — that doesn't make it any less deadly. — **NATHANIEL SCHARPING**

ANDRESGARCIAM/ISTOCK

Butterflies and Moths May Have Predated Flowers



Think of some scaly animals. Odds are butterflies didn't come to mind, but butterflies and moths have scales on their wings, legs and bodies. Thanks to those scales, researchers have found the oldest known fossils of butterflies and moths. Both are in the order Lepidoptera, according to a paper published in *Science Advances*.

While Lepidoptera is highly studied, scientists know little about its evolutionary history. But understanding how these primitive butterflies and moths evolved is important to shedding light on how modern-day climate change could impact today's insects.

Researchers analyzed about 70 scales and scale fragments, mostly wing scales, that were found in a drilled core dating back about 201 million years to the Triassic-Jurassic period in northern Germany. Some of the wing scales resemble those of living glossatan moths that sport a tongue-like sucking device called a proboscis to feed on liquids such as nectar.

Flowering plants, which moths and butterflies feed on with their liquid-sucking "tongues," didn't exist during the Early Jurassic period, as far as we know. This leads researchers to believe these primitive insects fed on plants such as gymnosperms, challenging the belief that developing the proboscis was an adaptive response to the evolution of flowers. Scientists from an August 2017 study estimate the first ancestral flower evolved between 140 million and 250 million years ago.

That means the sucker may have come before the flowers. The scientists hypothesize the proboscis could have evolved during the Late Triassic period as a way to help the insects maintain necessary water levels in that hot and arid environment. These findings are just a glimpse into the evolution of butterflies and moths, but it's a start. — **LAUREN SIGFUSSON**

HOSSEIN RAJAEI. INSET: TIMO VAN ELDIJK

Scaring Babies for Science

"Snakes, why'd it have to be snakes?" So sayeth Indiana Jones, and so, apparently, say babies.

In a study published in *Frontiers in Psychology*, European neuroscientists determined that our instinctive fears of snakes and spiders are so primal, even babies become alarmed at the sight of them.

How'd they figure it out? Well, they scared some babies. For science!

PRIMAL FEAR

Although not everyone is frightened of the two creepy-crawlies, studies have shown more than a third of the population has a strong dislike of them, and they're the most reported specific phobias. Even though venomous spiders and snakes aren't a huge problem for most of us now, they're still "ancestral threats" our primate ancestors had to deal with for millions of years. It's possible we've evolved to quickly recognize — and appropriately freak out over — such threats.

Scientists had already shown these fears are intrinsic to most people, but they were usually in adults or adolescents, so it was possible they'd learned such fears from their environments. To really prove whether or not human brains were automatically wired to dislike snakes and spiders, the experiments had to test people with almost no environmental influence: babies.

For this study, the neuroscientists showed 16 6-month-olds pictures of snakes and fish, and spiders and flowers. The idea was to match the scary animals with visually similar non-threats, to make sure it was really the snake-ness or spider-ness the babies would react to. And react they did, as eye-tracking software made clear: Their pupils were noticeably bigger when looking at the spiders and snakes, corresponding to a much greater stress reaction.

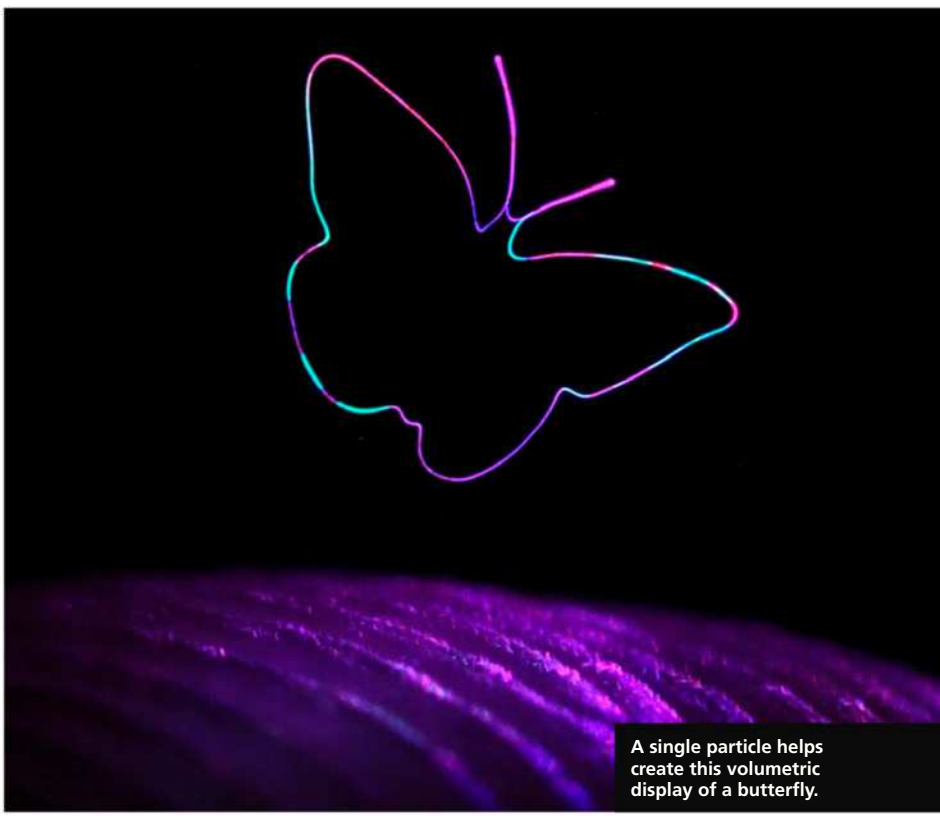
It was a success, since the results do suggest we have an innate evolved mechanism in our brains that is specifically attuned to notice, and not much care for, snakes and spiders. And the babies themselves were fine, with their parents right there, though the paper does include this ominous line: "The local ethics committee declared this study exempt." — **BILL ANDREWS**

BALIC DALIBOR/SHUTTERSTOCK

Scientists Create a 'Princess Leia-Style Display' of Light

People think they want holograms, but they (usually) don't. These are illusions, images trapped on two-dimensional surfaces that give the impression of a three-dimensional object.

What people really want are volumetric images — a display of free-floating



A single particle helps create this volumetric display of a butterfly.

light that actually takes up 3D space, visible from all angles. (Bonus points if you can interact with it.) Many of the coolest movies have them, such as Tony Stark's displays in *Iron Man*, the projection table in *Avatar*, and perhaps the most famous example: Princess Leia's plea to Obi-Wan Kenobi in *Star Wars.*

And now, according to a paper in *Nature*, so do we.

MOLDING LIGHT

Lead author Daniel Smalley of Brigham Young University and his colleagues could produce only tiny images, fractions of an inch across. Besides that, everything else about the technology, dubbed the Optical Trap Display, seems legit. It really does create 3D light structures.

To do this, Smalley's team took advantage of the human eye and how easy it is to fool. Using lasers, they trap and manipulate a single cellulose particle and guide it around in space to produce the desired image, while lights bounce off it at just the right times to give it the right color. The particle moves so quickly, human vision blurs its path together to look like a solid line, similar to how you can write words with sparklers in a long-exposure photo. If done over and over fast enough, they can even create moving images.

In a N*ature* video, Smalley compares it to 3D printing with light. Already, these images are extremely high resolution at 1,600 dots per inch.

The particle moves so quickly, human vision blurs its path together to look like a solid line, similar to how you can write words with sparklers in a long-exposure photo.

WHAT'S NEXT

As cool as this technology is — Smalley even calls it a "Princess Leia-style display" in a *Nature* news story — there's still work to be done. To increase the image size and depict more complex moving images, his team will have to improve their control of those particles, and learn how to handle more than one at once. Smalley is optimistic, saying in the same story, "If we make as much progress in the next four years as we made in the last, I think we will be successful making a display of useful size."

Controlling light like this would be a boon to anyone who depends on intricate visualizations, such as doctors learning their way around (and within) a patient's body, or air traffic controllers who have to keep track of various moving objects in a 3D space. Or, possibly, soldiers planning an invasion of the Na'vi or asking a wise old war buddy of your dad's for help. — **BILL ANDREWS**

SMALLEY HOLOGRAPHY GROUP

Viking Warrior in Famous Grave Was a Woman

This one goes out to all my fellow shieldmaidens: Researchers have confirmed through ancient DNA testing that the warrior buried in a famous Viking grave was a woman.

Archaeologists excavated hundreds of Viking-era graves at Birka, a UNESCO World Heritage Site in Sweden. One of the graves, originally excavated in the 1880s, was particularly noteworthy for both its position — on a prominent terrace — and for its grave goods, which included a variety of weapons, from a sword to armor-piercing arrows, and two horses.

The grave, archaeologists believed, belonged to a high-ranking warrior. Although the individual buried in the grave was assumed to be a man based on the grave goods, some researchers argued that the skeleton belonged to a woman. Controversy and the usual academic kerfuffle ensued.

But thanks to ancient DNA analysis, researchers confirmed in the *American Journal of Physical Anthropology* that Bj 581, as the grave is formally designated, belongs to a woman who was at least 30 years old when she died.

While other women of the Viking era have been found buried with weaponry, none had a grave suggesting a status as high as Lady Bj 581.

SISTERHOOD OF THE TRAVELING LANCE

While other women of the Viking era have been found buried with weaponry, none had a grave suggesting a status as high as Lady Bj 581. Among the grave goods, for example, was a game board and full set of game pieces; but we're not talking Chutes and Ladders here. Researchers believe the game set indicates she was an officer and involved in tactics and strategy.

In addition to extracting and sequencing her genome, the researchers conducted a strontium isotope analysis on three of her teeth. This kind of

An artist's reconstruction of the Viking warrior buried in Bj 581 at Birka, Sweden.

ÞÓRHALLUR PRÁINSSON (© NEIL PRICE)

testing can, like a chemical breadcrumb trail, reveal where an individual had lived early in life. Although the results did not identify any specific geographic areas, the team believes the woman was not born in the Birka area. (Genetically, she was most closely related to present-day populations in the British Isles and Scandinavia and, to a lesser extent, the eastern Baltic area.)

It's not too surprising that a woman from somewhere else in northern Europe would end up at Birka. From the eighth through 10th centuries, the site was a flourishing trading center. The grave itself dates from the mid-10th century.

The researchers note that Bj 581's skeleton did not have any signs of trauma typically seen in someone who died in combat. But then again, of 49 confirmed males buried at Birka, only two had signs of sharp-force trauma. Back in the day, not every warrior died in battle. Disease, infection and a variety of other ailments were all ways to shuffle off this mortal coil without getting your ticket to Valhalla punched.

There are also no signs that there was ever another body buried in Bj 581, so skeptics who want to argue that she was buried with her man don't have any evidence to back that up. — **GEMMA TARLACH**

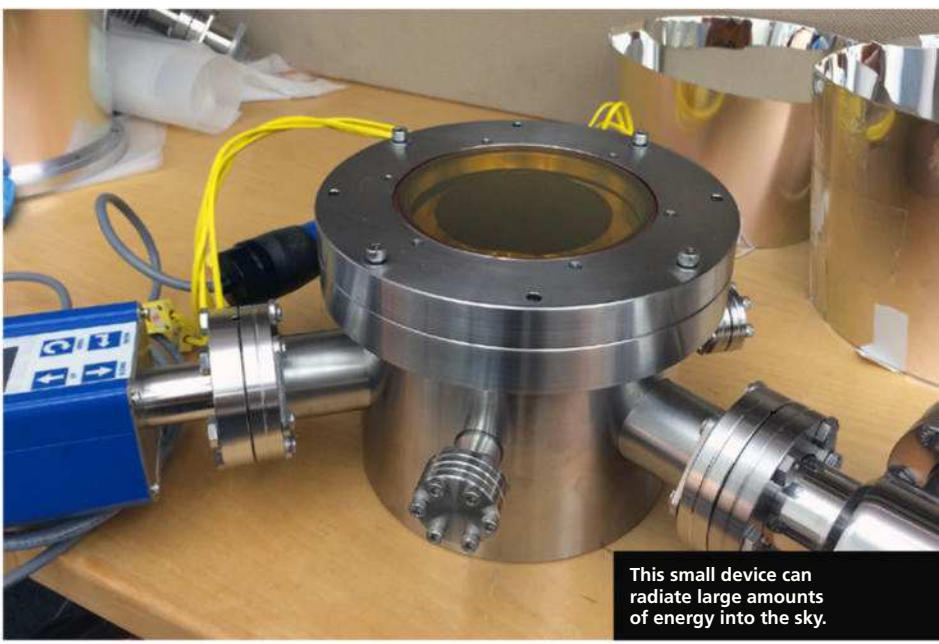
Device Sheds Heat by Sending It to Space

It's a tempting idea: getting rid of all of our extra heat by shooting it into space.

This concept, as embodied in a machine designed by researchers at Stanford University, won't solve global warming, or even keep your house cold (yet). But it is an intriguing idea — one that essentially harnesses the freezing vacuum of space to do away with some of our unwanted energy here on Earth. It's powerful, too. In early tests, the researchers report they cooled their small device by up to 42 degrees Celsius.

GIVE IT AWAY

The design takes advantage of a property called radiative cooling. Just as objects absorb energy in the form of radiation, they also send it back out. On



This small device can radiate large amounts of energy into the sky.

Earth, the atmosphere serves as a global thermostat by allowing short-wave energy (light) in and emitting long-wave (infrared) energy into space. Infrared energy also escapes Earth through a "transparency window." Basically, energy of certain wavelengths can pass through the atmosphere unhindered and dissipate in space.

The researchers' design takes advantage of this phenomenon by designing an emitter that does a much better job than Earth can. They published their work in *Nature Communications*.

WINDOW TO THE STARS

The emitter was shielded from the sun and enclosed in a vacuum, both measures that stopped it from getting or giving unwanted heat. The machine's job is to take energy from its surroundings and release it — in this case, right up through the atmosphere.

The only opening in the small enclosure is a small window made of zinc selenide pointed at the sky. The researchers picked the compound because it emits infrared radiation at a frequency that matches the atmosphere's transparency window.

The cooling device effectively shed a significant amount of energy. They demonstrated an average temperature reduction, compared with ambient air temperatures, of 37 degrees Celsius over a 24-hour period — enough to keep the device well below freezing.

What's significant is that the device works by passive radiation, meaning it doesn't need much energy to work. Generating the vacuum does take power, but the actual process of cooling doesn't require any more energy.

What's significant is that the device works by passive radiation, meaning it doesn't need much energy to work. Generating the vacuum does take power, but the actual process of cooling doesn't require any more energy.

Right now, the device is tiny and not ready for commercial use. Zinc selenide is too expensive to use on a commercial level, and the team wants to make the solar insulator better. But they say the core design, including the vacuum, would theoretically work at larger scales, meaning it could find its way into the refrigeration devices of the future. Pretty cool. — **NATHANIEL SCHARPING**

ZHEN CHEN/SOUTHEAST UNIVERSITY OF CHINA AND SHANHUI FAN/STANFORD UNIVERSITY

All Things Iron From the Bronze Age Had Cosmic Origins

It looks like King Tut's space dagger wasn't so special after all.

The legendary Egyptian pharaoh was buried with a dagger forged from a meteorite, a truly cosmic artifact fit for a king. But it turns out pretty much everything made of iron from that period came from space rocks. That's not to say that artifacts of meteoric origin are commonplace, but in the Bronze Age, if you were working with iron, it's a safe bet it fell out of the sky.

The blade of King Tut's dagger is made of meteoric iron.

SPACE METAL

Albert Jambon, a researcher at the University Pierre and Marie Curie in France, surveyed a collection of Bronze Age iron artifacts with a portable X-ray fluorescence scanner, the same technique that let researchers determine the origin of Tutankhamun's dagger. The imaging technology allows for non-destructive scans, important for examining priceless archaeological artifacts.

The scanner picks apart the composition of an object, and Jambon could then determine what kinds of elements are present. If the iron

artifacts also contained nickel and cobalt — rare in earthly iron — they were likely of extraterrestrial origin.

Jambon examined beads from Egypt, a dagger from Turkey, a pendant and ax from Syria, and artifacts from China. Not to be left out, Tut's dagger, in addition to other iron objects from the pharaoh's tomb, were included. He then compared them with iron that we know came from meteors and iron from Earth.

The artifacts were all from between 1300 and 3200 B.C., lining up with the generally accepted boundaries of the Bronze Age. Although the objects came from different places, the levels of nickel and the ratio of iron to cobalt indicated that the metal for each and every one came from space.

So in the Bronze Age, when all these artifacts were made, people shouldn't have been working with iron yet. Although some theories hold that the boundary between Bronze and Iron wasn't so neat, Jambon's work casts some doubt on that.

FROM STONE TO IRON

The find, published in the *Journal of Archaeological Science*, speaks to the general progression of technology in ancient societies. There's a rough three-part breakdown of historic eras: the Stone Age, the Bronze Age and the Iron Age. The names are literal; each age was defined by materials societies used to make tools and artwork.

So in the Bronze Age, when all these artifacts were made, people shouldn't have been working with iron yet. Although some theories hold that the boundary between Bronze and Iron wasn't so neat, Jambon's work casts some doubt on that. Mining and smelting terrestrial iron was more difficult than creating bronze from copper and alloys like tin, and involved a reduction process that drew pure metal from unusable iron ore. The technology to do so didn't appear until later, Jambon's work suggests, and there weren't any isolated incidents of iron smithing to muddy the waters.

When ancient peoples stumbled across metallic meteorites, however, the iron was already in its metallic form and could be worked with existing technology. Meteoric iron was their mithril, their adamantium, their Valyrian steel — rare and possessed of qualities no human could re-create.

Until the Iron Age, obviously. — **NATHANIEL SCHARPING**

EGYPTIAN MUSEUM OF CAIRO

Suppressing a Sneeze

Attempting to contain a sneeze could be a recipe for disaster.

A 34-year-old patient visited a hospital in the United Kingdom complaining of an extremely sore throat and a dramatic voice change after attempting to suppress a sneeze by pinching his nose and closing his mouth. He told doctors he felt a popping sensation in his neck and noticed immediate swelling after trying to contain the sneeze.

When doctors examined him, they could hear crackling sounds — known as crepitus in medical parlance — from his neck to his rib cage. When doctors hear those sounds, it's typically a sign that air pockets had been forced into the chest cavity — never a good thing. Because the man's symptoms could cause serious complications, doctors put him on a feeding tube and administered antibiotics until his pain and swelling passed.

When doctors hear those sounds, it's typically a sign that air pockets had been forced into the chest cavity — never a good thing.

After seven days, he was released and advised not to block his airways while sneezing.

The man's condition, which doctors called "spontaneous perforation of the pharynx," is typically caused by blunt trauma to the neck and can sometimes be a painful consequence of intense coughing, retching or vomiting. Rupturing the throat via a suppressed sneeze, however, is quite rare.

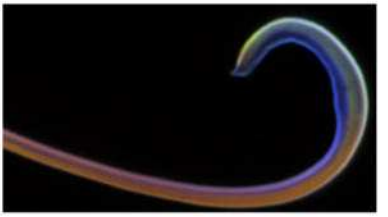
"Halting sneeze via blocking nostrils and mouth is a dangerous (maneuver) and should be avoided," the doctors concluded in their report, which was published in *BMJ Case Reports*.

In addition to perforating your pharynx, slamming your nose and mouth shut mid-sneeze could also perforate the eardrum or rupture a vein in the brain. So, when you feel that tickle in your nose, let all hell break loose — just remember to cover your mouth. — **CARL ENGELKING**

HALFBOTTLE/SHUTTERSTOCK

A Better Catheter, Via the Beetle Penis

Male beetles often have thin penises longer than their bodies. Scientists are now discovering how these insects can have sex without breaking their narrow, lengthy genitalia, findings that could help lead to longer, stronger catheters for use in medicine.



Scientists experimented with thistle tortoise beetles, *Cassida rubiginosa*. The insects are about 8 millimeters long, and their penises are roughly 10 mm long but less than 0.01 mm wide, about 10 times thinner than human hair.

"I am interested in the evolutionary histories of insect genitalia because insect genitalia are very diverse," says Yoko Matsumura, a functional morphologist at Kiel University in Germany and lead author of a study in *Science Advances*.

The male thistle tortoise beetle normally keeps its penis stored in the convoluted ejaculatory duct within its abdomen. When one wants to have sex, it mounts a female, and if the female is receptive, the male then begins copulation.

To see how these insects can have sex without the males' seemingly fragile members buckling or rupturing, scientists removed penises from 10 male beetles and carefully bent them under a microscope to analyze their stiffness.

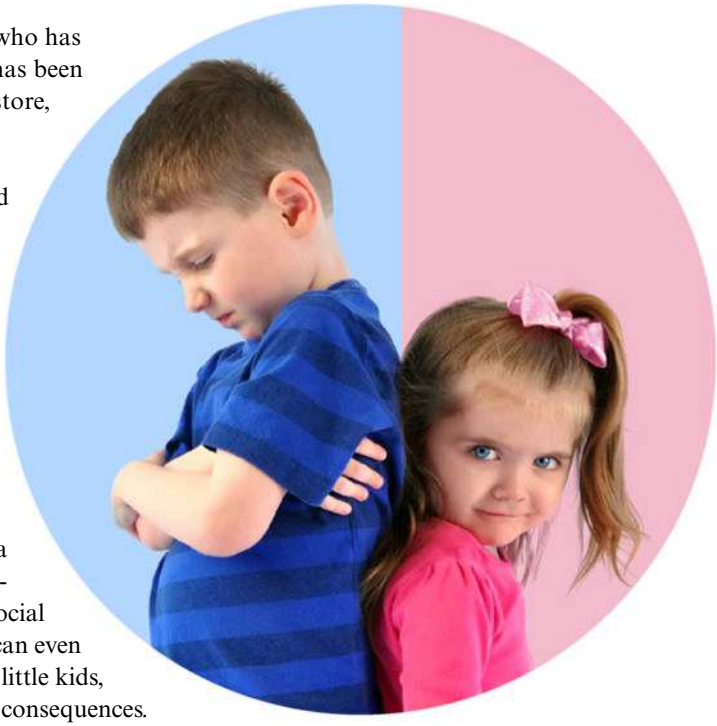
"As far as we know, there are no studies that apply a bending test for such a small biological structure," Matsumura says. "So we had to design our experimental setup and create tools to carry out the experiment completely by ourselves." She considered it "a miracle to have succeeded in the experiment."

The researchers discovered the beetle penis has numerous elaborate mechanical adaptations that likely aid its performance. For example, it has a soft tip and a stiff base, a combination that gives it enhanced flexibility and durability. In addition, they found the tip has a soft inner curve likely made of the rubbery protein resilin and a harder outer curve, which may work together to make it tougher during penetration. Moreover, they suggested the shape of the penis, which is cylindrical with a curled tip, could help it fit better inside a female.

"The animals can achieve the penetration of a delicate and elongated structure into a very complicated duct with very rare breakage," Matsumura says. "We hope that our finding will help improve medical tools." — **CHARLES CHOI**

MATSUMURA, KOVALEV, GORB/SCIENCE ADVANCES, DEC. 2017

Blue for Boys, Pink for Girls . . . That's Child's Play



Anyone who has kids, or has been to a toy store, is familiar with the gender color code: Blue is for boys, and pink is for girls.

But associating a gender with a particular color is a fairly recent development. And, like so much these days, it's actually the fault of society, man. According to a recent study, gender-based colors are a social preference, and we can even manipulate them in little kids, which can have real consequences.

GO GREEN AND YELLOW

The study, which appeared in the journal *Sex Roles*, tracked the preferences of 126 Chinese children in Hong Kong, ages 5 to 7. First, they just wanted to make sure Western color preferences (blue for boys, pink for girls) had permeated among the Asian children. They had.

With that established, things got interesting. The researchers introduced two new colors into the mix, green and yellow, and split the kids into two groups. The control group played with toys of the new colors, but the

experimental group first heard that yellow was for girls, and green was for boys. The researchers wondered: Would that be enough to affect the kids' color preferences, and even cognitive abilities?

The answer, on both counts, was yes. Apparently, little kids are super easy to manipulate.

Associating a gender with a particular color is a fairly recent development. And, like so much these days, it's actually the fault of society, man. According to a recent study, gender-based colors are a social preference, and we can even manipulate them in little kids, which can have real consequences.

COLOR CONTROL

The boys who were told green was a boys' color almost immediately began preferring to play with green toys, and ditto for girls with yellow. And not just toys — the color itself became more or less attractive to the two groups. Further, boys and girls preferred "their" color more strongly than boys and girls in the control group did theirs. (The researchers took into account the kids' previous color preferences for green and yellow, and even had the tester wear black to prevent any undue color influence.)

Interestingly, girls playing on "boy-colored" puzzles and vice versa didn't do worse than kids playing with the appropriate color, contradicting the researchers' expectations. Everyone did about the same as everyone else, on that front. What did happen, though, was the boys in the non-control group did better than everyone else. So, while the colors themselves didn't affect the kids, the existence of gender roles did, with boys coming out ahead.

As the study states: "Our results provided another picture of the effect of gender labels by showing that as long as boys had been exposed to information about gender appropriateness, their subsequent performance improved."

Not surprisingly, the researchers end up suggesting that it might not be a good idea to segregate toys into clearly marked and colored boys' and girls' sections. It's not exactly a new suggestion, but now at least more science backs it up. — **BILL ANDREWS**

HAYWIREMEDIA/SHUTTERSTOCK

Prehistoric Females Were Super Strong

Compared with hunting and gathering, farming may seem like pretty easy work. But the skeletons of Central European women who lived during agriculture's earliest days say otherwise.

An analysis of prehistoric women's upper arm bones shows they took on formidable tasks of manual labor. And the hard work left them pretty beasty — it was enough to make them stronger even than today's female competitive athletes, researchers say.

Venus of Malta, a Neolithic figure

BAD TO THE BONE

University of Cambridge archaeologist Alison Macintosh led a team of scientists who published a study in *Science Advances* comparing the bone structure of modern female athletes with female farmers in the Neolithic period and Bronze and Iron ages.

Not only is this the first study to compare the bones of ancient women with those of women today, but the research is also notable for not using male skeletons as a comparison point.

Using laser scans and molds, the researchers analyzed arm and leg bones from female skeletons thousands of years old. Assessing the bones' shape and rigidity let them ascertain the amount and type of physical strain endured by prehistoric women. Tasks like tilling soil, harvesting crops and grinding grain for as long as five hours a day to make flour made them exceptionally strong, the researchers say.

An analysis of prehistoric women's upper arm bones shows they took on formidable tasks of manual labor.

"By interpreting women's bones in a female-specific context, we can start to see how intensive, variable and laborious their behaviors were, hinting at a hidden history of women's work

THIS PAGE: DEA/A. DAGLI ORTI/GRANGER, NYC. OPPOSITE: COREPICS VOF/SHUTTERSTOCK

over thousands of years," Macintosh said in a university statement.

Bone density and content is widely variable depending on factors such as diet and age, so we should be cautious in our interpretations, but the researchers' findings are clear: Prehistoric women shouldered a much greater load than we thought.

A CONTEMPORARY COMPARISON

To get a more accurate picture of how ancient females ranked, the researchers then compared them with the bones of contemporary female athletes. The researchers took CT scans of modern sedentary women as well as female rowers, endurance runners and soccer players at Cambridge.

They found that Neolithic women's leg bones were about as strong as those of modern rowers, but their arm bones were significantly stronger, by about 11 to 16 percent. Compared with sedentary students, the gap was as high as 30 percent.

It's an indication that women played an integral role in the development of agriculture across Europe. In addition, the study highlights the importance of comparing prehistoric female behavior with that of other females, bringing new light to the lived experience of women through the ages. — **LEAH FROATS**

42

Uptown and Downtown NYC Rats Are Genetically Distinct

If you're an uptown sort of rat, you don't associate with the downtown kind.

Segregation is real if you're a rat in New York City, though likely for more prosaic reasons than we're used to. A recent genetic study of the Big Apple's rats found unique populations living in uptown and

downtown Manhattan, indicating that they probably don't interact with each other all that much.

CITY OF RATS

The project is the work of Fordham University graduate student Matthew Combs, whose dissertation focused on the city's rat population and some of the ways the animals' close cohabitation with humans has shaped them. As *The Atlantic* reported, Combs spent two years trapping rats in the city and sequencing their DNA.

The work allowed him to track the differences between various populations, and he found that he could map those genetic markers to locations within the city. In the paper, published in *Molecular Ecology*, Combs says he can even distinguish rats from different neighborhoods in Manhattan.

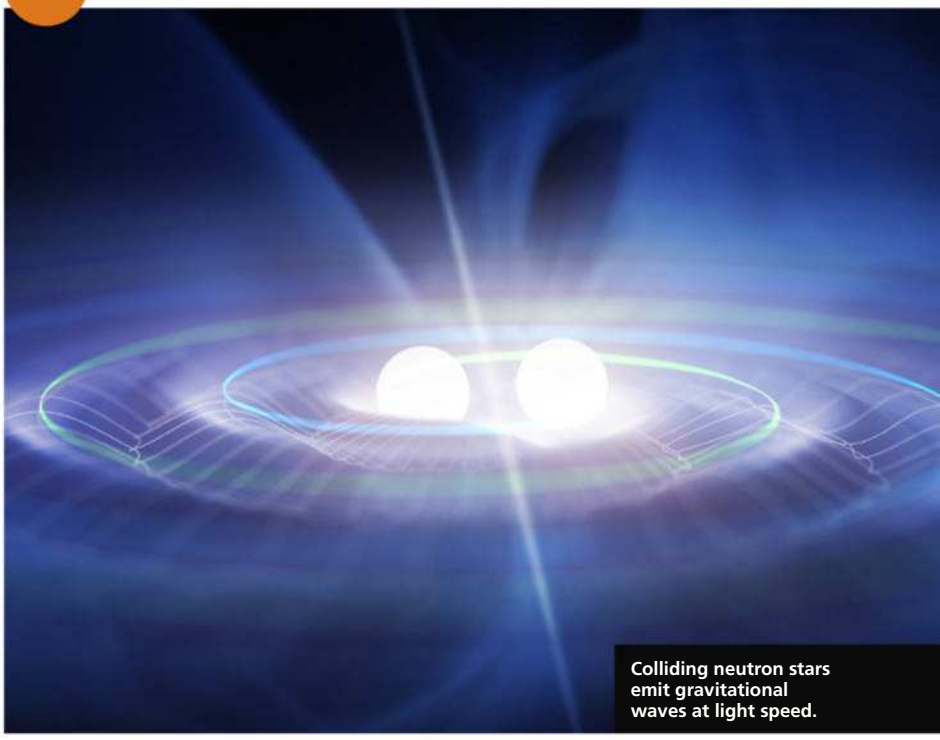
Rats don't often move more than a few blocks during the course of their lives — especially in New York, where food and shelter abound. In Manhattan, midtown forms a natural barrier of sorts: Home to bustling areas like Times Square and Fifth Avenue, it doesn't offer much in the way of living space for the rats.

The rats of New York City still look most similar to rats in Britain and France. In the cosmopolitan shipping port, rats from all over the world must have arrived via ship, yet the original Western European rats managed to remain dominant.

Another intriguing finding was that the rats of New York City still look most similar to rats in Britain and France. In the cosmopolitan shipping port, rats from all over the world must have arrived via ship, yet the original Western European rats managed to remain dominant.

Combs got his genetic samples from rats trapped all around the city, helped by a crowdsourced rat map. He cut off an inch or so of their tails to obtain the relevant samples, and he still has a collection of some 200 frozen in vials. The library of rat DNA could help inform future containment efforts, and it offers a look at how the built environment — subways, streets, parks and the like — guides the distribution of wildlife within a city. — **NATHANIEL SCHARPING**

MIKELANE45/DREAMSTIME



Colliding neutron stars emit gravitational waves at light speed.

Why Does Gravity Travel at the Speed of Light?

When the dead cores of two stars collided 130 million years ago in a galaxy somewhat far away, the crash was so extreme that it caused a wrinkle in space-time — a gravitational wave. That gravitational wave and the light from the stellar explosion traveled together across the cosmos, arriving at Earth simultaneously in 2017.

The event prompted worldwide headlines as the dawn of "multimessenger astronomy." Astronomers had waited a generation for this moment. But it was also the first-ever direct confirmation that gravity travels at the speed of light.

THE SPEED OF GRAVITY

We all know light obeys a speed limit — roughly 186,000 miles per second. Nothing travels faster. But why should gravity travel at the same speed?

That question requires a quick dive into Albert Einstein's general relativity, his theory of gravity — the same theory that predicted gravitational waves a century ago.

Einstein overthrew Isaac Newton's idea of "absolute time." Newton thought time marched onward everywhere at an identical pace, regardless of how we mortals perceived it. It was unflinching. By that line of thinking, one second on Earth is one second anywhere else.

Newton also thought gravity acted instantly. Distance didn't matter.

IT'S ALL RELATIVE

But then Einstein showed that time is relative. It changes with speed and in the presence of gravity. One of the ramifications of that is that you can't have simultaneous actions at a distance. So information of any kind has a finite speed, whether it's a photon — the light-carrying particle — or a graviton, which carries the force of gravity.

"In relativity, there is a 'speed of information' — the maximum speed that you can send information from one point to another," says University of Wisconsin-Milwaukee physicist Jolien Creighton.

"In relativity, there is a 'speed of information' — the maximum speed that you can send information from one point to another," says University of Wisconsin-Milwaukee physicist Jolien Creighton, an expert on general relativity and member of the team that first spotted gravitational waves.

Creighton explains that when you shake an electron, it creates a change in the electric field that spreads out at the speed of light. Gravity works the same way: Shake a mass, and the change in the gravitational field — the gravitational wave — propagates at that same speed.

"So the fact that the speed of gravitational waves is equal to the speed of electromagnetic waves is simply because they both travel at the speed of information," Creighton says.

There's an easy way to picture this, too. Imagine the sun vanishing right now. Earth wouldn't just drift into space instantly. It would take eight minutes before Earth would go dark and simultaneously reel off in a straight line.

— ERIC BETZ

ANDREYVP/SHUTTERSTOCK

How Volcanoes Likely Starved Ancient Egypt

For a time, Ancient Egypt was the most powerful civilization in the world. Monuments to the Egyptians' pharaohs stand to this day, a testament to the vast resources at their command.

But the architectural excess hid a crippling weakness. The country sits in the middle of a vast desert. To support a population in the millions, large-scale agriculture was vital. And for that, you need water — and therefore, the Nile. The river was so important to Egyptians that they still celebrate a two-week festival during the yearly floods, once thought to be fed by the tears of the goddess Isis. Even small fluctuations in flood levels could bring famine or catastrophe.

A paper in *Nature Communications* hints that a surprising force altering

the Nile's flow may have meddled in the affairs of the time, from uprisings and conquests to revolts. The nefarious agent? Volcanoes, say researchers from Yale University. Large eruptions can cause small but critical changes in rainfall around the headwaters of the Nile, something that lined up with periods of instability in Ancient Egypt.

VOLCANIC IMPACT

The researchers relied on a combination of ancient records and modern techniques to divine the weather thousands of years ago. Papyrus scrolls from the Ptolemaic era around 2,300 years ago provided insights into periods of social unrest and drought, and the researchers combined those with analyses of ice cores taken from Greenland and Antarctica. When volcanic eruptions spew sulfur (among other substances) into the air, it ends up settling and leaving a trace in the ice, forming a record of when major volcanic eruptions occurred.

This sulfur also serves to cool the planet by reflecting sunlight, which likely starved the Nile of rainwater during the monsoon season by shifting weather patterns.

This sulfur also serves to cool the planet by reflecting sunlight, which likely starved the Nile of rainwater during the monsoon season by shifting weather patterns. Readings from Nilometers, ancient observatories on the Nile that tracked yearly water levels, confirmed reduced flooding during these times. The Egyptians relied on an elaborate system of dams and canals to inundate their fields, bringing in silt to serve as fertilizer and water to keep crops alive. If the waters failed to crest high enough, the fields remained dry, and food production dwindled.

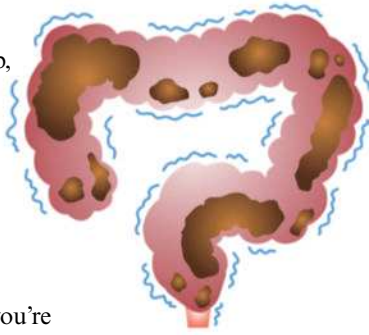
The researchers found a marked increase in societal troubles during years when the floods failed to deliver. A famous military campaign cut short lined up with unrest at home, as did a 20-year-long uprising during the Ptolemaic era. Eruptions may have even played a role in the fall of the Ptolemaic dynasty in 30 B.C., when a Roman invasion swept through the country, they say.

The lesson remains meaningful today. Some 70 percent of the world's population depends on monsoons in some way. Shifting the pattern of rainfall can cause real harm, whether you're in Bangladesh or Houston. It needn't be a massive eruption, either. Climate change is altering weather conditions across the globe at a rate much quicker than many can adapt to.

When we assess how a changing planet could affect us, we'd do well to learn from the Egyptians. — **NATHANIEL SCHARPING**

YOSH GINSU/UNSPLASH

To Go or Not to Go



You know the feeling when you have to poop, but there's no toilet in reach or you're too scared to stink up the stall at work? Then, instead of listening to Mother Nature, you end up holding in your poop?

How bad is it, really, to do that?

CONSTIPATION STATION

On average, mammals take 12 seconds to poop. But if you're constantly holding in your poops, for whatever reason, that might not be the case for you. Holding it for a couple of hours every once in a while won't cause big problems, says Jonathan Rosenberg, gastroenterologist and American Gastroenterological Association expert, but it's best to go when you gotta go.

"If you're holding in stool, you're more likely to suck all the water out of it, making it drier and drier, and therefore harder and harder to go," Rosenberg says. "You get into this vicious cycle of a learned behavior perpetuating the unwanted effect, which is the constipation."

According to the National Institutes of Health, about 42 million Americans experience constipation. And since poop-related topics are hard to talk about, there are likely countless more silent sufferers.

Thankfully, effective treatment options exist for people with occasional and chronic constipation. Prune juice and drugstore medications like Metamucil can do the trick for many who are constipated because of a certain meal or medication. But if you're chronically constipated — you have infrequent bowel movements weeks at a time and your stool is basically a riverbed of dry rocks, ouch — you may want to seek alternatives.

And that probably shouldn't be coffee. Drinking coffee often makes people poop, but Rosenberg never recommends that people drink caffeine to treat constipation. "I think it's a pretty unhealthy way to deal with your symptoms," he says.

Instead, the chronically constipated can opt for prescription medications. "They're safe to take on a daily basis for long term," Rosenberg says. "They don't get absorbed into your body in any meaningful way, so your hair can't fall out and your skin can't turn green."

So there you have it: Occasionally holding in your poop probably won't hurt you. But do it often, and it can turn into an unconscious habit with uncomfortable and bothersome consequences. — **LAUREN SIGFUSSON**

BLUE DAEMON/SHUTTERSTOCK

A Psychopath Might Not Think It's Funny

Having a good laugh is, among other things, a great way to bond socially. In fact, we're much more likely to titter, guffaw and crow when we're with other people than alone.

And once you hear someone start, it's hard not to crack up, too. However, a study in the journal *Current Biology* posits that this phenomenon might not be contagious for everyone, particularly for teen boys at risk of psychopathy.

Elizabeth O'Nions of the University College London and her team tested three groups of boys aged 11 to 16. The first — the control group — was made up of 31 boys who were developmentally typical; a second group consisted of 32 boys who displayed disruptive behaviors and high-callous traits that indicate a risk of developing psychopathy; and the final group had 30 boys who also displayed disruptive behaviors but low-callous traits.

Each boy listened to a recording of genuine laughter, fake laughter and also crying sounds. At the same time, the researchers took fMRI scans of each boy's brain. After the scans, the kids answered questions about the recording, such as, "How much does hearing the sound make you feel like joining in and/or feeling the emotions?" and "How much does the sound reflect a genuinely felt emotion?" answering on a scale of 1 to 7.

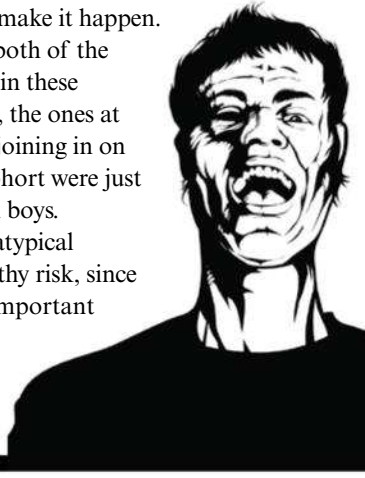
O'Nions and her team had predicted the two groups of antisocial boys wouldn't react as strongly to genuine laughter, both in their answers and in the activity of the relevant pre-motor and motor brain areas — the parts of the brain that get us ready to join in a giggle fit and the ones that make it happen.

And sure enough, compared with the control group, both of the other two sets of boys had lower levels of brain activity in these regions. Yet only the kids in the high-callous trait group, the ones at risk of psychopathy, were less likely to say they felt like joining in on the laughter they heard; those in the low-callous trait cohort were just as likely to want to laugh as the developmentally typical boys.

The authors argue it's possible the high-callous kids' atypical processing of laughter could actually up their psychopathy risk, since they're more likely to miss out on such a common and important way to bond with others.

Or, maybe, some people just aren't funny.

— LACY SCHLEY



JPA1999/ISTOCK

What Does a Meteor Sound Like?

When a meteor screams through our upper atmosphere, it's a silent show for us here on the ground. Most of them burn up dozens of miles above the surface, and even if a sonic boom reaches us, it comes minutes after the visual spectacle.

But for years, reports of meteors have included descriptions of strange sizzling sounds — like frying bacon — filling the air. Sound travels too slowly for the meteor to be directly responsible for the phenomenon, so such reports are usually dismissed or attributed to earthly causes. But now, researchers from Sandia National Laboratories and the Czech Academy of Sciences (CAS) say they have uncovered an otherworldly source for the mysterious crackling noises.

SOUNDS DELICIOUS

The sounds, they say, emanate not from the disturbance of air particles as the meteor shoves them aside, but from the flashes of heat it gives off as it burns up. Meteors can burn as hot as the sun, and the conflagration gives off so much energy that it can reach all the way to the ground in the form of electromagnetic

energy, known as radiative heating. When certain objects absorb those pulses of energy, they heat up and expand quickly, disturbing the surrounding air and creating the crackling sounds.

The researchers tested their idea in an anechoic chamber — which blocks all external sounds — using an LED light and a microphone. When they aimed the light at a variety of objects, including wood, paint, felt and a wig, they picked up the same sounds described by meteor observers: pops, hisses and rustling noises. Flashing the light at a frequency of 1,000 hertz generated sounds at 25 decibels — loud enough for humans to hear. The test confirmed their hypothesis that meteors may be transmitting heat all the way from the upper atmosphere to objects on the ground in sufficient quantities to make them sizzle. They published their work in *Nature Scientific Reports*.

This phenomenon is known as the photoacoustic effect. It was first noticed in 1880 by Alexander Graham Bell, who found that rapidly interrupting a beam of sunlight with a slotted wheel would cause certain objects to emit sounds. The effect occurs when rapid pulses of energy heat up an object and jostle the air particles surrounding it, producing sound waves.

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FLICKERING METEORS

When most meteors turn into fireballs, it's not as a steady burn but a series of high-speed flickers. These spikes last only about a millisecond and go by too quickly for us to notice. A series of observations with high-speed photometers by the Czech Fireball Network, run by the Astronomical Institute at CAS, tracked the light curve of over 100 fireballs and found that what appears to us as a steady flame is actually a series of spikes and dips. These pulses are similar to the flashes of light created by Bell in his experiment and are likely sufficiently powerful to excite the molecules of certain objects on Earth.

The team found that materials that both absorb light quickly and don't conduct heat well produced the sounds the best. This includes dark clothing and hair, leaves and grass. The team's model suggests that meteors that appear at least as bright as the moon should be able to produce an audible photoacoustic effect.

So, if you're lucky enough to spot a meteor, listen closely — it might be talking to you. Or at least your hair. — **NATHANIEL SCHARPING**

ESO/C. MALIN

Male Lemurs Try to Get Lucky Via 'Stink Flirting'

Researchers call it "stink flirting." A male ring-tailed lemur rubs his signature scent onto his long, fluffy tail, then waves it over his head in the direction of a nearby female. Males seem to intend this gesture as a sexual overture, but it often gets them into fights — with lemurs of both sexes. In fact, scientists aren't sure stink flirting helps male lemurs at all.

Smell is an important communication tool for ring-tailed lemurs (*Lemur catta*). Both males and females use scent glands on their genitals to mark their territory. Extra scent glands on males' chests and wrists make different smelly secretions.

Sometimes male lemurs rub secretions from their chest and wrist glands into their tail fur. Then they may wave their tails at other male lemurs,

something researchers call a "stink fight." In this case, the tail waving is an "aggressive act," write Amber Walker-Bolton of the University of Toronto and Joyce Parga of California State University, Los Angeles.

But at other times, male lemurs wave their stinky tails at females instead. "When males signal to females in this way, they gaze directly at the receiving female, often in close proximity," the authors write. This stink flirting hasn't been studied as much as stink fighting, so the researchers went to a nature preserve near the southern tip of Madagascar to investigate.

The scientists observed two groups of wild lemurs, as well as two outsider males who were trying to join one of the groups. Although females rule ring-tailed lemur society, the researchers saw that the social rank of males mattered: Higher-ranking males did more stink flirting.

This flirting came at a cost. While regular scent marking rarely got males in trouble, waving their stinky tails at females was met with aggression more than half the time. That aggression usually came from the female lemur that got waved at.

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Walker-Bolton and Parga think stink flirting may be an "honest signal," a way for a male animal to show a female he has good genes to give her offspring. If males can afford costly displays — giant horns or tails that weigh them down, smelly signals that get them into fights — then they'll be healthy mates, the logic goes.

But for lemurs, that costly signal doesn't have an obvious benefit. The researchers didn't find evidence that stink-flirting males mated more often, though they admit they may have missed some sneaky mating events.

However, females seemed more likely to make "sexual presentations" — a prelude to mating — to males who had waved stinky tails in their direction. So, even if it chagrins most other animals around them, males may find it worthwhile to keep making smelly displays. — **ELIZABETH PRESTON**

KAMONRUTM/DREAMSTIME

A Lover's Scent Can Lower Stress

The human sense of smell is perhaps our most underrated ability. The power of scent may not get the credit it deserves because we experience it differently from our other senses. Rather than proceeding directly to the thalamus — the seat of consciousness — like other sensory signals, scent information travels to parts of the brain associated with emotions and memory. Therefore, much of the information we receive through our noses is experienced subconsciously.

Consider this: The olfactory system can detect over 1 trillion different odors, which is orders of magnitude higher than previous estimates of roughly 10,000. Sniffing our palms seconds after a handshake can give us insights about another person's emotional state. Our vigilance perks up when we smell a shirt worn by a stressed-out person, and a smile may cross our face when we catch the whiff of a person who just watched a funny video. We're under the spell of odors,

even if we aren't fully aware of it.

And in a recent demonstration of the power of scent, researchers from the University of British Columbia showed that sniffing a romantic partner's shirt can lower levels of the stress hormone, cortisol.

Researchers recruited 96 opposite-sex couples for their study, and men were given a shirt to wear for 24 hours. They were told to avoid smoking, cologne, deodorant, eating spicy foods — anything that could interfere with their natural scent. Then, the T-shirts were frozen to preserve their unique olfactory aura.

The women were then given one of three T-shirts to sniff: their lover's shirt, a stranger's shirt or one that had never been worn. Each woman participated in a stress-inducing test that involved a fake job interview and a math test. They also answered questions about their stress levels and provided a saliva sample to monitor their cortisol levels.

Women who had unknowingly sniffed their partner's scent had lower levels of cortisol throughout the test compared with women who sniffed a stranger's shirt. Women who sniffed their partner's shirt *and* correctly identified it as their partner's had even lower cortisol counts.

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"From a young age, humans fear strangers, especially strange males, so it is possible that a strange male scent triggers the 'fight or flight' response that leads to elevated cortisol," the study's lead author, Marlise Hofer, said in a university statement. "This could happen without us being fully aware of it."

Women were chosen as the "smellers" because researchers say they have a better sense of smell than men. Of course, future research might flip the tables and see if guys experience the same stress-reducing effects as gals. Hofer and colleagues published their findings in the *Journal of Personality and Social Psychology*.

So when times get tough, or your beloved partner is an ocean away, you might want to try reaching into that pile of dirty laundry for comfort.

— CARL ENGELKING

ELNUR/SHUTTERSTOCK

Sushi Is to Blame for a Man's 5-Foot Tapeworm

A Fresno, California, man is rethinking his diet after one of his favorite dishes came back to bite him.

As Fresno emergency room doctor Kenny Banh explained on a recent episode of the medical podcast "This Won't Hurt a Bit," a young man came into the emergency department complaining of bloody diarrhea. He also specifically asked to be treated for a tapeworm. Banh said he's seen patients who think they have a tapeworm, but their fears are often unwarranted. But this time, the patient had proof.

"I see next to him he's got this little grocery bag, plastic bag, sitting next to him. I said, 'I hope it's not a stool sample." He goes, 'No. It's the worm." The doctor peeked inside the bag. Sure enough, there was a tapeworm wrapped around a cardboard toilet paper tube.

The patient, Banh said, had been quite worried. After using the bathroom, he noticed blood in his stool. He also noticed something else hanging out of his rear. The man, fearing this strange new appendage was actually a piece of his intestines, gave

Salmon are typically caught and shipped on ice, rather than frozen. That means tapeworm larvae can survive their trip from the ocean to your sushi plate. Cooking salmon or freezing it is enough to kill the parasite.

A digital rendering of a tapeworm shows the parasite in all its glory.

it a tug. And he kept tugging.

When he picked it up to examine what had just exited his body, it moved.

The patient, relieved his entrails weren't falling out, coiled the worm onto a cardboard tube and went to the hospital. Banh said the worm, known generally as a helminth, stretched to a length of 5 feet, 6 inches. How the tapeworm entered the patient's body stumped Banh, until the patient revealed he absolutely loves eating salmon sashimi, a raw fish dish that's a Japanese delicacy.

Several salmon species are the principal sources of *Diphyllobothrium nihonkaiense*, or the Japanese broad tapeworm. Officials used to think this parasite was a problem unique to Asia, but in 2017 the Centers for Disease Control and Prevention warned that North American fisheries were also at risk.

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While the thought of a 6-foot tapeworm calling your insides home is haunting, tapeworms typically aren't a major threat to your health. Often, they can dwell inside the intestine for years undetected. In rare cases, a tapeworm might cause gall bladder disease, obstruct sections of the intestine or cause a vitamin B12 deficiency.

Treating a tapeworm is very simple. A patient takes one dose of a deworming medication, and that's usually enough to kill them all.

Still, Banh confirmed that the patient will probably avoid sashimi for now.

— CARL ENGELKING

OPPOSITE: NANTPIPAT VUTTHISAK/SHUTTERSTOCK. THIS PAGE: CREVIS/SHUTTERSTOCK

Afternoon clouds roll into a Himalayan valley in Nepal.

Earth's 'Third Pole' Faces Grim Future

There's so much ice packed into the high mountains of Asia that scientists call it Earth's "Third Pole." The Himalayas and the Tibetan Plateau hold the largest reserves of freshwater outside the Arctic and Antarctic.

Here, thousands of glaciers form the headwaters for 10 of Asia's largest rivers, which help supply the region with drinking water, crop irrigation and hydroelectric power. And these glaciers are already melting because of climate change.

In a recent study published in *Nature*, researchers have modeled all the glaciers in Asia to figure out what will happen to them as Earth warms even more.

Their results show a disturbing trend. Asia's glaciers will still see significant

melting even if global governments can meet the optimistic goals under the Paris Agreement, which would hold global warming at 1.5 degrees Celsius. Humans would have to stop burning fossil fuels by 2050. However, if greenhouse gas emissions keep rising, some two-thirds of Asia's glaciers could melt by the year 2100.

That could spell trouble for the millions of people who rely on that water in India, Pakistan, China, Nepal and other neighboring countries. Cross-border tensions go back centuries, and mountain skirmishes are already breaking out among these nuclear-armed nations.

"The irrigation fields and also drinking water and hydropower might really be impacted," says study author Philip Kraaijenbrink of Utrecht University in the Netherlands. "It can be a big cascade of impacts if irrigation changes — if food security changes."

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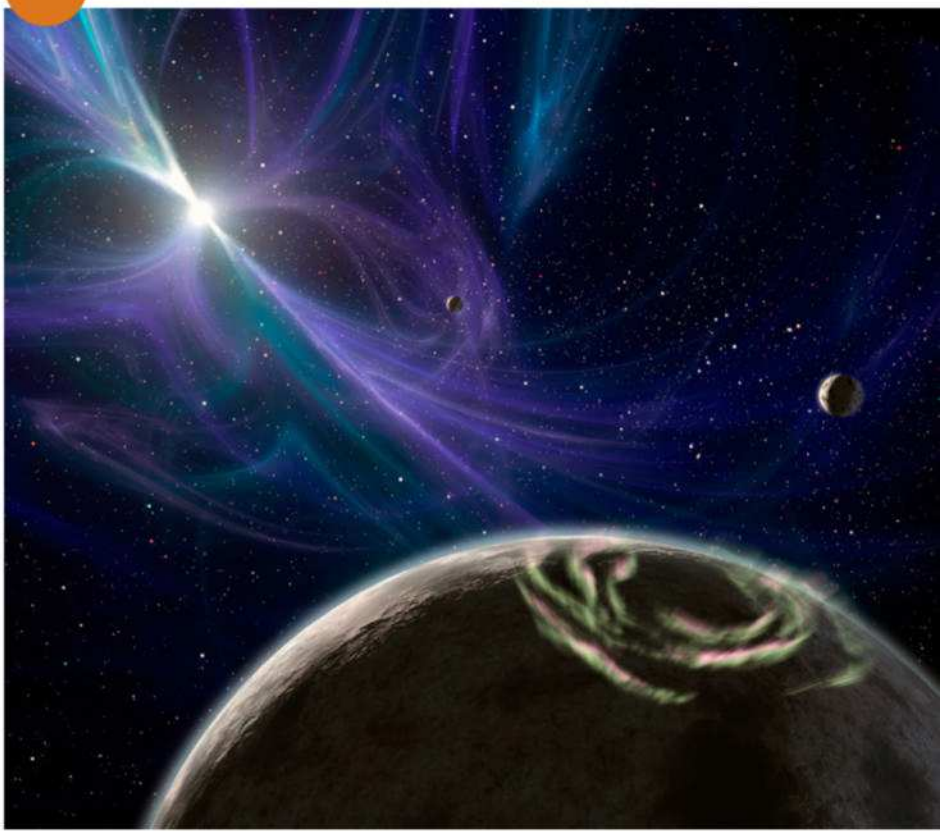
For their study, Kraaijenbrink and his team paired digital models of glacier evolution with satellite observations, then ran thousands of glaciers through various future climate projections. In some regions, they incorporated images Kraaijenbrink captured from small drones to account for localized effects, such as debris-covered glaciers, which can melt faster. Once they'd run the glaciers through many different climate models, they focused on the six that projected what Earth's climate would be like if nations hit the temperature goal of 1.5 C.

They found that Asia's glaciers are already locked into losing roughly 14 percent of their mass, even if emissions stopped now. That's because the glaciers take a long time to shrink or grow to the size their climate will allow.

But their study also provides some sense of optimism. In the past, some scientists suggested Asia's glaciers could vanish entirely in the coming decades. These latest models suggest it would take 11 C of warming to melt the glaciers entirely. That's much hotter than expected, which means we can expect to keep some high mountain glaciers for a while longer.

"The authors have shown that achieving the 1.5 degree C target will conserve a substantial fraction of Asia's water resources," Trent University glaciologist J. Graham Cogley, who wasn't involved in the study, wrote in a *Nature News & Views* companion piece. "If we fail in this regard, we will pay in direct proportion to the extent of our failure." — **ERIC BETZ**

JOSEPH SHEA



Even Near Pulsars, Life May Survive

Exoplanets have dominated astronomy news so much in recent years, some people are getting sick of them. It's funny to think we've known about their existence for only 25 years. Before astronomers announced in 1992 that pulsar B1257+12 had a couple of planets in tow, the idea of planets existing beyond our solar system was just that — an idea. It made sense, but no one had ever seen any.

The not-so-secret motivation behind exoplanet research nowadays is the hope of one day finding an Earth twin, a world that could — or even does — support

life. Pulsars are radiation-spewing monsters, so those first exoplanets couldn't possibly support life, and they've gradually faded from the spotlight. But a paper in *Astronomy & Astrophysics* suggests we shouldn't have been so hasty.

PULSAR PROTECTION

The most exciting exoplanet finds are those that orbit within their host star's habitable zone, an area at just the right distance from the star to allow for liquid surface water and thus, potentially, life. The paper's authors, two astronomers at Leiden Observatory in the Netherlands, suggest that pulsars have their own habitable zones — surprising, given the harsh X-rays and other radiation such stars emit.

But if a planet is big enough — about one to 10 times Earth's mass — and has an atmosphere at least 1 million times as thick as Earth's, then it might just cut it as habitable, even around a pulsar. The idea is that the enormous atmosphere would shield the planet's surface, absorbing the pulsar's deadly radiation while still allowing for enough heat to melt water. And a bigger world, preferably with a decent magnetic field, is necessary to hold on to that atmosphere over long enough time scales.

So not only are pulsar planets in general potentially habitable — as a bonus, the OG pulsar planets specifically may be, too. The paper looked at B1257+12's three planets and found that all three could be in their star's habitable zone, with the two bigger ones fully compatible with habitable conditions — as far as we know, of course. We don't have enough data to tell for sure.

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LIFE FINDS A WAY

This is cool not just for the historical curiosity involved (the very first exoplanets discovered might just be habitable!) but also for what it says about habitability in general. Even the universe's death traps could be survivable!

Life is a hardy thing on Earth, found even in the harshest environments — it doesn't need much. If even pulsars can host habitable planets, it looks like the odds for life existing elsewhere in the cosmos just got that much better.

— BILL ANDREWS

NASA/JPL-CALTECH