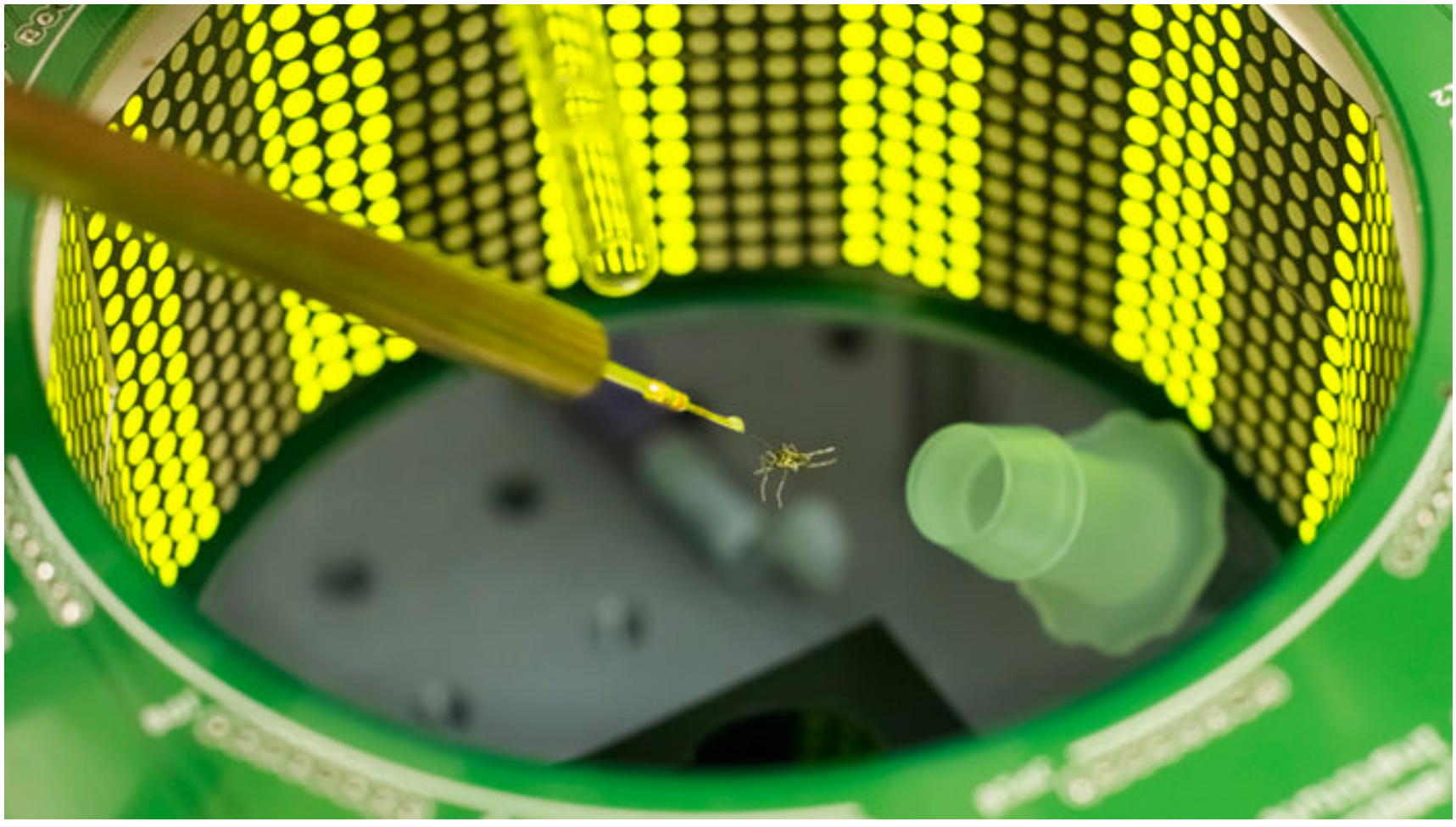

A mosquito in the arena where the insects are taught to shun certain scents. Credit: Kiley Riffell

Neuroscience

25 January 2018

How to teach mosquitoes to avoid temptation

Experiments help to map the insects' response to odours.

Mosquitoes can be taught to steer clear of particular people — even those who smell particularly alluring.

Jeffrey Riffell at the University of Washington in Seattle and his colleagues wafted appealing human odours towards yellow-fever mosquitoes, *Aedes aegytpi*, while also giving the insects swat-like mechanical shocks. The mosquitoes learned to suppress their urge to fly towards the scent — a lesson they were unable to learn after the team disrupted their receptors for dopamine, a compound that carries messages between neurons.

The scientists monitored the mosquitoes' brain cells as the insects learned to suppress their responses to some of the individual compounds in attractive body odours. Different classes of chemicals tended to trigger the firing of neurons in a slightly different patch of the brain, giving the researchers a map of the brain areas involved in coordinating the mosquito's response to odours.

Curr. Biol. (2018)

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More Research Highlights...

Plastic debris can devastate coral reefs. Credit: Kathryn Berry

Ecology

25 January 2018

Plastic trash is sickening the world's coral reefs

Exposure to plastic junk makes fragile reefs highly susceptible to disease.

Plastic waste in the ocean makes reef-building corals highly vulnerable to several potentially fatal diseases.

Joleah Lamb at Cornell University in Ithaca, New York, and her colleagues surveyed 159 reefs in the Asia-Pacific region for signs of disease and plastic pollution, and discovered a dramatic correlation: the likelihood of disease on a coral free of plastic waste was only 4%, but jumped to 89% on a coral blighted by plastic.

The debris might act as a vector for white syndrome, which destroys coral tissue, because the bacteria that trigger outbreaks of the disease are good at colonizing plastic. The low-light, low-oxygen conditions created when plastics settle on coral are also hospitable to the microbes that cause black-band disease, another often-lethal condition.

Plastic seems to be particularly destructive to branching and structurally complex species of coral, which provide crucial habitats for fisheries in the Asia-Pacific region, according to the authors.

Science (2018)

Impalas are fast but cheetahs are faster. Credit: Anup Shah/Minden Pictures/Getty

Animal behaviour

24 January 2018

An evolutionary arms race on

the savannah

Nimble prey slip away during slow chases.

Mighty muscles and phenomenal speed should give powerful predators the edge. But scientists have learned that prey animals have their own winning strategy: the last-minute dodge.

Predators and prey are engaged in a constant evolutionary arms race, each striving to be faster and more nimble than the other. To investigate the animals' interactions, Alan Wilson at the Royal Veterinary College in Hatfield, UK, and his colleagues studied lions in pursuit of zebras, and cheetahs chasing down impalas, on the savannah in Botswana.

The team found that each predator had 20% more muscle power than its prey. Data from animals wearing sensors revealed that predators were also faster and had better acceleration than their intended dinners. But in simulated hunts, prey animals had the advantage at lower speeds, when their agility enabled them to outmanoeuvre their pursuers.

Predators must be more athletic than their quarry to survive, the authors conclude.

Nature (2018)

A toothy predator punctured this shell of an Aldabra tortoise, an animal that can reach 250 kilograms. Credit: T. M. Scheyer et al./Royal Soc. Open Sci./CC BY 4.0

Palaeontology

24 January 2018

Extinct crocodile tackled challenging prey

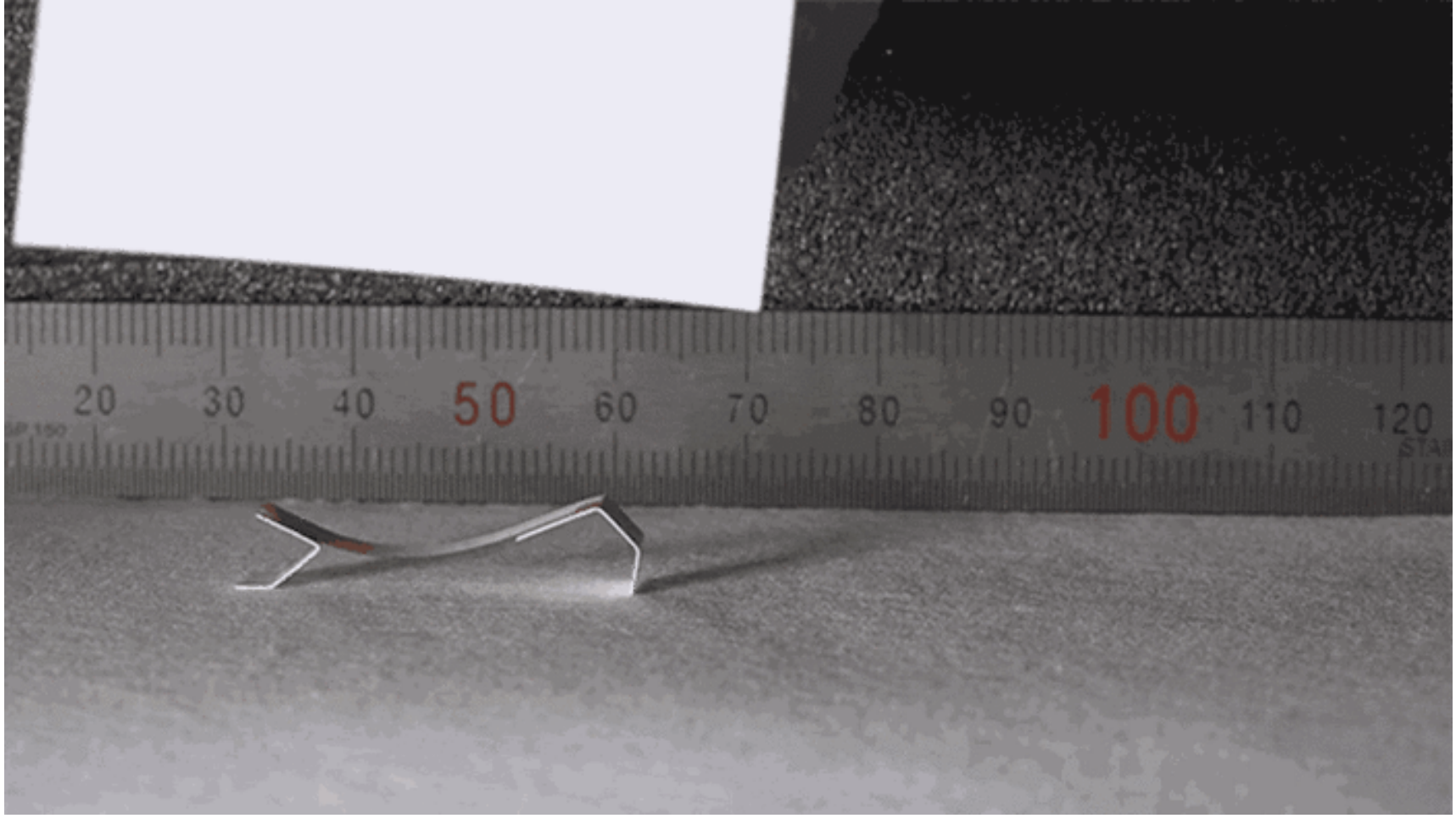
Even immense tortoises weren’t safe from this island predator.

An ancient crocodile that measured more than 3.5 metres from snout to tail was large enough to tackle super-sized prey.

The Aldabra tortoise (*Aldabrachelys gigantea*) lives on an island of the same name in the Indian Ocean and can measure up to 1.2 metres in length. Adult animals have no natural predators, because no animal can open its mouth wide enough to crack their shell. Near a pond on the island, members of a team headed by Torsten Scheyer and Dennis Hansen of the University of Zurich in Switzerland found fossilized remains of these tortoises that dated to between 90,000 and 125,000 years ago. The fossils bore puncture marks and scratches characteristic of a predator attack.

At the same site, the researchers found fossils from the same period of a 3-to-4-metre-long crocodile that is now extinct. These huge predators may have attacked giant tortoises that came to drink from the pond, the authors say.

R. Soc. Open Sci. (2018)



This miniature robot’s inchworm-style movement is powered by the wet paper beneath its feet. Credit: B. Shin et al./Sci. Robot

Technology

24 January 2018

An inchworm robot powered by humidity

Plant-inspired ‘microbot’ creeps forward on two legs.

A simple bio-inspired robot propels itself forward by absorbing moisture from its environment.

Many plants generate motion by moving fluid through their tissues. A team led by Ho-Young Kim at Seoul National University designed a robot, measuring only a few centimetres in length, that works on similar principles.

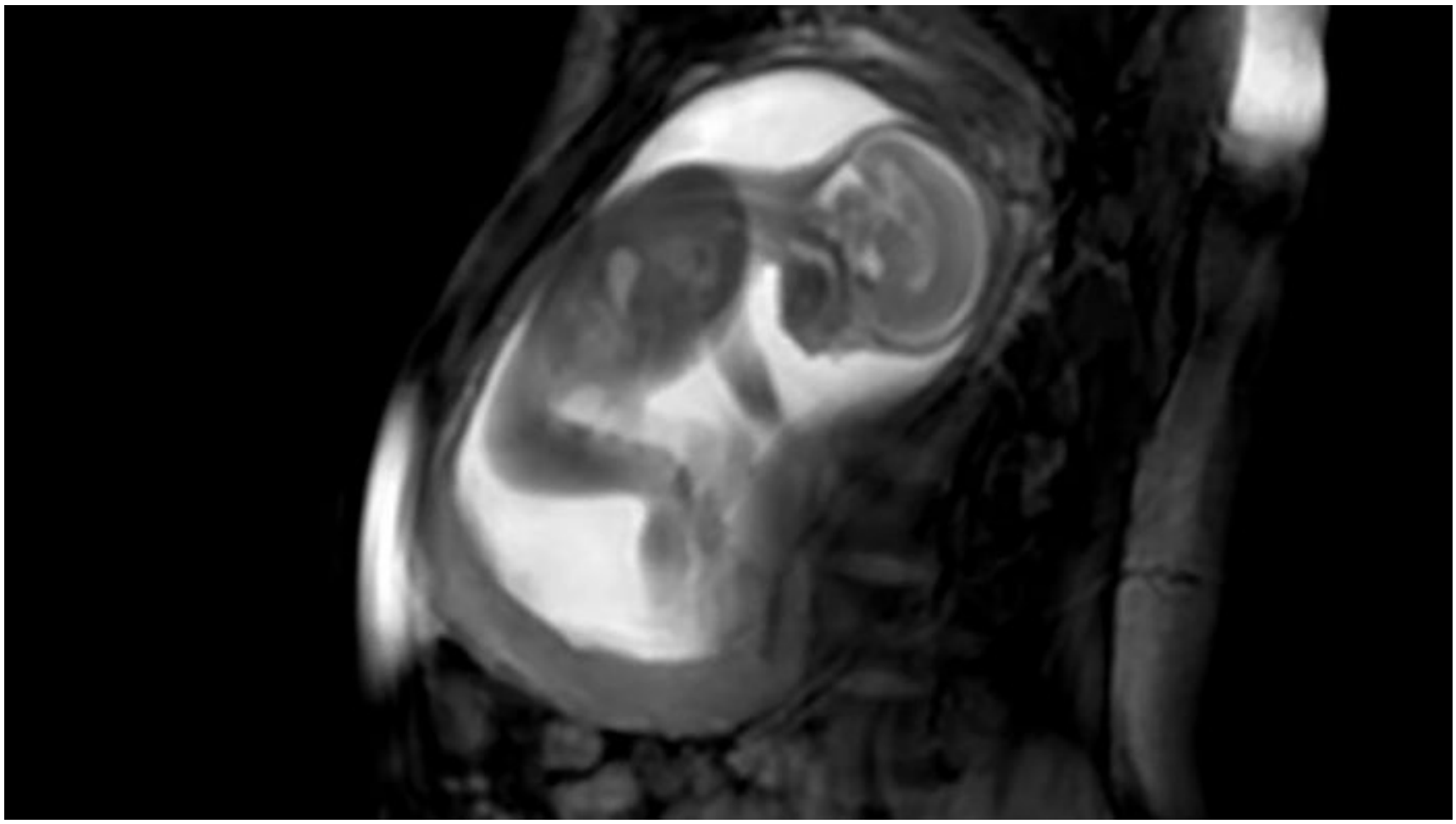
The microbot has two legs and a body made up of two layers: an upper layer that expands when moistened, and an inert lower layer. When the robot is placed on damp paper, expansion of the upper layer causes the robot’s body to arch away from the surface. This pulls its hind leg forward and lifts the robot into less-humid air, where it dries. Once dry, the contracting forces exerted by the inert layer take over. The robot’s body sags back towards the wet surface, its front leg moves forward and the cycle repeats, allowing the microbot to scoot forward like an inchworm.

Similar microbots could be designed to crawl across moist human skin for medical purposes, the authors say.

Sci. Robot. (2018)

Share

Continue Reading about An inchworm robot powered by humidity



A fetus in the womb. Credit: Division of Imaging Sciences & Biomedical Engineering, King's College London/CC BY

Biomechanics

24 January 2018

Fetal kicks do more than make Mum jump

Movements in utero help to build a strong skeleton.

For the first time, researchers have calculated the forces generated by the movements of human fetuses, and the effects that these forces have on the growing skeleton.

When a fetus kicks and wriggles, its movements place stress and strain on its skeleton. These forces are thought to stimulate healthy development of muscles and bones, but directly measuring their effects has been difficult.

Niamh Nowlan at Imperial College London and her colleagues analysed the kicks of 20- to 35-week old fetuses whose movements had been recorded using an advanced type of magnetic resonance imaging. After creating mathematical models of the uterine wall and the fetuses' limbs to infer muscle forces and skeletal impacts, the researchers found that kick forces rose between 20 and 30 weeks' gestation. Later in gestation, kick forces decreased. But stresses and strains on the fetal skeleton were high throughout the second half of pregnancy, the authors say, probably owing to crowding in the womb.

J. R. Soc. Interface (2018)

Materials science

23 January 2018

Jelly blocks that send a message

Glowing mosaics can be sliced and diced to change their encrypted content.

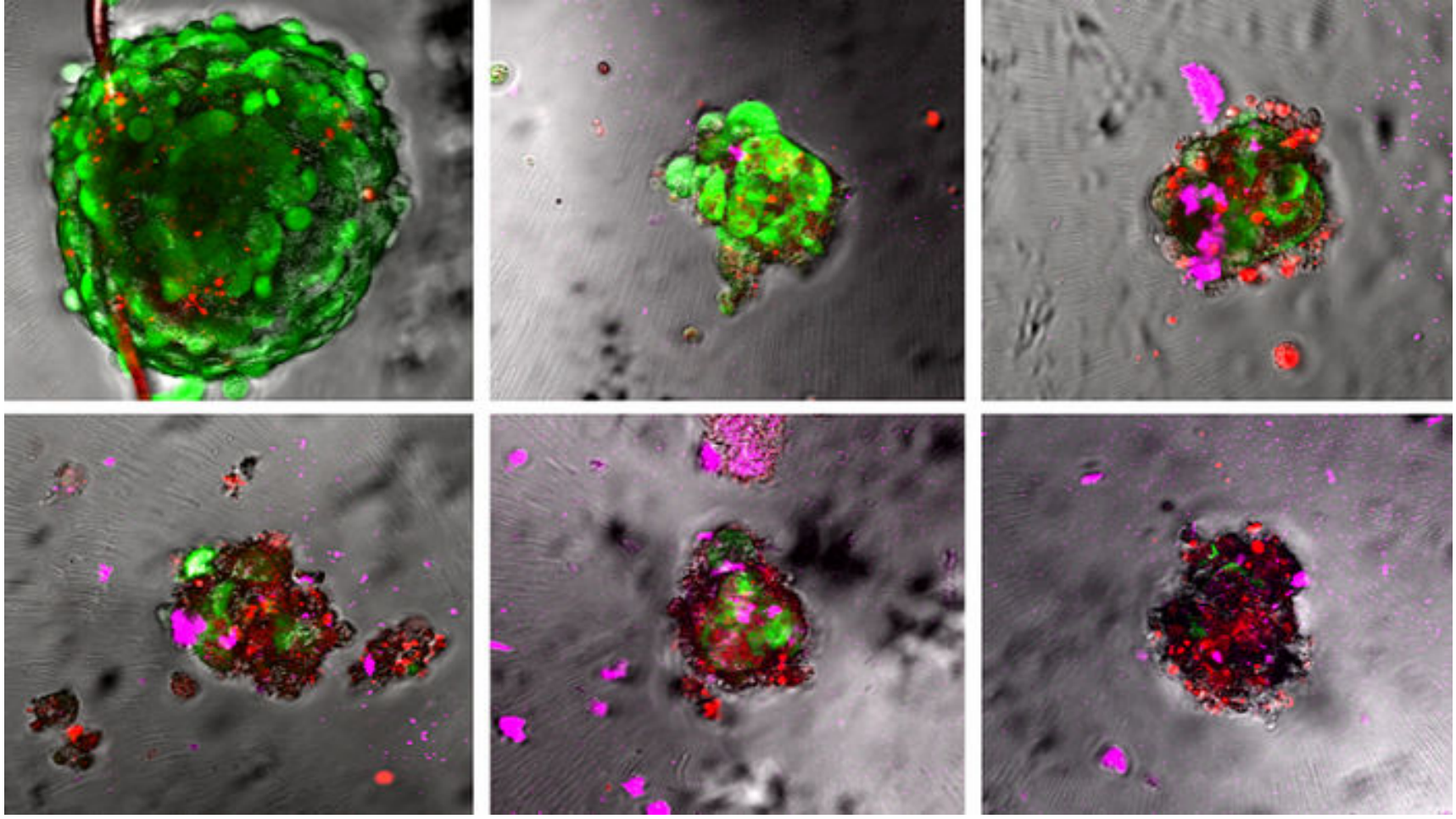
Information can be encoded in a mosaic of fluorescent gel cubes, and can be easily manipulated by changing the cubes' positions.

Jonathan Sessler at the University of Texas at Austin and his colleagues devised a recipe for sticky gel cubes that glow red, blue or green when illuminated with ultraviolet light. When 25 cubes were pushed together, they adhered to form a rough square. The team programmed a smartphone to display a designated website when the phone detected a square with a particular colour pattern.

The researchers could mask the encoded information physically, by excising one gel cube, or chemically, by sprinkling the cubes with a compound that quenched their colours. The mosaic could also be cut and the cubes rearranged to form a pattern that triggered the display of a second website.

The soft gels could be incorporated into smart clothing, the authors say.

Adv. Mater. (2018)



Nano-pills loaded with a potent drug infiltrate simulated tumours (living cells in green) and kill them (dead cells in red). A control tumour (upper left) showed no change, but tumours treated with increasing concentrations of the drug (lowest, upper middle panel; highest, lower right) succumbed. Credit: L. Su et al./J. Am. Chem. Soc.

Biochemistry

23 January 2018

A sweet pill turns deadly for tumours

Glucose-based nano-pill delivers potent drug to cancer cells, then fades away.

Nanoparticles have been designed to sneak into tumour cells and blast them with anti-cancer drugs before degrading into harmless byproducts.

Karen Wooley and Justin Smolen at Texas A&M University in College Station and their colleagues sought to develop a drug-carrying nanoparticle that could kill cancer cells but minimize collateral damage to healthy cells. To do this, the team based their nanoparticle on the sugar glucose, which breaks down into simple products.

The team loaded the nanocarrier with a version of the potent cancer drug paclitaxel, which is activated by molecules that are found in greater quantities in cancerous cells than in normal cells. The nanoparticles are just the right size to penetrate cells in lung tissues.

When mice with metastatic tumours in their lungs inhaled the nanoparticles, growth of the metastases slowed, raising hopes for future lung-cancer treatments.

J. Am. Chem. Soc. (2018)

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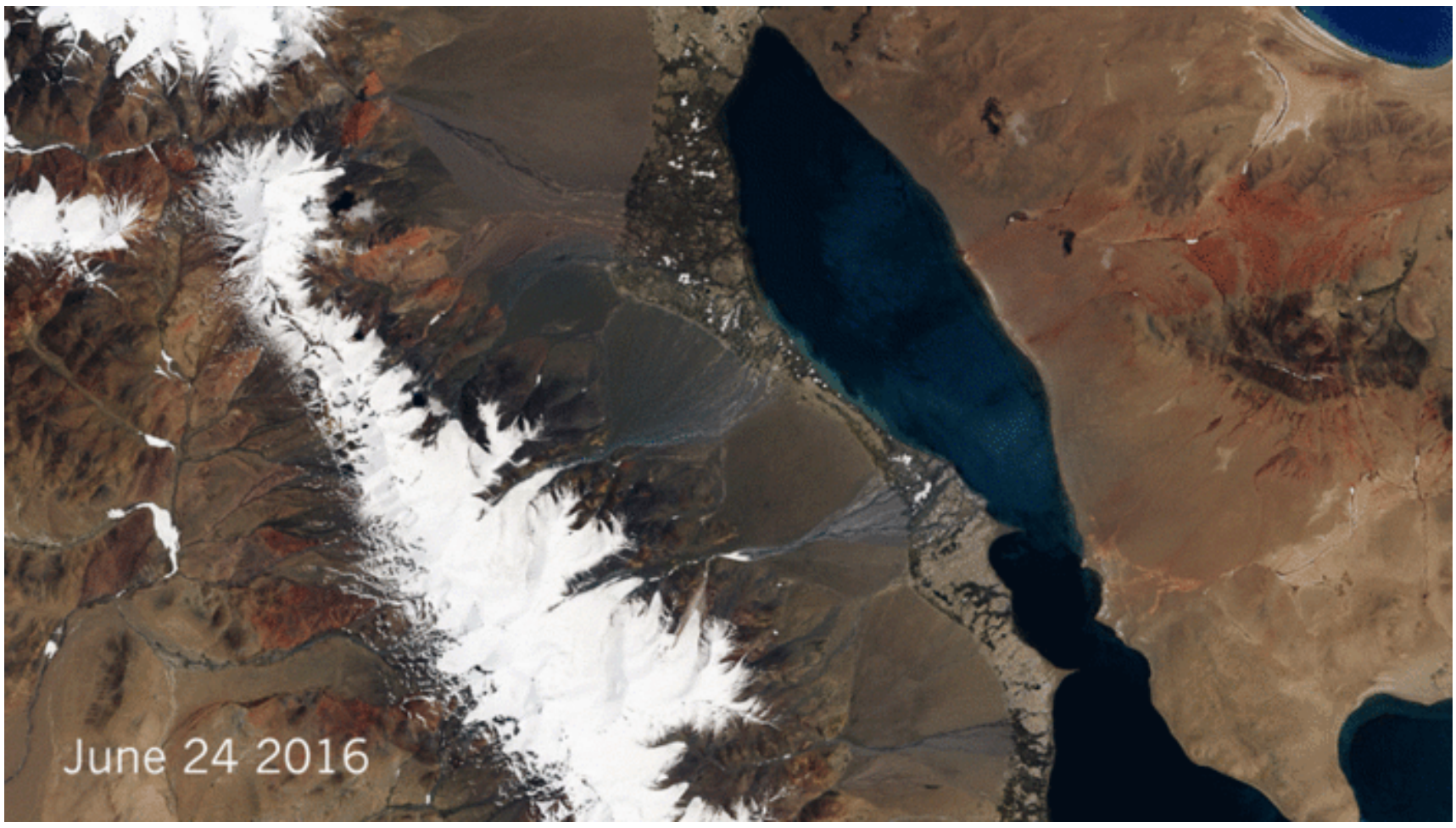
Continue Reading about A sweet pill turns deadly for tumours



The same mountain valley in Tibet is shown before and after part of a glacier sheared off on 17 July 2016. Credit: NASA/Joshua Stevens/USGS/ESA

Climate sciences

22 January 2018

The underlying causes of Tibetan ice avalanches

Similar collapses could be predicted.

The collapse of two valley glaciers in Tibet was partly the result of the region’s changing climate.

In July 2016, part of a glacier in the Aru Range broke away and slid down the valley, killing nine people. Two months later, a neighbouring glacier shattered in a similar manner.

During the past two decades, local temperatures and precipitation levels have risen, making the glaciers steeper and causing more liquid water to flow to their bases, says a team led by Andreas Kääb at the University of Oslo. These changes put stress on the glaciers and made them vulnerable to collapse. Other factors, such as valley geometry and the type of rock at the glaciers' base, also had a role in the process.

These collapses represent a new type of failure of glaciers in relatively flat valleys. The authors say that available technology could be harnessed to create early-warning systems for such events.

Nature Geosci. (2018)

Continue Reading about The underlying causes of Tibetan ice avalanches

An electric car gets ready to roll. Credit: Kiyoshi Ota/Bloomberg /Getty

Energy

22 January 2018

Cars that are good for the air

but bad for the grid

Drivers who charge plug-in cars at home could harm power infrastructure.

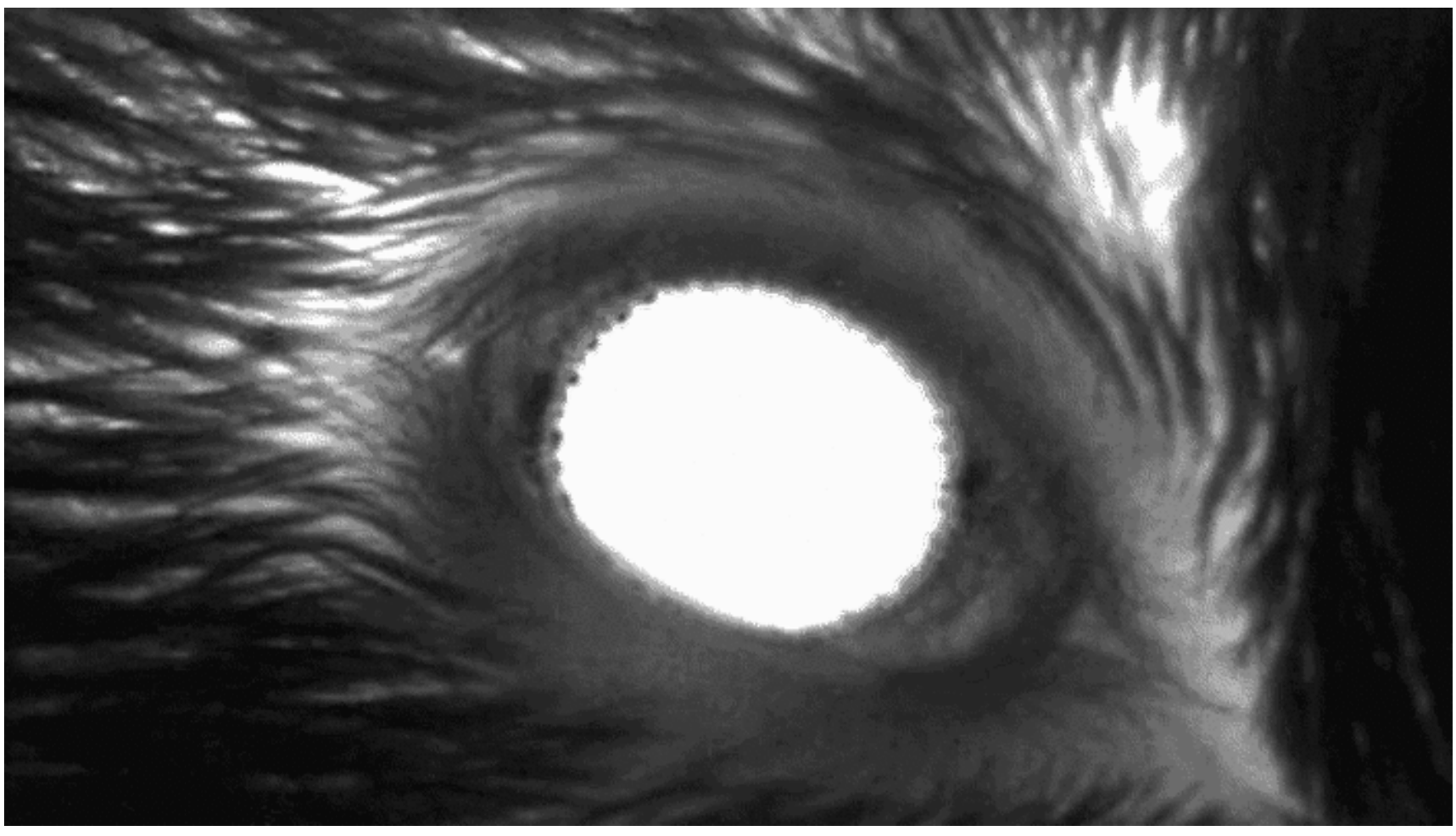
Plug-in electric vehicles are lauded for their low emissions, but could cause headaches for utility companies by creating spikes in power demand.

Previous studies have tended to assume that drivers would charge such vehicles when overall power demand is lowest. Matteo Muratori at the US National Renewable Energy Laboratory in Golden, Colorado, used models to predict what would happen if drivers plugged in their vehicles as soon as they got home.

Muratori found that if every home in a six-household neighbourhood had a plug-in electric vehicle, the peak demand on the electrical transformer serving that neighbourhood could rise by as much as 60%. That's enough to shorten a transformer's lifespan.

Future studies should analyse drivers' willingness to postpone charging to periods when power demand is low, Muratori says.

Nature Energy (2018)



The pupils of mice constrict and widen whether the animals are asleep or awake. Credit: Özge Yüzgeç, Mario Prsa, Robert Zimmermann, Daniel Huber

Neuroscience

19 January 2018

The eyes’ guardians of sleep

How pupils keep the brain in the dark.

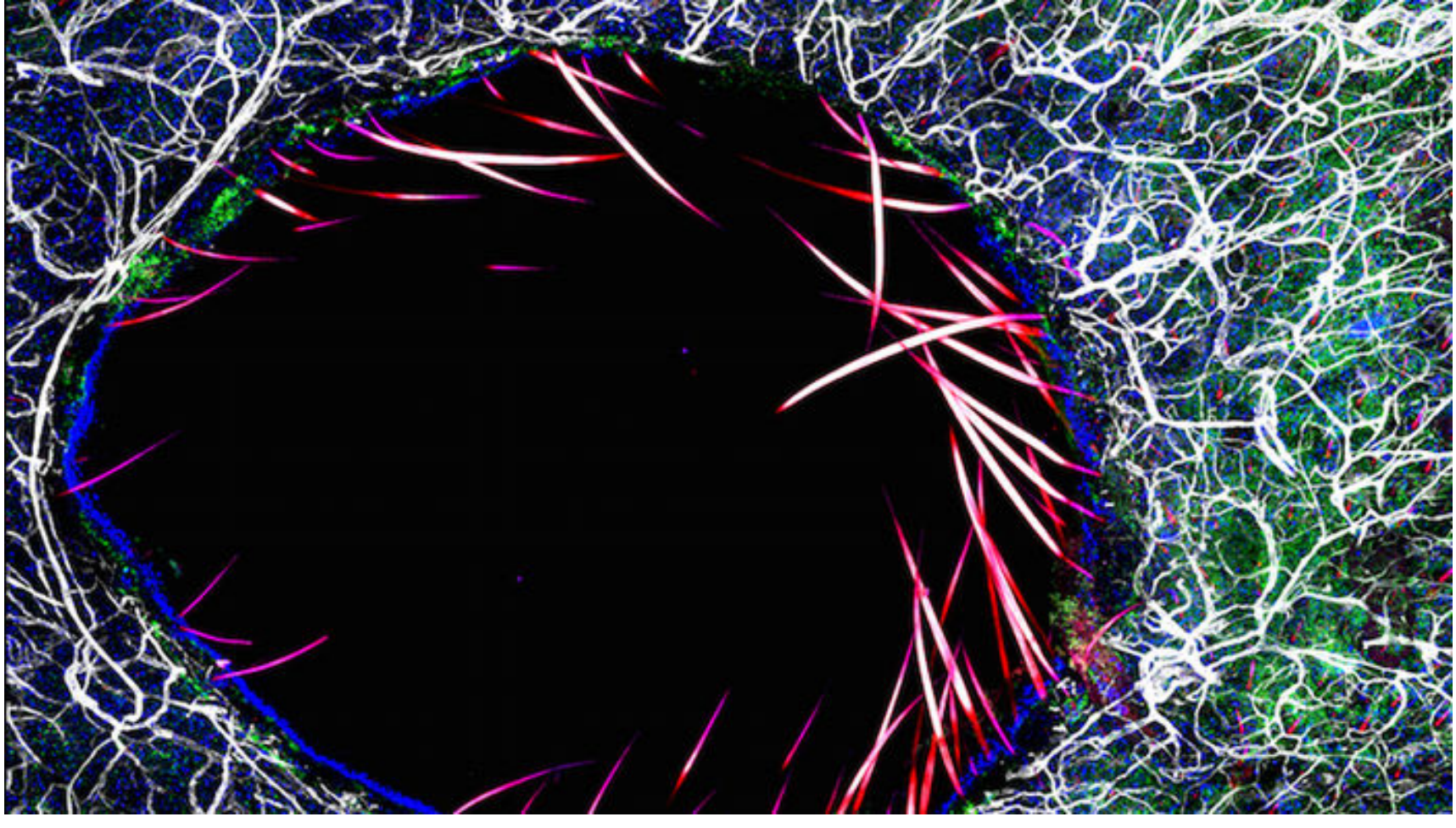
The secret to a night of sound slumber has been hidden behind closed eyelids. But now scientists have used infrared light to spy on the sleeping eye.

Daniel Huber and his colleagues at the University of Geneva in Switzerland illuminated the back of the pupil with infrared light, allowing the researchers to track fluctuations in pupil diameter in dozing mice. The team found that when mice snoozed, their pupils continued to shrink and widen, as they do during wakefulness.

Pupil oscillation was closely linked to activity in a brain region responsible for functions such as memory. During a period of dreamless, deep sleep when memories are consolidated, the animals’ pupils constricted considerably, limiting the light that entered the eye.

Super-constricted pupils probably serve as reinforcement for the eyelid to protect crucial brain functions from interruption, the team suggests.

Curr. Biol. (2018)



A skin wound is fringed by hairs (pink-white), and surrounded by immune cells (green) and beneficial bacteria too small to be imaged. Credit: NIAID

Immunology

18 January 2018

Bacteria on your skin could speed healing

The immune system and microbes join forces to overcome injury in mice.

Microbes on the surface of the skin help the immune system to respond to injury and heal wounds.

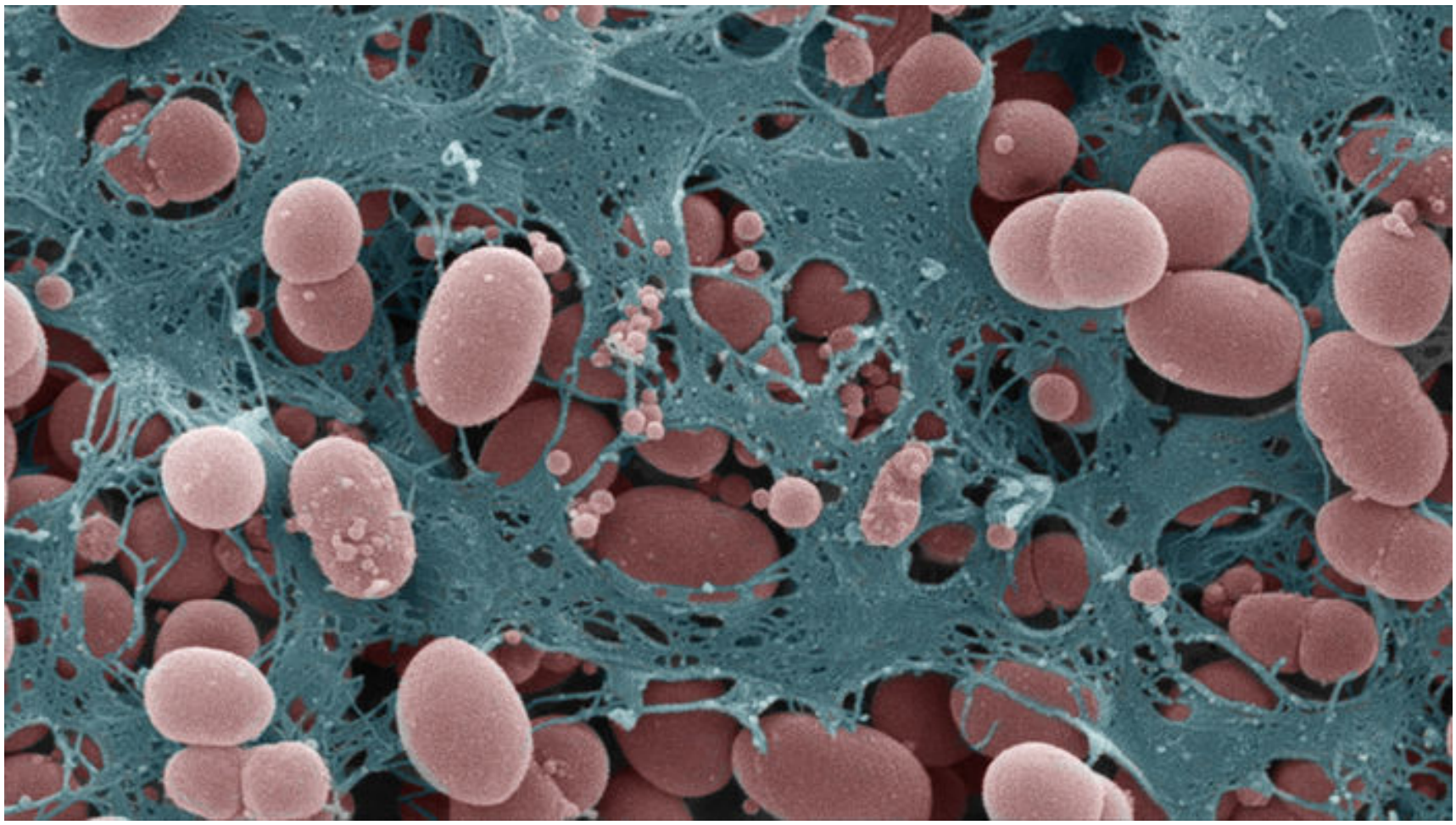
Immunity research has historically focused on the response to pathogens and inflammation, and so relatively little is known about how our own microbiota interact with and regulate the immune system. Yasmine Belkaid at the National Institute of Health in Bethesda, Maryland, and her colleagues set out to understand how the immune system senses and responds to microbes living on the body. Studying mice, they found that after injury, the immune system recruits different molecules to detect skin microbes than it uses to sense pathogens, and that its response to certain microbes encourages tissue repair.

Future research will explore whether the findings apply to humans, and whether a deeper understanding of certain microbes' role in immunity could lead to novel approaches to tissue repair, a fundamental challenge in medicine.

Cell (2018)

Share

Continue Reading about Bacteria on your skin could speed healing



A biofilm of *Escherichia coli* bacteria (red) enmeshed in a network (green) made partially of cellulose. Credit: Diego Serra & Regine Hengge

Biochemistry

18 January 2018

How bacteria make their fortresses

Insights into bacterial biofilms could help to beat antibiotic resistance.

Researchers have determined the structure of a crucial ingredient in bacterial biofilms, the sticky matrices that help to protect communities of bacteria from antibiotics.

To learn more about how these films function, Lynette Cegelski at Stanford University in California, Regine Hengge at the Humboldt University of Berlin and their colleagues isolated bacterial cellulose — a primary ingredient in the biofilm matrix —

and used spectroscopy to probe its structure.

Plants are the best-known producers of celullose, which forms their cell walls. The team discovered that bacterial cellulose has an extra molecular group, called phosphoethanolamine, that plant cellulose does not. The team also identified the genes involved in triggering the assembly of this addition.

These insights will help to illuminate how bacterial biofilms are able to resist antibiotics, the researchers say.

Science (2018)

Continue Reading about How bacteria make their fortresses

A male saiga antelope on the steppes of Russia. Credit: Getty

Infection

18 January 2018

Mass die-off of rare antelope linked to heat

High temperatures and humidity made a harmless bacteria lethal.

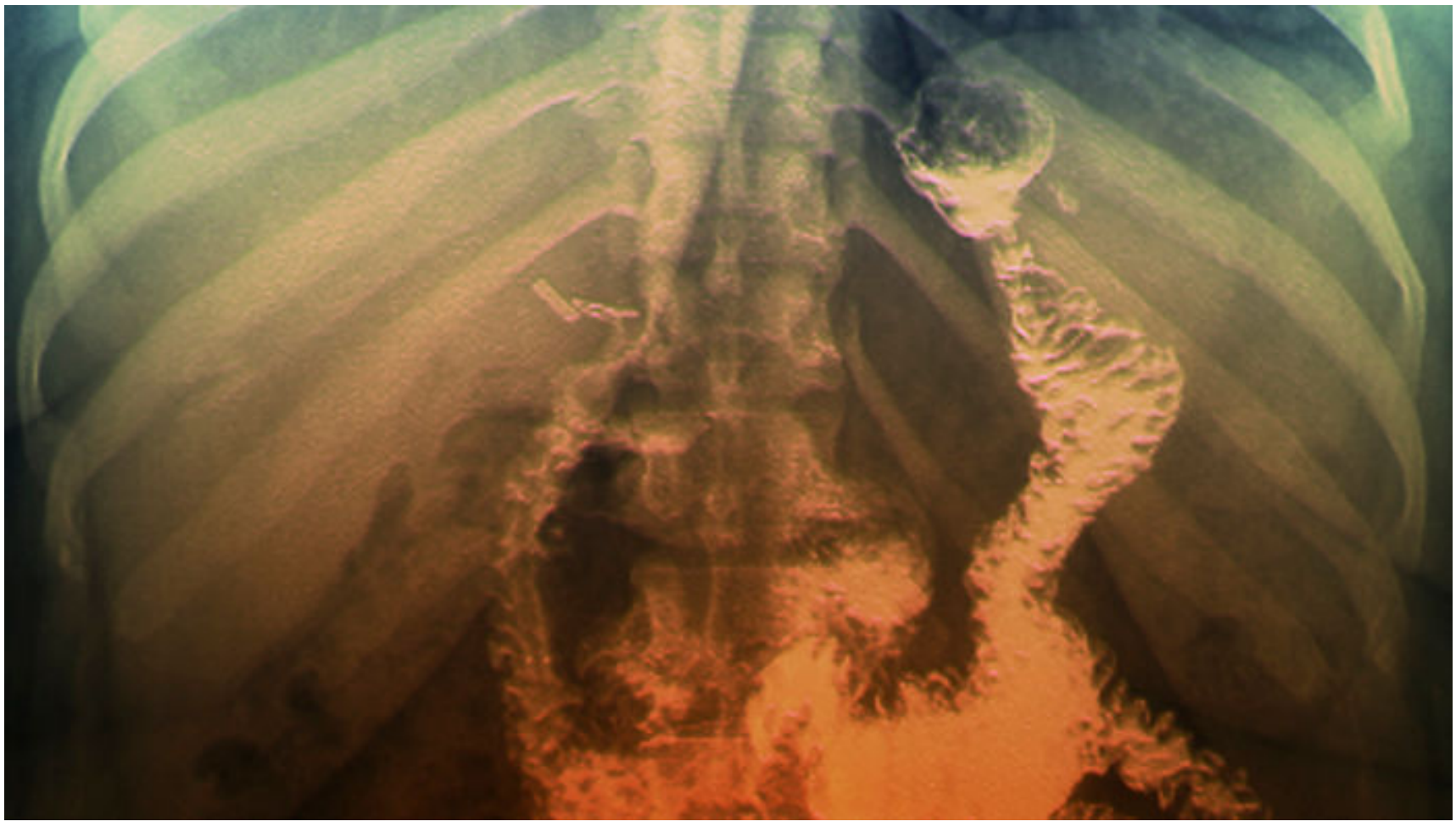
Climatic conditions transformed a usually harmless bacterial infection into a dangerous outbreak that killed more than 60% of the world's saiga antelope.

More than 200,000 saiga antelope (*Saiga tatarica tatarica*) in Kazakhstan died of a virulent infection over a 3-week period in May 2015. Richard Kock at the Royal Veterinary College in London and his colleagues conducted post-mortem examinations of 33 animals and identified a bacterium (*Pasteurella multocida*), which caused extensive internal bleeding, as the culprit.

The bacterium does not typically harm healthy saiga, which suggested that an environmental factor might have made the microbe more dangerous. The team analysed weather data from 1979 to the mid-2010s, a period that included three mass die-offs of saiga — in 1981, 1988 and 2015. They found that the outbreaks were linked to relatively high daily temperatures and humidity levels.

Careful management is needed to protect the remaining populations of this critically endangered species, especially in the face of climate change, the authors say.

Sci. Adv. (2018)



An X-ray shows the shrunken gastrointestinal tract resulting from a gastric bypass, an operation that can help obese people to lose weight. Credit: Zephyr/SPL

Medical research

17 January 2018

Surgery that slims also cuts risk of death

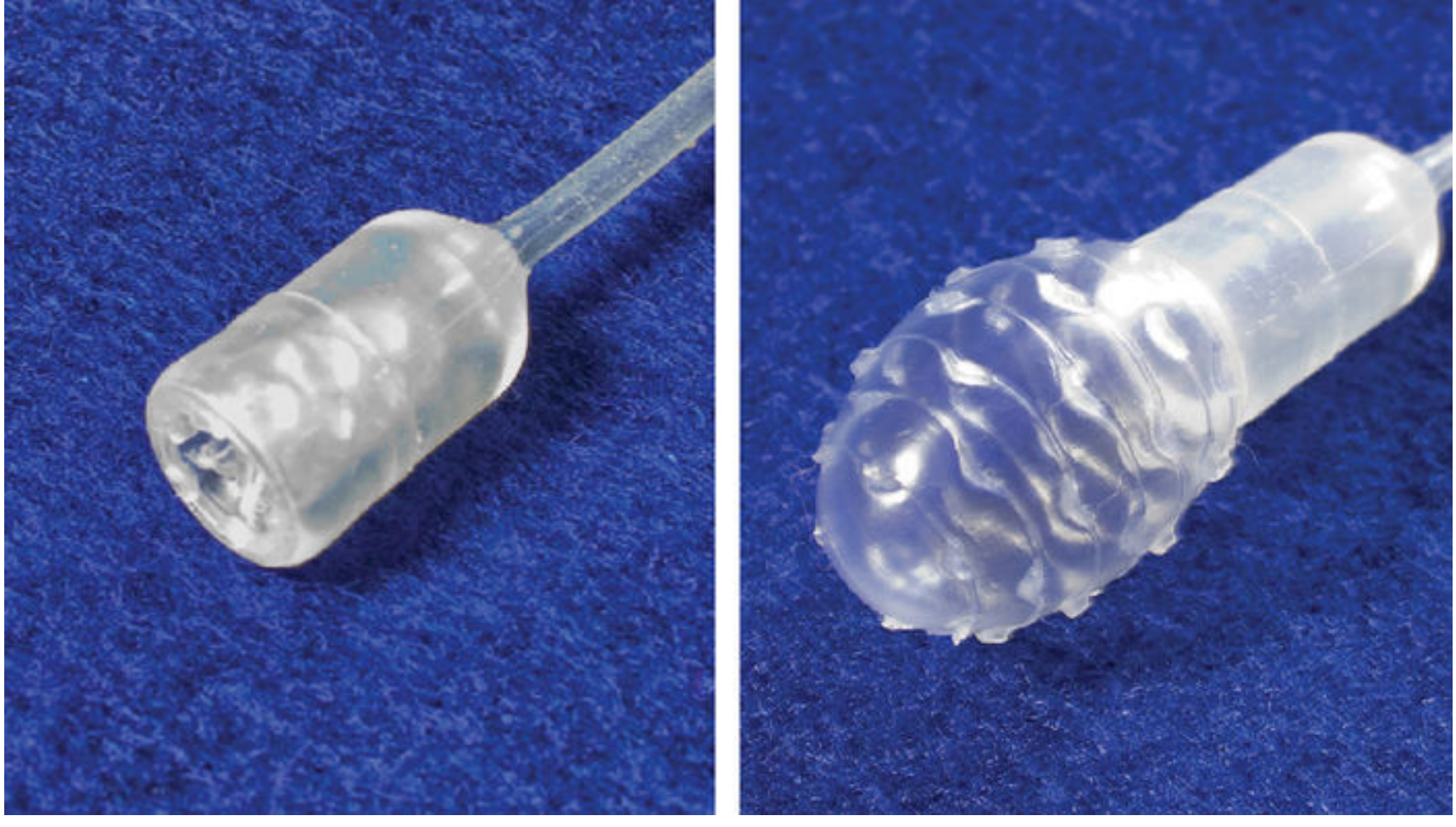
Health benefits persist years after procedure.

Weight-loss operations could cut death rates in people who are obese, according to a large study performed in Israel.

Bariatric surgery, which aims to reduce patients' weight, is known to produce health benefits in the short term, but relatively little is known about its long-term effects. To address this question, Orna Reges at the Clalit Research Institute in Tel Aviv and her colleagues studied the health records of 8,385 people who had undergone gastric bypass or other types of surgery to treat obesity between 2005 and 2014. The researchers examined the patients' medical outcomes up until the end of 2015 and compared the records against those of more than 25,000 obese individuals of similar age, sex and health who did not receive surgery.

Over a median follow-up period of 4.5 years, mortality rates were significantly lower among people who had had surgery: 1.3% died, compared with 2.3% of non-surgical patients.

J. Am. Med. Assoc. (2018)



A capsule only 1.6 centimetres long conceals a mini-balloon that can be inflated in the stomach after the capsule is swallowed. Credit: Carla Schaffer/Moinova et al./AAAS

Cancer

17 January 2018

A tiny balloon to survey cancer risk

Inflatable device samples cells for signs of a pre-cancerous condition.

An easily swallowed mini-balloon might offer a way of screening people who are at risk of esophageal adenocarcinoma, a deadly type of cancer.

Sanford Markowitz at Case Western Reserve University in Cleveland, Ohio, and his colleagues developed an aspirin-sized capsule containing an uninflated balloon. After being swallowed, the balloon can be inflated in the stomach, and then pulled through the esophagus and deflated before recovery through the mouth.

The team used the balloon to collect esophageal cells in the hope of identifying a biological marker for a condition called Barrett's esophagus, which often precedes esophageal adenocarcinoma. A genetic analysis of cells from more than 400 people, including samples retrieved using the balloon technique, revealed a pattern of DNA modifications that accurately detected 90% of Barrett's-esophagus cases.

Barrett's esophagus is currently diagnosed by passing an endoscope through the mouth into the stomach. The balloon method in combination with DNA analysis could provide an efficient and minimally invasive technique for screening large numbers of people, the authors say.

Sci. Transl. Med. (2018)

The colony of endangered African penguins on South Africa's Robben Island shrank from about 4,200 to some 1,200 breeding pairs between 2008 and 2015. Credit: Richard B. Sherley

Ecology

17 January 2018

Baby penguins benefit from fishing bans

South African survey provides rare evidence on fishery impacts.

Even modest restrictions on fishing can improve survival rates for penguin chicks in South Africa.

Richard Sherley at the University of Exeter, UK, and his colleagues monitored chicks in populations of African penguins (*Spheniscus demersus*) on South Africa's Robben Island and neighbouring Dassen Island. For all but one year between 2008 and 2015, fishing was banned within 20 kilometres of one or other of the islands.

The team found that chick survival improved by 11% in years when fishing was prohibited. Computer simulations showed that the fishery closures reduced the risk that these colonies would decline to fewer than 500 breeding pairs by 2025. Below that number, the long-term odds of colony survival drop to less than 50:50.

But the team found that closures had no consistent effect on the African penguin colonies on two other South African islands. All the same, the results provide some of the first evidence that human harvests of small, schooling fish can affect entire populations of marine predators, the authors say.

Proc. R. Soc. B (2018)

Continue Reading about Baby penguins benefit from fishing bans

Image enhancement revealed that this faded painting depicts not a hawk carrying an egg, as previously thought, but a vulture holding a symbol known as an ankh — a rare combination in the art of ancient Egypt. Credit: L. Evans & A. -L. Mourad/J. Archaeol. Sci. Reports

Archaeology

16 January 2018

Egyptian tombs depict seldom-

seen creatures

Imaging technique reveals painted details lost to time.

Brightly coloured paintings of pigs and other creatures rarely seen in Egyptian art have been found on the walls of ancient tombs by scientists using image-enhancement software.

Detailed depictions of ordinary life adorn 12 tombs at the Beni Hassan cemetery, which sits alongside the Nile River south of Cairo and dates to the period known as the Middle Kingdom, from 2050 to 1650 bc. Hoping to reveal obscured details, Linda Evans and Anna-Latifa Mourad at Macquarie University in Sydney, Australia, examined the artworks with software that highlights trace pigments.

The software revealed details such as a pig and two bats, which are seldom shown in images from the time of the pharaohs. The technique also revealed a previously unidentified bird to be a vulture clutching a religious symbol in its talons.

The technique could be used to uncover a wealth of hidden detail in the extensive wall paintings of ancient Egypt, the researchers say.

J. Archaeol. Sci. Rep. (2018)

A man is treated for malaria in Thailand. Credit: Pornchai Kittiwongsakul/AFP/Getty

Infection

16 January 2018

Lethal malaria parasite’s weaknesses revealed

Genomic insights could inform discovery of more durable drugs.

A sweeping genomic analysis of the most deadly malaria parasite has revealed targets for more resilient drugs against the pathogen.

The parasite *Plasmodium falciparum* has evolved resistance to every licensed drug. To aid the search for compounds that present higher barriers to resistance, a team led by Elizabeth Winzeler at the University of California, San Diego, exposed 262 strains of *P. falciparum* to a range of antimalarial agents. By analysing the genomes of strains that evolved resistance to the chemicals, the researchers identified the mutations that were most- and least-often linked to the parasite’s ability to survive an onslaught of antimalarial drugs.

The team reasoned that genes with infrequent mutations would make good drug targets, because they seem less likely to adapt to new antiparasitic agents. Some of those genes code for enzymes, which can be targeted by drugs that are easier to administer than other types of therapy.

Science (2018)

Supercooled water was made by spraying microscopic water droplets into a vacuum.

Physics

12 January 2018

Liquid water chilled to –42.6 °C

Supercool technique allows precision measurement.

Under certain conditions, water can exist in a liquid state well below its freezing point, but reliably measuring the temperature of such ‘supercooled’ water has proved challenging. Physicists now report a technique that allowed them to make exceptionally accurate measurements.

Robert Grisenti at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany, and his colleagues sprayed micrometre-sized droplets of water into a vacuum. Molecules of water evaporated from the surface of the droplets, making them smaller and colder.

The droplets shrink proportionally as they cool, which enabled the researchers to determine the water’s temperature by measuring droplet size with a laser. The team achieved this with 10-nanometre precision, and calculated the water’s temperature to be –42.6 °C.

Because supercooled water occurs naturally in Earth’s upper atmosphere, gaining a better understanding of its properties, as well as how and when it transforms into ice, could help researchers to develop more-reliable climate models, say the authors.

An earlier version of this story incorrectly stated that the summarized paper included observations of "a record low

temperature" for liquid water.

Phys. Rev. Lett. (2018)

Share

Continue Reading about Liquid water chilled to –42.6 °C

Nature

ISSN 1476-4687 (online)