

pace with climate change.

Tereza Jezkova and John Wiens of the University of Arizona, Tucson, looked at 56 plant and animal species and documented shifts in their 'climatic niche' — the temperature and precipitation conditions they survive in.

They compared these shifts in climatic niches with rates of predicted future change under global warming. On average, expected rates of change in temperature were more than 200,000-fold higher under future climate conditions than rates seen in past shifts, and precipitation changes were more than 10,000-fold higher. Even those groups that had the fastest niche shifts in the past will still experience rates of temperature change that are 300-fold higher in future.

Historical changes were slowest for tropical species, suggesting that they will be especially vulnerable to climate change, the authors warn. *Proc. R. Soc. B* <http://doi.org/btn5> (2016)

## PALAEOLOGY

## Ancient reptile had a diaphragm

The muscle that allows mammals to breathe deeply — the diaphragm — may have been present in some reptiles 300 million years ago, about 50 million years before it was thought to have appeared. Markus Lambertz at the University of Bonn in Germany and his colleagues studied the fossilized skeletons of caseids: extinct mammal-like reptiles that lived 300 million years ago (artist's impression **pictured**). These creatures weighed around 500 kilograms, with short necks that would have made foraging difficult and barrel-shaped bodies that would have restricted their ability to move air into their lungs. Their bones were lightweight and filled with air bubbles, similar to modern whales. The researchers conclude that caseids were probably aquatic, similar to present-day

manatees (sometimes known as sea cows), and must have had muscular diaphragms to inhale all the air they needed during brief trips to the surface.

*Ann. N.Y. Acad. Sci.* <http://doi.org/btkw> (2016)

## QUANTUM PHYSICS

## Record set for linked photons

Particles that have linked quantum states, known as 'entangled' particles, can affect each other's states even if they are physically separated. Now scientists have set a record by entangling ten photons — two more than achieved previously.

Entangled particles should one day enable quantum computing and communications, but they are inefficient to produce. A team led by Jian-Wei Pan of the University of Science and Technology of China in Hefei created the ten entangled photons by running five photon pairs through a series of four polarizing beam splitters. They also developed a laser light source that produced their photon batches about 100 times faster than did previous tests. *Phys. Rev. Lett.* 117, 210502 (2016)

## MATERIALS SCIENCE

## Atom-thick coats for copper

Coating metals with a high-quality, single-atom-thick layer of 2D boron nitride can protect them from corrosion.

Layers of 2D materials have been touted for use as protective coatings on surfaces but have shown mixed results,

with some apparently even increasing corrosion rates in the long term.

Zhenguo Huang at the University of Wollongong in Australia and his colleagues used optical microscopes and spectroscopy to study how well films of the insulator boron nitride protect copper from corrosion. They found that copper coated with a high-quality atom-thick film of the material remained almost unaffected by salt water over 1 hour, whereas coating the metal with a multi-layered but cracked film increased corrosion. Such defects probably accelerate oxidation, so coatings could be improved by patching up imperfections and growing films with fewer defects, the authors suggest. *Adv. Mater.* <http://doi.org/f3s8tb> (2016)

## MATERIALS

## Sensor detects UV exposure

A sensor that sticks to the skin can give colour-coded readouts of ultraviolet light levels from the Sun, the leading cause of skin cancer.

John Rogers at the University of Illinois at Urbana-Champaign and his colleagues developed the stretchable device (**pictured**), which is less than one-fifth of a millimetre thick. It has several layers, including a compound that changes the colour of a dye when activated by UV light; filters to monitor both UV-A and UV-B radiation levels; and a small chip that wirelessly sends signals to a nearby device.

The technology could be used to manage UV exposure



on certain regions of the body, and could be adapted to sense other types of environmental exposure, such as pollution and chemical or biological agents, the authors say.

*Adv. Funct. Mater.* <http://doi.org/f3s7dr> (2016)

## EPIGENETICS

## Gut microbes shape DNA

Gut microbes and the fatty acids they produce can regulate gene expression by influencing the 3D shape of their hosts' DNA.

Intestinal bacteria are known to affect several aspects of host health, including the risk of cardiovascular and metabolic diseases. To study the mechanisms by which this occurs, Federico Rey and John Denu at the University of Wisconsin-Madison and their colleagues compared mice raised with and without gut bacteria. They found that gut microbes mediate chemical changes to histone proteins, which in turn regulate gene expression by binding to DNA and altering its 3D conformation.

Feeding mice a high-fat, high-sugar diet provides little material for microbes to digest and so blocked some of the changes to DNA shape. Giving short-chain fatty acids (which are produced by gut microbes) to mice raised without gut bacteria restored these effects.

*Mol. Cell* <http://doi.org/btr6> (2016)

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