BBC Earth Magazine Issue five March 2017

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earth

NEW

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Facing the jaws of death

NATURE

HALTING THE CHEETAH'S SPRINT TO EXTINCTION

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March

FEEDBACK

Let us know what you think of *BBC Earth* magazine by emailing bbcearthmagazine@therivergroup.co.uk. This magazine is yours, even more than ours. Help us plot its destiny. Thank you for joining us, and see you next month.

Congratulations to Tara Babrah from Norfolk who has won January's competition prize of a luxury stay in Oxford

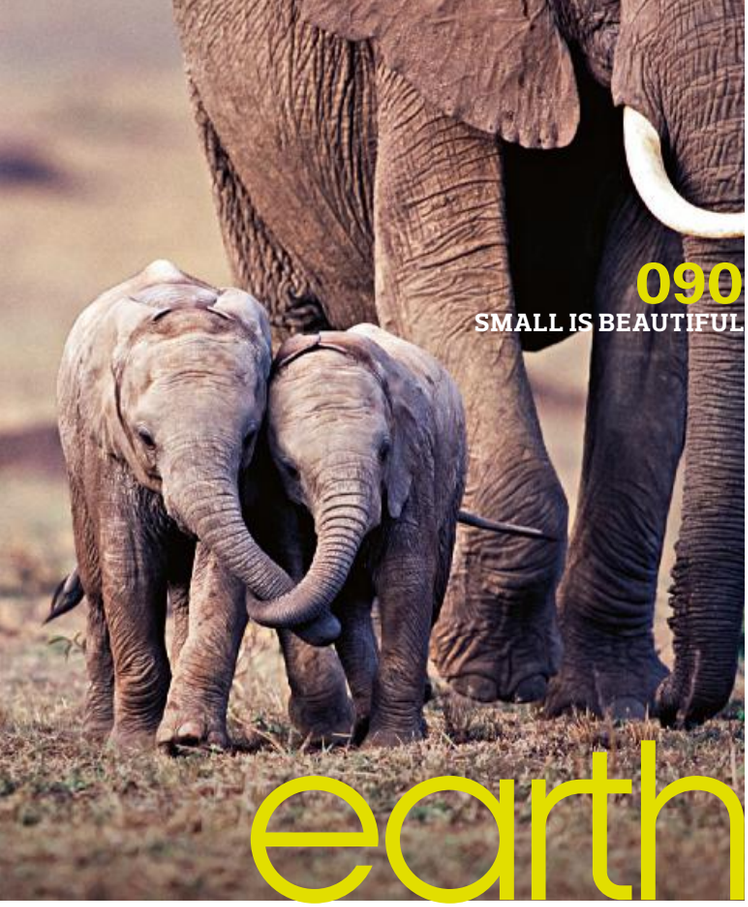
earth

Welcome to the March issue of *BBC Earth* magazine. We're delighted you're joining us on a whirlwind tour of the planet, hooking up with Steve Backshall on an intrepid voyage through Papua New Guinea, meeting the Aboriginal astronomers with a fascinating knowledge of the southern sky, dropping in on brick-makers in West Bengal and catching up with surprising developments for wildlife at Chernobyl.

One of the things I love about editing *Earth* is that every story turns up a fact or concept that blows your mind. In the case of our stargazing in Australia feature, it was the nugget from writer and astronomer Ray Norris that one star-related parable in Aboriginal mythology has such common threads with a similar story in other cultures, there's a strong chance it may predate humankind's first migration from Africa in about 100,000BCE. Ray is planning an attempt to sequence the way the star-story evolved as humans spread around the world. I can't wait to find out what this reveals about our ancestors, their knowledge of the universe and our unique place within it.

There's bold endeavour closer to home in this issue, too. Spring may not have sprung just yet, but the evenings are getting lighter, so what better time to emerge from winter torpor and head off for a microadventure? Alastair Humphreys explains how on page 100, adding that you don't need to take time off work or school – just doing something slightly outside your comfort zone can be enough to press the reset button on life. Among his suggestions is to go for a cold-water swim, and having taken the plunge with a dip in the sea off Cornwall this winter – admittedly in a wetsuit – he's right, you don't regret it (afterwards), and it leaves you buzzing all day. You might prefer to wrap up warm instead this month and go pond dipping – there's more on page 28. Or if swimming in tropical seas is more your style, turn to page 69 for the low-down on the enviable life of a marine biologist. As always, let us know what you think of the issue.

Cover photographs: Getty, iStock, BBC Pictures, Alamy. This page: Nature Picture Library



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SMALL IS BEAUTIFUL

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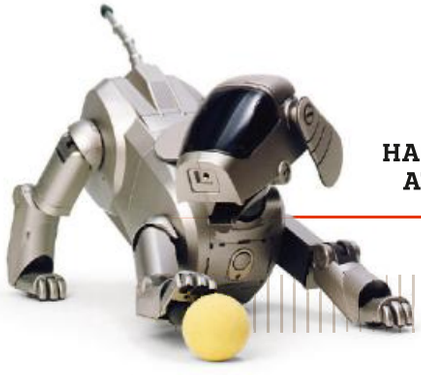

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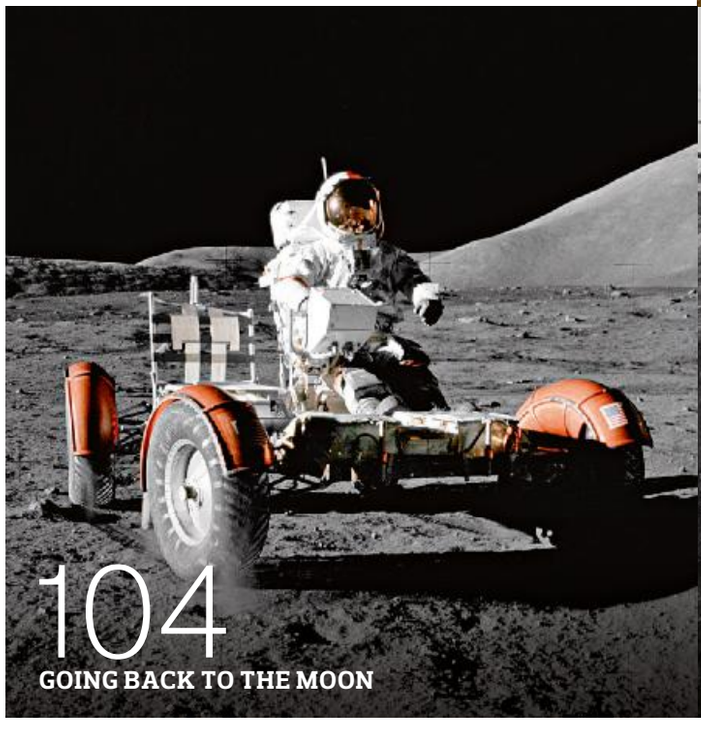
HANDS-ON EVENTS AT SCIENCE WEEK



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GOING BACK TO THE MOON

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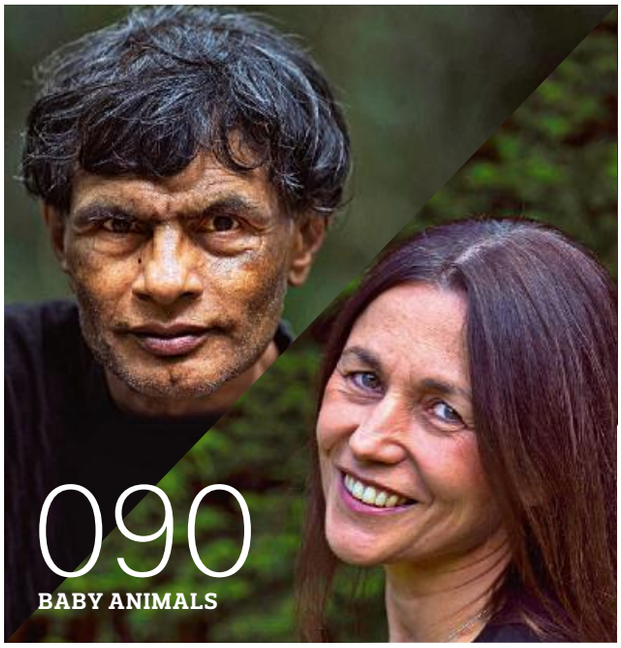

PHOTOGRAPHERS

ANUP SHAH & FIONA ROGERS

Anup Shah and Fiona Rogers are the husband-and-wife team of wildlife photographers behind this month's study of baby animals and our response to their cuteness. One of their favourite images is their photo of a western chimpanzee in the Boussou Forest in New Guinea (seen on page 92). 'We photographed the group he was in for two months and were fascinated by his nature,' says Shah. 'He was playful, fearless, prone to tantrums. Personality does have an effect on cuteness.'

WRITER

RAY NORRIS

Professor Ray Norris is an astronomer with CSIRO Astronomy & Space Science, whose day job is researching how galaxies formed and evolved after the Big Bang. As the BBC's *Stargazing Live* broadcasts from Australia this month, he looks at the astronomy of Aboriginal Australians (page 32). 'It opened my eyes to the depth and complexity of their culture,' he says.

WRITER

KATIE STACEY

After quitting her job as a broker in the City five years ago, Katie has dedicated herself to telling conservation-focused stories. Alongside her partner, photographer Luke Massey, she visited the Chernobyl exclusion zone for our feature on page 78. 'It was like stepping back in time,' she says. 'Wildlife is flourishing there, and destroying any remnants of human existence in the process.'

WRITER

DAWN EMERY

Journalist Dawn Emery has interviewed A-list celebrities from Drew Barrymore to Kim Kardashian, and in this issue she turns her attention to the natural world, speaking to Steve Backshall about his adventures on the remote Baliem River in Papua (page 49). Dawn has had some pretty eventful wildlife encounters herself, she says, including getting chased by a kangaroo in Australia.

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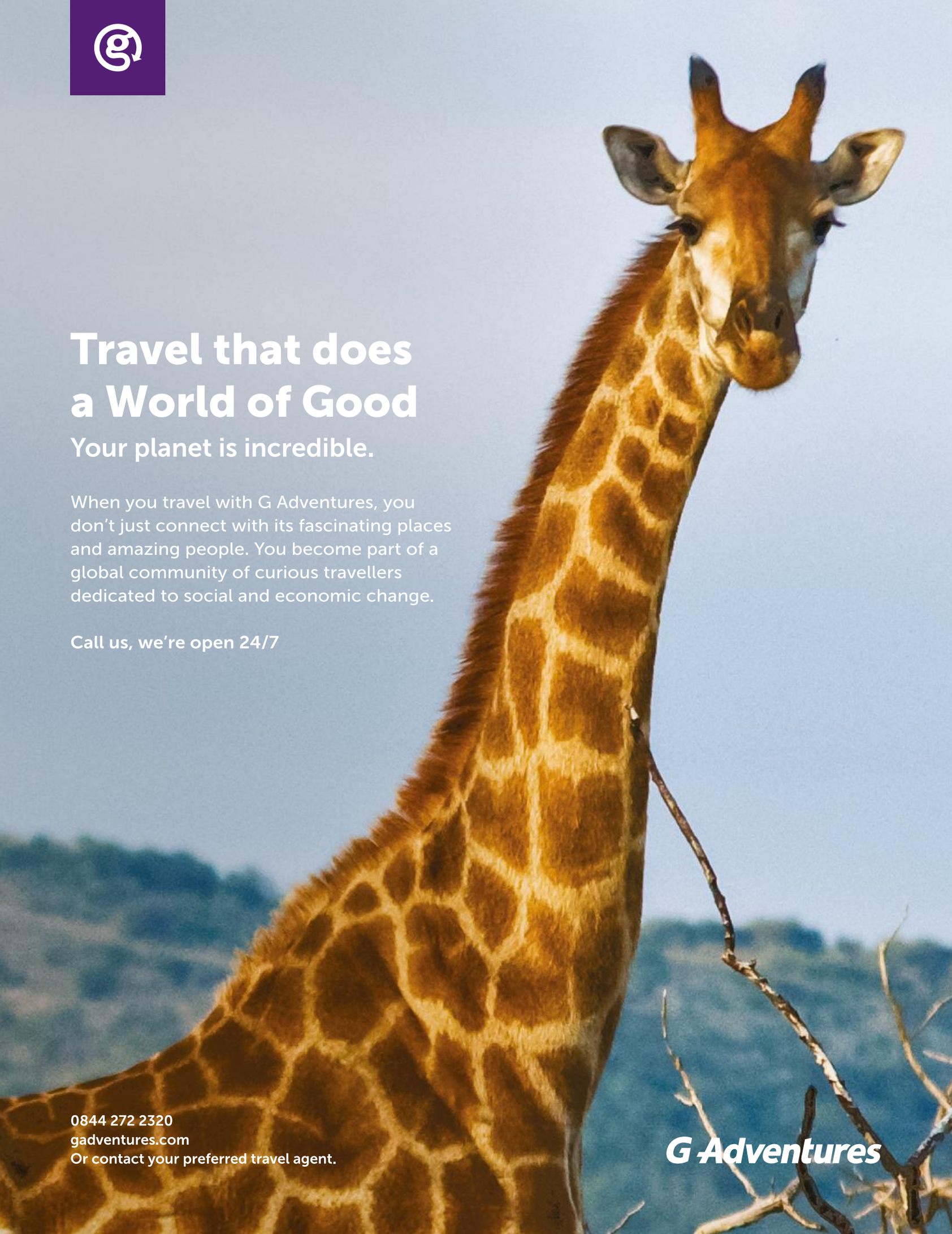
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All about us

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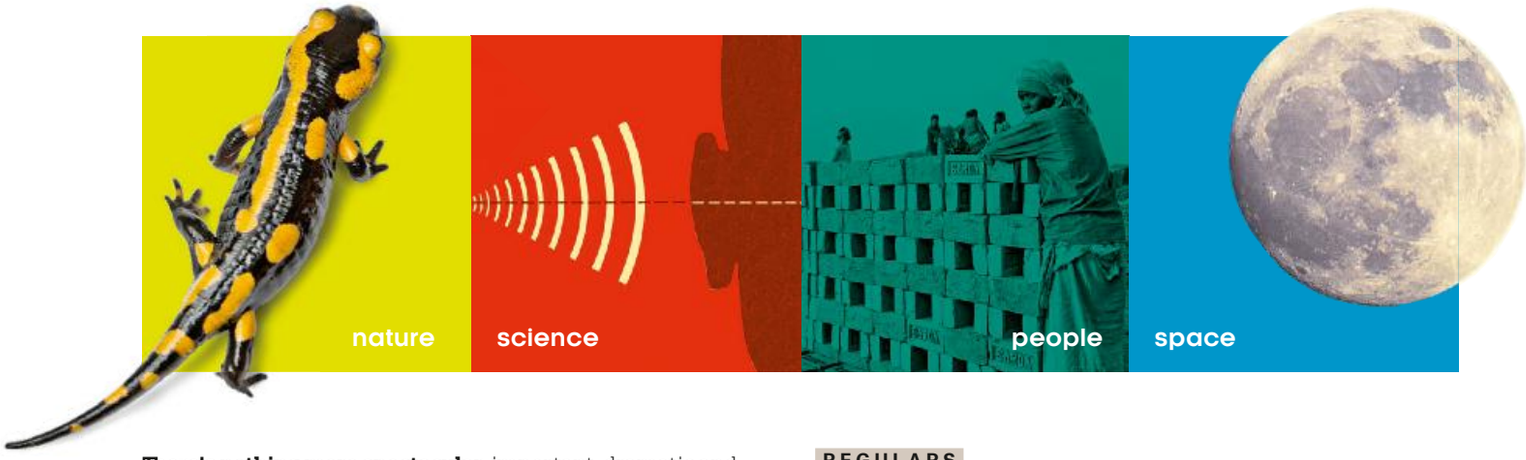

There's nothing more spectacular, important, dramatic and exhilarating than life on this planet. Each month we invite you to explore the fascinating world of *BBC Earth*, finding out about everything from the smallest creatures under the microscope to the limitless expanses of space.

Our magazine is part of the BBC Earth family, and you can enjoy other BBC Earth content on television, on the web (bbc.com/earth), through virtual reality experiences and other digital apps and also across our social channels including Facebook, Instagram and YouTube.

Dive into our pages for amazing imagery, timelines, infographics and stories that bring you face-to-face with heart-pounding action, mind-blowing ideas and the wonder of being human.

REGULARS

Every month to help you (and your children) find your way around the magazine you'll recognise these regular features:

- **Adventure hackers** Ever dreamed of being an astronaut or a polar bear researcher? We ask the professionals how they started out, and show how you can, too
- **A world like no other** The best of our planet in pictures
- **Earth news** Stories from the frontline of the natural world
- **Rare Earth** Showcasing species on the brink of extinction
- **Earth masterclass** Your essential guide to upgrading your own photos
- **Anatomy of...** Discover the talent for adaptation of Earth's most extraordinary creatures.

Look out for these icons that appear throughout the magazine. They signpost ways to drill down into content and get involved.

DID YOU KNOW?
Fascinating facts and background to the stories

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Letters bbcearthmagazine@therivergroup.co.uk (please mark if 'not for publication')

World like no other

This boulder could have been stationary for decades before the perfect conditions combined to steer it across the valley floor

Words: Matilda Battersby. Photograph: Shutterstock

To see the sailing stones in action and to find out more, visit bit.ly/1nNcKcg

ROCK 'N' ROLL?

Rolling stones are all very well, but rocks that sail on by? The so-called 'sailing stones' of Death Valley National Park, California, remain one of the strangest phenomena of the natural world.

Stones as heavy as a large vending machine travel across the valley floor, as if by magic, leaving deep trails in their wake. Death Valley is so famous for its sailing stones and the mark they make on the landscape that their location is called 'Racetrack Playa' – playa meaning 'dry lake bed'. Different rocks sometimes trace a parallel course, turning corners and zigzagging back again, creating a spooky pattern.

They have been the subject of scientific investigation since 1948. But it wasn't until the winter of 2013–14 that *Twilight Zone* theories were replaced by hard facts when a research team led by paleobiologist Richard Norris from the Scripps Institution of Oceanography, UC San Diego, caught the stones in action. Having set up time-lapse cameras and attached GPS trackers to rocks back in 2011, the team's patience was finally rewarded. They discovered that it wasn't magnetic forces, hurricane-force winds or slippery algae that caused them to slide about, as had been previously suggested – the real culprit was ice: thin, floating windowpanes of it.

Death Valley, which is the hottest, driest and lowest American national park, can be scorching by day but, when the nights are cold enough to freeze the shallow film of water that can cover the playa following rain or snow melt (often in March), it can turn into an ice rink for rocks. When these ice sheets start to melt and create floes around the rocks and there's at least a light breeze, even large stones that have sat in the same place for decades can be sent sailing off at heady speeds of about 5m per minute.

Okay, so you won't see them whizzing past like something out of *The X Files*. But they gradually travel a course that can take them over 200m from their original location.

HARE TODAY

What is it about March that turns a timid creature that ventures out only under cover of darkness into a crazy beast that owns the day? We're talking about the usually shy, nocturnal European hare (*Lepus europaeus*).

When a male (jack) starts looking for a mate in spring, he will chase his intended. If the female (jill) isn't ready to mate, she'll turn on the jack and begin an exaggerated boxing match.

This is where the phrase 'mad as a March hare' comes from. It has been around for at least 600 years, but Lewis Carroll cemented it in literary history in *Alice's Adventures in Wonderland* where a March hare attends the Mad Hatter's tea party. 'The March hare will be much the most interesting, and perhaps as this is May it won't be raving mad – at least not so mad as it was in March,' observes Alice.

March is the best time to witness these hare-brained creatures going the full 12 rounds.

Two centuries ago there were around 4 million brown hares, but numbers have dropped by about 80 per cent in the last century. Intensive farming has reduced their habitat and, classed as a pest, they can be shot by farmers and hunters – although coursing and beagling are now illegal.

Words: Matilda Battersby. Photograph: Alamy

To view a *Springwatch* clip of hares boxing, visit bbc.in/NK4R6o

World like no other

PETAL POWER

You see the world through rose-tinted glasses at this time of year in South Korea. The country turns a ravishing shade of pink when cherry trees bloom in their millions. Their beauty is fleeting; it peaks over the course of two weeks before the blossoms start to fall.

In Korea, it's called the *beot-kkot* season although people also use the borrowed Japanese word *sakura* (meaning cherry blossom), and refer to the activity of blossom viewing as *hanami*, a much-anticipated event usually involving friends or families walking or picnicking under the trees.

Part of the reason *hanami* is so popular is that it marks the arrival of spring. Supermarkets stock up on cherry-blossom-flavoured snacks months in advance and coffee houses devise festive drinks (cherry blossom frappuccino, anyone?). In early March, the Korea Meteorological Administration releases its forecast of when and where the fabled flowers will appear. When they finally burst into bloom, people celebrate with festivities that last for days. There are parties, concerts, even a cherry blossom marathon in the city of Gyeongju.

The Korean cherry tree, known as the king cherry, originates from Jeju Island, where the blossoming starts in late March. It is a rare plant, however, and the Yoshino variety, which is native to Japan, is more common. There are hundreds of varieties of cherry trees around the world – and the blossoms aren't always pink. Some of them, like the Ukon variety, change colour throughout the blooming period – turning from greenish yellow to white to pink.

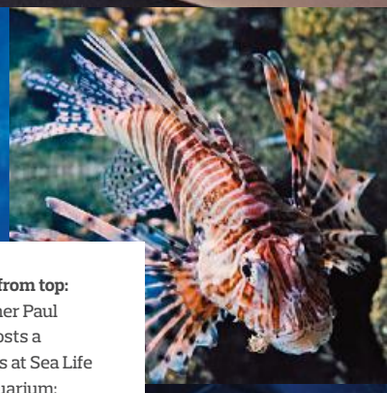
These short-lived blossoms are reminiscent of the transient nature of life and are a symbol for its brevity and beauty in several Eastern cultures. After making the trees and their surroundings come alive and banishing the winter gloom, the blossoms fall, one petal at a time, like a shower of pink rain.

South Korea's blossom season is less well known than Japan's – but no less beautiful

World like no other

Words: Yashi Banymadhub. Photograph: iStock

News of the Earth



Clockwise from top: photographer Paul Williams hosts a masterclass at Sea Life London Aquarium; lionfish and sharks at the aquarium; a *BBC Earth* reader puts what she's learnt into practice

HAIR'S A MYSTERY

You've heard of animals changing shape, colour or texture for camouflage but you probably haven't heard of them growing new hair to keep safe. Among 150 other new snail species discovered in Australia, scientists have found one with hairs that may have evolved to help it hide from prey. The quirky mollusc (below), christened *Setobaudinia umbadayi*, was found during a survey of remote islands off the Kimberley coast by scientists from the Australian Museum Research Institute. The purpose of these hairs is still unknown, but Dr Frank Koehler, who led the expedition, explains they could help with camouflage. 'Small particles of soil stick to the shell, making it difficult to distinguish from its habitat - especially in leaf-litter-dwelling species.' The Kimberley Islands are home to around 300 species of snail, and Dr Koehler predicts there is a similar number of undiscovered species in the region.

Cars have feelings, too

If you grew up watching *Knight Rider* and wishing for a car that could interact with you, your dream has come true. New 'autos with empathy' will monitor not only vocal tone but even perspiration and pupil dilation to determine your emotional state, playing soft music when you're angry, or talking to you when you're sad. Toyota's Concept-i (right) will also be able to suggest impromptu dates based on your friends' social media posts, and Honda's NeuV will listen in on your conversations and update your route if your plans change.

Words: Yashi Banymadhub. Photographs: Felype Campos, Pares Tailor, Vince Kessner, Toyota

A class act

Paul Williams, BBC film director and wildlife photographer, has captured some spectacular wildlife shots, from a blizzard of budgerigars in an Australian desert to baby palm squirrels in Sri Lanka. And last month he shared his expertise at a photography masterclass for *BBC Earth* readers at Sea Life London Aquarium.

Presenting some of his incredible images to the audience, he took us through his process, from practicalities such as filters, to the months of preparation he undertakes. 'I work with scientists around the world to find out where animals are going to be and what they're going to be doing,' he said. 'You can have all the kit, but it's really about being in the right place at the right time.'

Readers then had the chance to take their own photographs of animals at the aquarium, under Williams's guidance. Williams himself took a dramatic photograph of a crocodile with its mouth hanging wide open in mid-yawn.

Williams is currently shooting a new BBC series on wild cats in Sri Lanka, due to come out next year, and working on a film with Sir David Attenborough that will uncover the origins of a huge 'sea dragon' fossil. His parting advice was simply to take lots of photos. 'You never know what your subject is going to do next, so don't stop, even if it means taking several hundred images. You might run out of time but you should never run out of creativity, angles and shots.'

Find out about future *BBC Earth* events by emailing bbcearthevents@therivergroup.co.uk

Filling the black hole

Black holes, the super-dense space phenomena believed to have been formed by imploding stars, cannot be directly imaged. But NASA has just launched a $188million bid to find out more about them. Sending a trio of advanced telescopes with cameras into space, scientists are hoping to learn more about the gravitational, electric and magnetic properties of these extreme objects by studying the cosmic radiation that occurs when black holes heat surrounding gases by more than a million degrees.

ALL-YOU-CAN-EAT ALGAE BUFFET

Food can be a big incentive in animal behaviour, including fish. Reef fish evade predators such as sharks by hiding in coral reefs, but they venture out at times to eat the algal blooms that are caused by pollution and which threaten coral reefs worldwide. It's a risky business, however, as emerging from safety means they run the risk of being eaten themselves. The fish can weigh up the costs and benefits, though, a study has found. When scientists placed 'buffets' of algae at locations off the island of Mo'orea in French Polynesia, the fish would ignore the dangers if the amount of food on offer was generous enough. The hope is that if overfishing is prevented in coral reefs, the fish can counteract at least some of the damage caused by algal blooms.

Copperband butterflyfish are among the reef fish that eat damaging algae

The newly discovered Skywalker gibbon: this *is* the primate they're looking for

GALACTIC GIBBON

The force is strong in the Gaoligong Mountains of southwest China, with a new Skywalker in their midst. An entirely new species of Hoolock gibbon has been discovered there and it has been named after the protagonist of the original *Star Wars* trilogy. Gibbons are considered mystical beings in ancient Chinese culture and this, combined with their use of high treetop homes, led scientists from Sun Yat-sen University and Zoological Society of London to choose the skyward-looking name. There are two other Hoolock species in China: the *H leuconedys*, living on the eastern side of the Chindwin River, and *H Hoolock* on the western edge.

Words & pictures

The best of this month's books, apps and TV

WATCH

Wild Scotland

A celebration of amazing wildlife, such as otters (pictured), puffins, red deer and grey seals, *Hebrides: Islands on the Edge* is a four-part series narrated by Ewan McGregor. It shows how these animals are at the mercy of the restless Atlantic Ocean, surviving the highest tides, the harshest of winters and even rare spring storms. Made for BBC Scotland, the documentary series features awe-inspiring footage of wild animals in this unforgiving but scenic habitat; the first episode follows thousands of geese and swans on their journey to the islands for the winter.

The series will be shown in full at the Wild Film Festival in Dumfries, Scotland, which takes place on 24–26 March (look out for BBC *Springwatch* presenter Iolo Williams sharing his filmmaking adventures on the 25th). If you can't make it to the festival, the series is also available to download.

£3.99 (£1.49 per episode) on iTunes; wildfilmfestivalscotland.co.uk

BOOK

Take to the flies

Entomologist Erica McAlister is on a mission to change the world's opinion of the humble fly. Her book *The Secret Life of Flies* will open your eyes to these unappreciated insects – from the flies that pollinate *Theobroma cacao* plants, supplying the world with chocolate, to the bumblebee robber fly (left) that has a lance-like mouth tube to spear beetles, release venomous saliva and suck them dry. McAlister's tone is witty and fun, and, as curator of Diptera at the Natural History Museum, she has a wealth of knowledge to share. You won't tell flies to buzz off again after reading this book.

Natural History Museum, £14.99; out 6 April

Words: Yashi Banymadhub. Photographs: Maramedia/Otter Films, Thames and Hudson, NASA, Trustees of the Natural History Museum, Octopus Books

BOOKS

Sticky situation

Colouring books for grown-ups have been a wild success, providing relief from fast, technology-driven lives. Now sticker books (those saviours of rainy days with kids) are the latest craze for those looking to unplug. *The Flower Garden* and *The Forest* are gorgeous books from the Stickertopia range, with 30 nature-inspired illustrations of real places, such as the Palm House on Mainau Island (above). Calm your mind as you peel off the stickers and focus on bringing each illustration to life one leaf, insect and flower at a time. There are also fun facts – the Palm House is home to date palms up to 15m tall, for example. A great way to escape reality with your inner five-year-old.
Mitchell Beazley, £10; out now

BOOK

Get closer

From around 1898, German photographer and sculptor Karl Blossfeldt produced photographs of plants that looked like anything but. You can see architectural columns and totem poles in his striking images, or even a bishop's crozier, as in this furled frond of a western sword fern (left). Blossfeldt used the images as a teaching tool in his sculpting classes and later shared them in his book *Urformen der Kunst* (1928). Now, *Masterworks*, a new collection of his work by Ann and Jürgen Wilde, explores how his images provoke us to draw connections with the natural world, and reveals his traditional darkroom techniques. Sure to inspire fans of botany and photography alike.
Thames and Hudson, £40; out 9 March

WATCH

Astronauts in action

Get closer to space from your armchair as NASA is now live-streaming footage of astronauts at the International Space Station on NASA TV. The first two space walks of the year showed astronauts upgrading the ISS's power system. The world watched in awe as astronauts, including Frenchman Thomas Pesquet (left), edged their way around the artificial satellite and clipped to it to stop them from floating away as they worked. For live streams and breaking news, visit the NASA website, nasa.gov.

App: The Elements

Based on popular science writer Theodore Gray's book of the same title, The Elements app is an illustrated periodic table. You can tap on each element to see an object made from it, with facts about the element (including melting point, boiling point, atomic weight and density). You'll also find out how these elements have been used in the past. It's quite pricey for an app but will definitely make revision more entertaining.
£13.99, iTunes, available on iPhone and iPad (iOS 9.0)

What's on this month?

Find talks, workshops and more, countrywide

BRAIN TEASERS

To coincide with the Oxford University Museum of Natural History's Brain Diaries exhibition, the Super Science Saturday biannual fair for families will feature around 100 scientists presenting different workshops and demonstrations related to the brain. The exhibition, which runs throughout March, will show the development of the brain from adolescence to old age, and events at the fair will include the chance to see what real brains look like (human and animal). There will also be fun activities to take part in, including making your own model of a brain. **Oxford, 11 March. Free. oum.ox.ac.uk**

1. Night at the museum

Who said sleepovers aren't for adults? Stay up late at the Natural History Museum and enjoy a night of music, food, science and cinema. Lay your sleeping bag close to the dinosaurs, enjoy a three-course dinner, then eat edible insects instead of popcorn at a monster-movie marathon. Other activities at this event, and upcoming sleepovers, include stand-up comedy, a live science show and gin tasting. **London, 24 March. £180 (£162 for members) for adults. Sleepovers for kids cost £60 (£54 for members). nhm.ac.uk**

FACE THE MUSIC

Bust a move and learn about how sounds are made at the Valley Community Theatre in Liverpool. As part of British Science Week, the charity is using the art of dance to get people excited about science. Make your own tune by moving your hands, feet and head into an invisible sound beam projected across the room to make different notes. (The beam can be adjusted for users with limited movement.) You can also find out how DJ Mark Rowland, who has cerebral palsy, used the sound beam to compose original tracks. **Liverpool, 10 and 15 March. Free. britishscienceweek.org**

Words: Yashi Banymadhub. Photographs: iStock, Getty Images, Shutterstock

4. In for a shock

Can lightning trigger life on extraterrestrial planets? That is a question Dr Christiane Helling and her team at the University of St Andrews are trying to answer. Her talk 'Sparkling Clouds and Crackling Lightning in Extrasolar Planets' at the University of Dundee will be about her research on the creation of lightning and its different properties on brown dwarfs (the universe's inbetween objects, too big to be a planet, too small to be a star), gas giants and other planets beyond our solar system. The theory is that large-scale lightning discharges could have caused the formation of prebiotic molecules that created life on Earth. **Dundee, 16 March. Free. britishscience association.org**

WONDER OF WHALES

Dr Helen Scales, marine biologist and author of bestselling book *Spirals in Time*, returns to the Cambridge Science Festival (which runs 13-26 March) to reveal a few things you never knew about whales. These ocean giants once lived on land and Dr Scales will take you back 50 million years to track their evolution as one of the smartest marine animals. The talk, in the Babbage Lecture Theatre at the University of Cambridge's New Museums Site, is aimed at families with children of 12 and above. **Cambridge, 19 March. Free. sciencefestival.cam.ac.uk**

5

Find an event near you

1. Natural History Museum, London
2. Valley Community Theatre, Liverpool
3. Oxford University Museum of Natural History, Oxford
4. University of Dundee
5. University of Cambridge
6. Horniman Museum and Gardens, London

6. Calling the 'bots

Meet robot animals and find out about the mechanisms that allow their flesh-and-blood counterparts to survive in the wild, at the Horniman Museum and Gardens' Robot Zoo exhibition. The animatronics, built using everyday machine parts and gadgets, including tubes, hinges and even a fly-swatter, are designed to showcase the ways in which animals have evolved to eat, hunt and hide in order to survive. Take in the lightning-fast reactions of the housefly, as well as the colour-changing cleverness of the chameleon, and try out some awesome interactive exhibits, such as jet-propelled squid racing and designing your own mutant robot. **London, until 29 October 2017. £7 for adults, £4 for children. horniman.ac.uk**

Our world
Your photos

Every month in *BBC Earth* magazine we'll be showcasing your pictures of the natural world. Get inspired by our favourite images this month, then grab your camera or smartphone to join in the #earthcapture adventure

Email your pictures to us at **earthcapture@therivergroup.co.uk.** As well as featuring a selection each month, we'll also share your work with the BBC #earthcapture team, who regularly post contributed images on their social media platforms. You could end up sharing your work with the world!


Louise Thacker


Simon Jones


Vicki Andrew


Gisela Sepulveda


Andy Thomson


Martin Tyler


Ben Fitzcosta

PHOTO OF THE MONTH

'A stocked-up squirrel, ready for the cold days,' says Ben Fitzcosta. 'I took this image at Grosvenor Park in Chester. I went there to try out my new DSLR Pentax K-50 camera. I thought the squirrels that live in the park would be a good subject as they are quite fearless around people. I'm studying for a degree in Animal Behaviour and Welfare and I try to use what I'm learning to improve my photography.'

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#earthcapture

4 OF THE BEST

TELESCOPES IN FOCUS

So, you've got into stargazing and are ready to buy your first telescope – where do you start? We ask Dan Oakley, dark skies ranger for the South Downs National Park, for the lowdown on the different types and what to look out for. There are two basic types: the refractor and the reflector. The first was made famous by Galileo in 1609 and is really just two pieces of glass and a long tube. 'They work like reading glasses and are quite good at transmitting light,' says Oakley. The reflector type has a larger aperture for looking at big sky objects like galaxies, clusters and nebulae and was first built by Newton in 1668. With these, 'a big mirror at the bottom of a big tub redirects light to a secondary mirror and eye piece,' Oakley says. Here are four of his favourite buys.

CELESTRON ASTROMASTER 70AZ – refractor telescope with two-axis mount
'Refractors are good for kids because the eye pieces are at the bottom. It lets in a lot of light and is great for looking at the moon and planets. The sturdy mount won't wobble and is a simple two-axis design, moving from top to bottom and left to right, so it's fairly straightforward for children. This telescope is quite robust, too – the kids could drop it on the floor – and it packs away easily.'
£113; celestron.uk.com

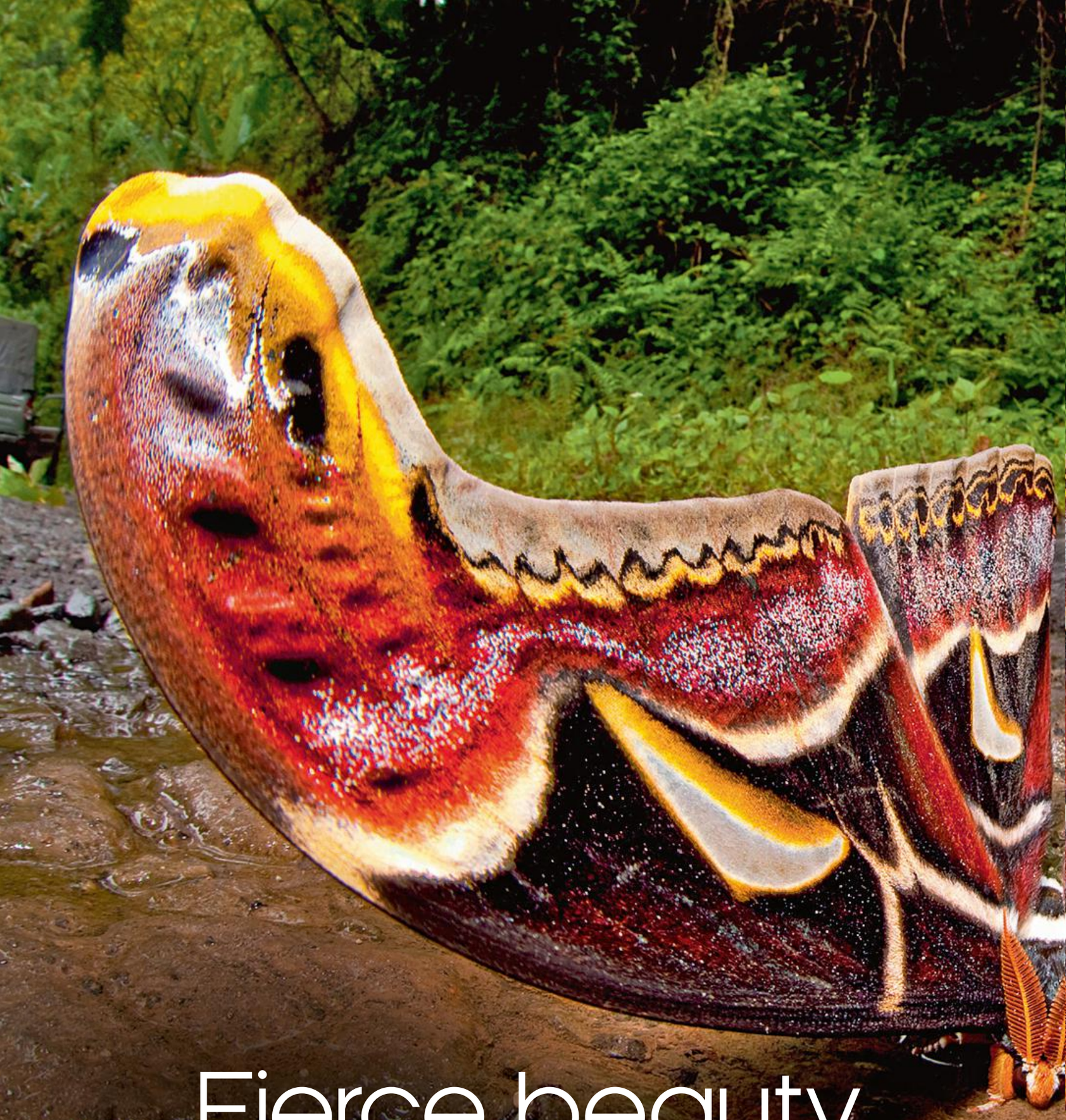
ORION SPACE PROBE 130ST – basic reflector telescope with equatorial mount
'This telescope is for anybody wanting to dabble in astronomy. It's lightweight with a good eye piece and basic viewfinder. The equatorial mount can be a bit tricky to use as it has to be facing dead north. But you'll need to know about these things if you want to get into astronomy and there are plenty of YouTube tutorials. Experiment with this first before splashing out thousands on a high-end 'scope.'
£230; uk.telescope.com

MEADE ETX80 – portable and computerised refractor telescope
'Don't waste time tracking the sky by eye – this fancy gadget is computerised so if the BBC announces a meteor shower, you can enter the latitude, longitude and time of day, and the telescope will whirl around to find it. You can attach it to your camera to snap close-ups, plus it comes in a backpack so you can dash out in search of darker skies (then quickly stuff it back in when you get cold).'
£299; meade.uk.com

SKY-WATCHER EXPLORER 200P EQ5 PRO – advanced reflector telescope with computerised equatorial mount
'Here's a telescope that does a bit of everything but does it well, especially if you want to get more advanced with autoguiding. The 20cm aperture lets in a lot of light. so it's ideal for astrophotography. On a basic model you would see a fuzzy little blob when looking at the Hercules cluster, but this one gives you tons of detail.'
£899; skywatcher.com

Interested in the stars? Invest in a telescope, then keep your fingers crossed for clear nights

Words: Yashi Banymadhub. Photograph: iStock



Fierce beauty

Photographer and filmmaker Sandesh Kadur jumped out of the car when he saw this 'leaf'. And it's this curiosity and spontaneity that leads to the best images, he says

This is an image that demands a double-take. Is it a snake? Two snakes? 'Nope, it's a moth,' says award-winning filmmaker and photographer Sandesh Kadur, who has worked on BBC documentaries *Planet Earth II*, *Natural World* and *Wonders of the Monsoon*, to name but a few. 'I saw it in the Himalayas where I spent six months. An Edward's Atlas Moth, to be exact, in the throes of a defence display. When this moth senses danger, it drops to the floor and slowly undulates its magnificent wings, to resemble a snake.'

Kadur says that curiosity is the key to unlocking great wildlife photography. 'This was enormous for a moth, at around the size of my face, but I nearly missed it. I was driving past in my car, when the vivid colours caught my eye. I thought, "What is that, a brightly coloured leaf?" I stopped, out of pure photographic nosiness; I wanted to find out which tree this unusual leaf was from, and was confronted with this extraordinary sight. I got down on the ground with it to shoot at moth level. Professional photographers spend much of their lives lying on the ground,' he says.

I get a thrill when I capture previously undocumented behaviour. A few years ago, I was with a team filming a pair of king cobras who were courting. They were headbutting each other, which is typical behaviour before mating. Suddenly, a second male cobra emerged from the jungle, and the two males fought. Incredibly enough, cobras don't bite each other during combat. It's more like a snake version of a thumb war, as they attempt to pin each other to the ground. The new male was victorious, so we expected him to mate with the female. Instead, to our astonishment, he ate her! Cannibalism had never been documented in cobras before. We can only assume that he could tell she was already pregnant with the other male's offspring. Gruesome.

A shoot in Mexico made me stop eating shrimp. Sometimes, I'll learn something I really wish I could un-know. We were filming the critically endangered Kemp's Ridley sea turtle; there are fewer than 1,000 nesting females left in the wild. I realised that the main thing these little guys eat is shrimp. And we're fishing it all. Then I found out that for every kilo of shrimp caught, fishermen can dredge up to 12 kilos of by-catch. Shrimp is the most expensive thing you can eat, ecologically speaking. And I absolutely love shrimp. I investigated every loophole to keep shrimp in my life, like 'I'll just eat farmed shrimp!', but I found out that they have to clear mangrove swamps to farm it. I couldn't justify eating it after that. Worse luck.

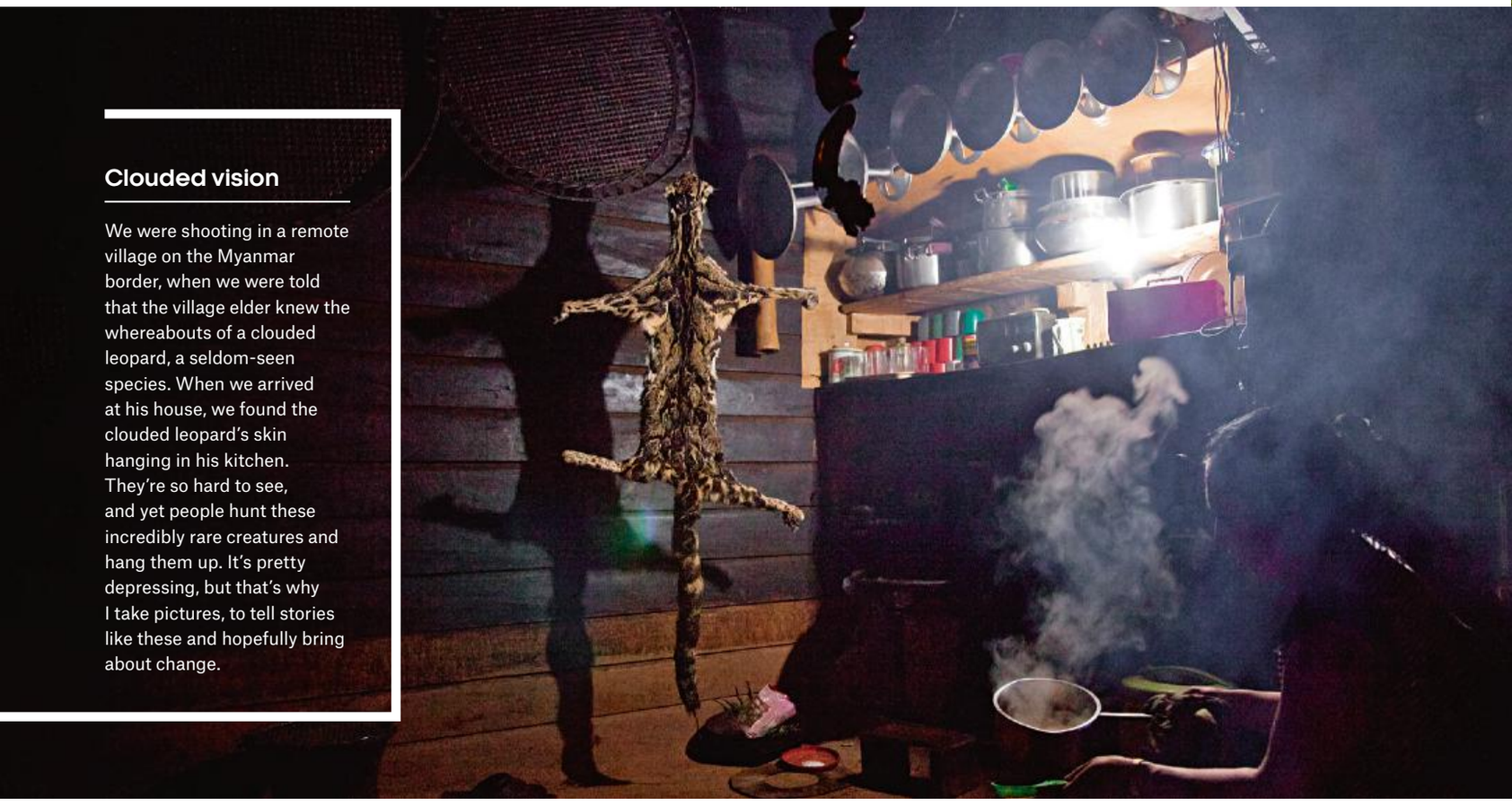
in focus

- You can take 100+ shots of an animal and only get one where they've made eye contact. That's the one that gives you the intimacy.
- In the late afternoon in winter, animals such as foxes come out of their dens to catch the last of the sunlight. It's a good time to shoot.

If I could go back and give my younger self a piece of advice about photography, it would be to invest, invest, invest. When I was starting out, I tried to save cash by buying cheaper kit. But it just didn't deliver the quality, or only lasted for a short time. So I had to buy it again, or buy something else, so it made no sense. The initial outlay is eye-wateringly large when you buy good quality, but the kit will stay with you forever. I now use Panasonic Lumix camera bodies with Canon lenses.

Everybody's a photographer now, as you can take amazing images with camera phones. I love that this has given the power of photography to everyone. My advice would be to seek the story in the wildlife image. For instance, elephants use their sense of smell to navigate and to sense danger. I've shot thousands of photos of elephants, but my favourite one is of a mother and her calf trotting along with their trunks in the air, trying to pick up a scent map. It tells us something interesting about elephants, rather than just being a pretty picture. That's what wildlife photography is all about. Understanding what you're seeing, rather than just pressing a button.

Read before you shoot. Learning about wildlife is the first port of call. I grew up devouring books by British-Indian explorer Jim Corbett and hunter-turned-conservationist Kenneth Anderson. They inspired me. I remember sitting high up in a tree as a teen in India, above a waterhole, watching the animals come and go. A hush came over the scene. I realised that there was a leopard beneath me, bathed in the rays of a full moon. He wasn't remotely interested in me. He swung



Clouded vision

We were shooting in a remote village on the Myanmar border, when we were told that the village elder knew the whereabouts of a clouded leopard, a seldom-seen species. When we arrived at his house, we found the clouded leopard's skin hanging in his kitchen. They're so hard to see, and yet people hunt these incredibly rare creatures and hang them up. It's pretty depressing, but that's why I take pictures, to tell stories like these and hopefully bring about change.

‘A wildlife image needs to be more than a pretty picture. Always seek the story’

The power of three

I already had the mountain range and the rainbow light, but I needed something in the foreground to give the shot intrigue and scale. I drove around for ages in Ladakh looking for this Tibetan kiang, a type of ass.

himself up into the neighbouring tree and started scratching himself, calling out to females. I instantly understood what Corbett had meant when he wrote about the ‘sawing call’ of a leopard. That’s exactly what it sounds like, the raspy sound of a saw’s teeth biting into wood. It was an exhilarating moment.

My bucket list trip would be to Ethosha National Park in Namibia – lions, giraffes and rhinos aplenty. I’m dying to go, having seen many, many pictures of the incredibly rich wildlife you can see just by hanging out at a waterhole. Another place I would go back to at the drop of a hat would be Kaziranga National Park in Eastern India. It’s the land of giants. Not just giant wildlife like elephants and water buffalo, but also elephant grass – the world’s tallest grass – which hides its colossal inhabitants. I filmed there for the *Planet Earth II* episode I worked on, Grasslands.

We’re taught to be afraid of animals that wish us no harm. My nickname in my family is an Indian translation of ‘the uncle who loves snakes’. When I lived in the USA, I once rescued an injured racer snake and introduced it to my niece. Her mother, my sister-in-law, was appalled when she saw her daughter handling the snake with no fear. She’s terrified of snakes. But children aren’t... until they’re taught to be. Sensationalist fearmongering of snakes, tigers and sharks means that children become frightened, when there’s usually no need to be. I hope my work teaches children to have respect and reverence, rather than fear.

For more on Kadur’s work, see sandeshkadur.com or follow him on Instagram @sandesh_kadur

Speed deer

I set up a slow shutter speed and followed this barasingha galloping through the forest. A fast shutter speed freezes the action and makes it look flat, but a slow shutter here captures the lovely energy.

Words: Catherine Gray. Photographs: Sandesh Kadur

A pond in your garden will attract frogs – and they'll repay you by keeping slug numbers down

LUCKY DIP

Frogspawn, tadpoles and the great circle of life... It's not just kids who are fascinated by the miracles happening in ponds right now. Grab a net and take a look!

Frogs that have holed up for the winter among rotting leaves or in a bed of mud, emerge from brumation – a torpor similar to hibernation – when the weather starts to warm up (night-time temperatures above 5°C). They head straight to a pond and croak enthusiastically for a mate. The male embraces a female and fertilises her eggs as she lays them in still water.

The resulting clumps of frogspawn at this time of year are one of the standout events in the pond-life calendar – not to mention one of the most tangible (and teachable) displays of the magic of nature. We might live in a world of digital learning for children, but you can't beat a bit of pond dipping – plunging a net or jam jar into the water and seeing what comes out.

'It sounds old-fashioned, but pond dipping is big with kids now because it's an easy and not-too-dirty way of getting them involved with nature,' says BBC *The One Show*'s resident zoologist and RSPB president Miranda Krestovnikoff. 'I remember at primary school going "Wow!" as we scooped into the water and realised what was in there.'

Even if you don't have a garden, let alone a pond, there are RSPB and Wildlife Trust events across the country throughout the year.

As well as frogspawn and perhaps tadpoles, you'll also find aquatic macroinvertebrates like caddisflies, mayflies and water beetles in ponds in March, says David Courtneidge, a Water for Wildlife project officer with the London Wildlife Trust (LWT). These small, spineless organisms – which include mites, crayfish, molluscs and flatworms – are brilliant indicators of the health of ponds, which support a huge amount of flora and fauna. Worryingly, around 80 per cent of wildlife ponds in the UK are in a 'poor' or 'very poor' state and ▶

Pond dipping in central London at LWT's Camley Street Natural Park. Left: a blue-tailed damselfly larvae

A light-coloured tray will help you to easily see your findings

HOW TO POND DIP

- First, think about where you're exploring. If it's not your garden, do you need permission? Never pond dip at a nature reserve unless you're with an organised group. Make sure children are supervised by an adult.
- You'll need a tray (or old Tupperware) and a net – you could try making one from a pair of old tights and a metal coat hanger.
- Fill your tray with pond water before you start, so it's ready for the creatures you find.
- Choose your position on the pond bank carefully, avoiding vegetation and slippery mud.
- Gently swish your net about in the water in figure-of-eight movements.
- Carefully empty out your net into the tray, turning it inside out, wait for the water to settle and then see what you've caught. Repeat the process several times, trying different areas of the pond, until you've got a good haul of creatures.
- After you've examined, identified and recorded your finds – touching them as little as possible – carefully tip them back into the pond, keeping the tray as close to the water as possible.
- Wash all equipment before pond dipping elsewhere as diseases can be passed on. Never transport frogspawn from one pond to another. And wash your hands before you eat anything!

WHAT TO SEE AND WHEN

Frogspawn (March)

Tadpoles (April, May, June)

Froglets (June and July)

Dragonfly larvae and emergence of adults (June–August)

Look out for tadpoles from April

50%

of frogs in Britain live in garden ponds – and they tend to return to the same pond every year.

Did you know?

- Frogs and toads are 'anurans' which means 'tail-less'.
- Amphibians have permeable skin, which means they can jump into a pond to slake their thirst.
- The natterjack toad is Europe's noisiest amphibian. It's found in some coastal areas of the UK, and the male's call is audible over several kilometres.

we've lost almost half a million ponds during the last century, according to the Wildlife Trust.

This is bad news as ponds are habitats for a huge variety of wildlife, including the great crested newt, which is a European protected species. As well as water-dwelling creatures, ponds also support water voles, grass snakes – which hunt among the vegetation – and bats, which eat insects from the surface. They are being lost because of urban development, farming and – in family gardens – safety concerns about small children.

Wildlife haven

'When we moved to our house, we dug a really big wildlife pond. It's been the most brilliant part of our garden,' says Krestovnikoff, who lives outside Bristol with her children, aged eight and 11. 'It did seem unusual at a time when most people are filling in ponds. But it has provided my children – and me, too – with hours of entertainment. Obviously, in the middle of summer there's more to see. The dragonflies are beautiful. But we also get swifts, swallows and bats coming to feed on insects. It's the most incredible

Children will enjoy identifying their finds

Left: grass snakes are excellent swimmers and eat frogs and toads
Far left: water voles are protected by law
Below: frogspawn maturing into tadpoles

SLEEP TO FORGET?

When mammals wake up from hibernation, it is widely thought that they suffer from some memory loss as well as weight loss. It's a subject under debate, but now new research has shown that amphibians who sleep through the colder months do not forget what they learned beforehand.

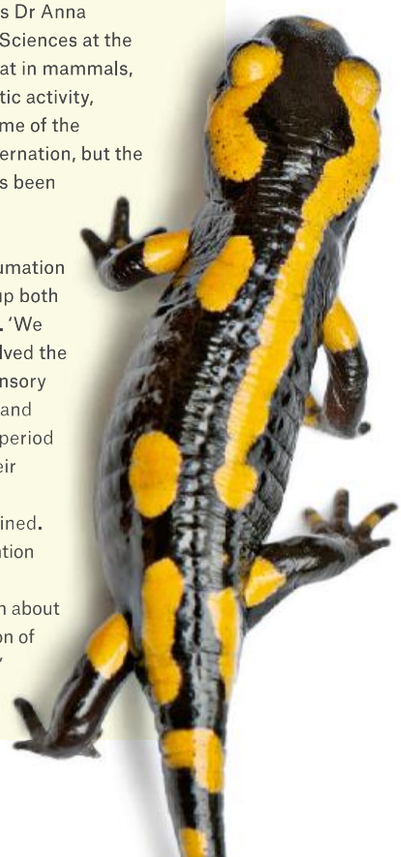
Researchers from the University of Lincoln and two universities in Vienna, Austria, made this surprising discovery using a group of fire salamanders (pictured below right) and a maze.

The scientists taught the 12 salamanders to navigate a maze in exchange for a food reward, then placed half the creatures in brumation – a kind of long-term torpor – for 100 days.

'Long-term torpor is an adaptive strategy that allows animals to survive harsh winter conditions. However, the impact that this has on cognitive function is poorly understood,' says Dr Anna Wilkinson from the School of Life Sciences at the University of Lincoln. 'We know that in mammals, hibernation causes reduced synaptic activity, which can result in them losing some of the memories they formed prior to hibernation, but the effect of brumation on memory has been unexplored, until now.'

After the brumation, a memory retention test revealed that the brumation group and the non-brumation group both recalled how to navigate the maze. 'We demonstrated that both groups solved the task using memory, rather than sensory cues such as smelling the reward, and we're therefore confident that the period of brumation did not impact on their ability to remember,' Anne Hloch, another author on the paper, explained.

'For these animals, memory retention is essential for survival as it allows them to recall important information about the environment, such as the location of food and the presence of predators.'



wildlife feature if you've got the space for it. Even just a small pond can be brilliant fun.

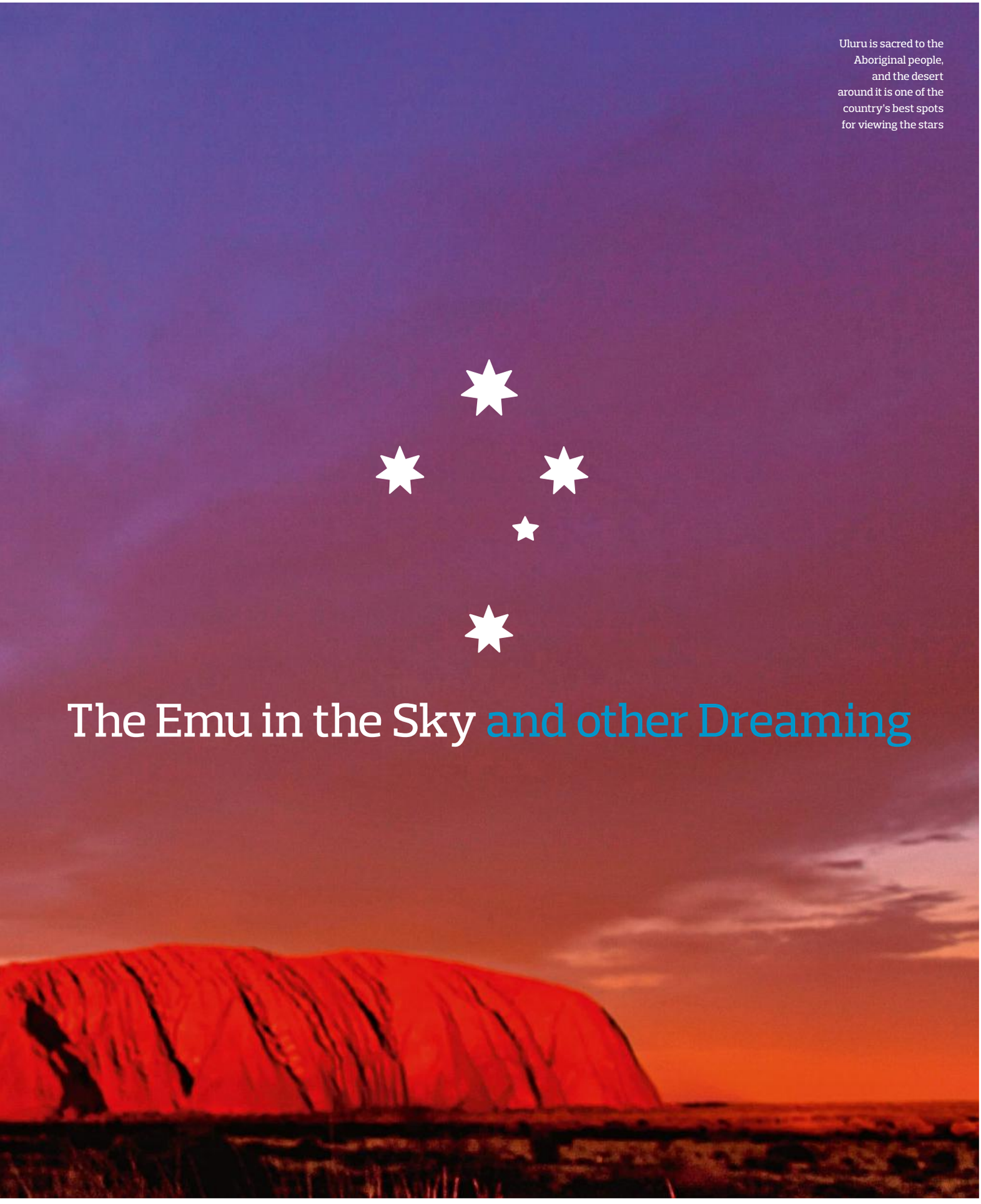
'The kids are always down at the pond with nets. The biggest spectacle for us is the frogspawn. The kids wake up and say, ''The pond is boiling!'' It really looks like it is – there are so many frogs mating,' she says. 'We had well over 100 clumps of frogspawn this year. Every year we collect frogspawn to put in an aquarium we have and take it into the kids' schools. The children never tire of it. It's a moment of magic seeing these blobs of jelly turning into tadpoles and froglets. I still get excited after all these years.'

'The Wildlife Trusts run pond-dipping events for children,' says Courtneidge. But that doesn't mean adults can't get involved, too. 'Part of my job involves macroinvertebrate sampling – basically pond dipping,' he says. 'It's a good indicator of the health of a body of water. Adults can volunteer for the River Monitoring Initiative, which is currently sampling conditions along the Crane and Hogsmill rivers. Information gathered by pond dippers is passed to the Environment Agency to help them set trigger levels [for pollution].' So sticking on your wellies could be useful for the EA as well as fun for you.

To find out how to volunteer, contact The Riverfly Partnership, riverflies.org. Find your local Wildlife Trust at wildlifetrusts.org

Words: Matilda Battersby. Photographs: Alamy, iStock, London Wildlife Trust, Nature Picture Library, Shutterstock

From creator spirits to celestial rivers, there's an intimate link between knowledge of the southern sky and Aboriginal culture. Could it be that these hunter-gatherers were the first-ever astronomers?



Uluru is sacred to the Aboriginal people, and the desert around it is one of the country's best spots for viewing the stars

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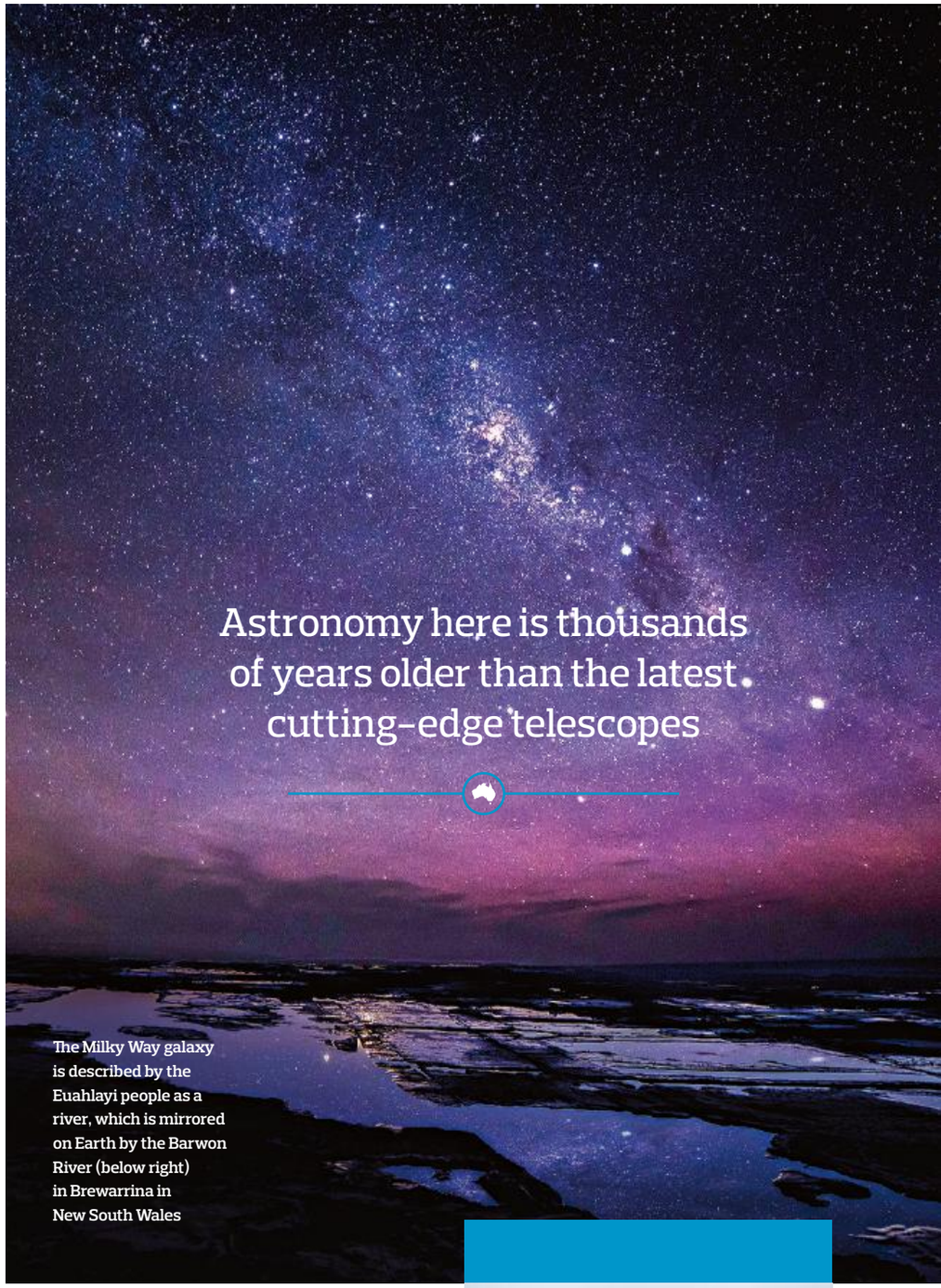
This month, in the BBC's *Stargazing Live*, Professor Brian Cox and Dara O'Briain will be heading to Australia to bring us a stunning perspective of the night sky, looking into the middle of the Milky Way itself – something we cannot do in the northern hemisphere. With its dark skies, the Australian outback is home to huge telescopes at the cutting edge of astrophysics. But astronomy here goes back thousands of years and this land may have been home to the world's first astronomers.

Astronomy is deeply embedded in many of the 300-odd Aboriginal cultures across Australia, all of which share some common roots such as a belief in the Dreaming – a time beyond time when creator spirits roamed the Earth, could move easily between Earth and sky, and could change shape between animal and human. Ancient stories about the creator spirits are told in songs and dance. Often they are written in the sky, as constellations, and their sky-stories are also reflected on Earth, in rocks and lakes and cave paintings.

For example, the Milky Way is viewed by the Euahlayi people as a river. Either side of it, in Sagittarius, are two bright patches, known to astronomers as the Galactic Bulge. Euahlayi people say these are the spirits of the two sons of the creator spirit Baiame. The whole story is reflected on the Earth, where the Barwon River at Brewarrina is identified as the Milky Way, and two large rocks either side of it are identified as the bodies of the two sons.

In these ancient songs and stories can be found traces of generations of Aboriginal Australians seeking to understand the sky.



Astronomy here is thousands of years older than the latest cutting-edge telescopes

The Milky Way galaxy is described by the Euahlayi people as a river, which is mirrored on Earth by the Barwon River (below right) in Brewarrina in New South Wales

The Siding Spring Observatory gives one of the world's best views of our galaxy

For example, the Yolngu people in Northern Australia explain how the tides work: as the moon rises through the ocean, it alternately fills and empties with water, making the sea level rise and fall. This explains why the tides are synchronised with the moon, and why tides are higher at full moon and new moon than at a quarter moon, because then the moon isn't filling up as much. If this idea seems a bit different from the modern scientific explanation involving the gravitational pull of the moon, bear in mind that, pragmatically, it works. It enables a Yolngu elder to predict the timing and height of the next tide. Contrast ▶

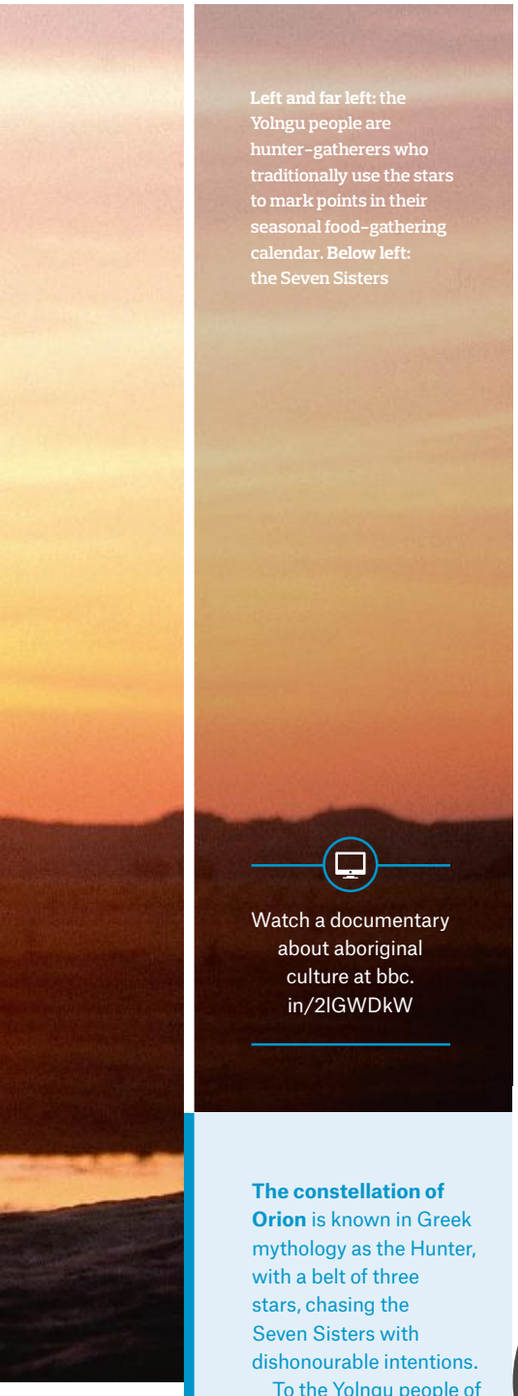
that with the explanation by Galileo, the father of modern science. His interpretation, involving the motion of the Earth around the sun, was not only totally wrong but also failed to explain the connection between the ocean tides and the moon. Unlike the Yolngu explanation, his theory had no predictive power.

Similarly, we find explanations of why eclipses work (it's the sun-woman being covered by the body of the moon-man as they make love). We are told why the moon has a halo around it in cold weather (it's a shelter to protect the moon-man from the cold winds). And we are told that the nebulae in the Milky Way galaxy are the camp fires of the spirit people camping on the banks of the great river of the Milky Way. These stories may seem quaint, but they are clear evidence that the Aboriginal people were observing the sky carefully, and sought explanations for what they saw.

Star seasons

But astronomy is not just about curiosity – it's also about using the sky for practical purposes, such as time-keeping and navigation. Throughout Australia, Aboriginal people divide up their year into seasons, which in many cases are marked by the appearance of particular stars in the sky. For example, many groups mark the start of winter by the appearance of the cluster of stars known as the Seven Sisters. So why did the Aboriginal people, many of whom were hunter-gatherers, need a calendar? Hunter-gatherers, such as the Yolngu people in Northern Australia, move through their land in a seasonal cycle. They must move camp at the right time, down to the beach to catch the barramundi fish, or up to the Arnhem plateau to harvest berries before the birds eat them, or down to the rivers to harvest the water chestnut roots before the magpie-geese have taken them all.

And how do they navigate? One technique is to use oral maps, called songlines. For example, according to Yolngu stories, the planet Venus (Barnumbirr in Yolngu) guided the first humans to Australia in the Dreaming, by flying from the east, describing it in her



Left and far left: the Yolngu people are hunter-gatherers who traditionally use the stars to mark points in their seasonal food-gathering calendar. Below left: the Seven Sisters

Watch a documentary about aboriginal culture at bbc.in/2lGWDkW

The Aboriginal people observed the sky carefully and sought explanations for what they saw

song. When she reached the coast of Australia, she continued across the land, describing the land below her in great detail, including clan boundaries, waterholes, impassable swamps and pleasant camping grounds. That song, memorised by generations of Aboriginal Australians, constitutes an oral map. If you want to navigate across the Top End of Australia, Barnumbirr's song will tell you the way, explaining the best route, the good waterholes, and the places to avoid.

Many other songlines crisscross Australia, providing a set of oral maps for traversing the continent. Because early British settlers often used Aboriginal guides to show the way, many of Australia's great highways follow songlines. But how did people memorise all these detailed instructions? By using the stars as a mnemonic, attaching details to each star, much like the 'method of loci' used by ancient Greeks as a memory tool, or even the 'memory palace' used by BBC sleuth Sherlock Holmes, played by Benedict Cumberbatch. Modern-day Aboriginal elders can identify waypoints on their route with particular stars in the sky, and will consult the sky while travelling to remind them of the songline.

Compass points

Another navigational technique is to use the sky like a compass, to tell direction. Many Aboriginal groups use the four points of the compass just as Europeans do. How accurately did they know these directions? A recent study of stone arrangements shows that traditional Aboriginal people knew these directions to an accuracy of a few degrees, which is no mean feat given that there is no pole star in the south. Instead, to get that sort of accuracy, you'd have to make careful measurements, such as noting the position of the sun over a year and then marking its midpoint. Do we find any evidence of this?

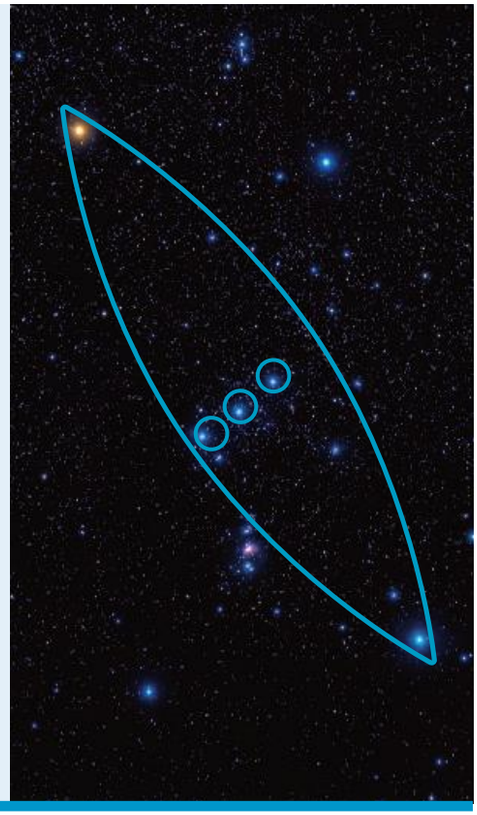
At a site in Victoria is Wurdi Youang, a stone ring about 50m across that's sometimes

The constellation of Orion is known in Greek mythology as the Hunter, with a belt of three stars, chasing the Seven Sisters with dishonourable intentions.

To the Yolngu people of Australia, he is called Djulpan, and the three stars are three brothers in a canoe, who were placed in the sky as punishment for eating a taboo fish. Each Aboriginal language group has a different story about Orion, and yet there is a remarkable underlying thread. Nearly every group associates it with a man or a group of young men, often hunting or fishing, and they are often chasing the Seven Sisters.

How is it that the Aboriginal stories are so similar to the European stories, given that the Aboriginal tales are very old, and there was no contact between Europe and Australia until the 18th century? Perhaps these stories are *really* old, dating to when humans left Africa to migrate to Australia, Europe, and everywhere else. Most civilisations around the world have similar stories about Orion and the Seven Sisters. And most of them, including most Aboriginal groups, call them the Seven Sisters, even though none of us can see seven stars. Depending on your eyesight, you may see four or six, but not seven. Some Aboriginal groups even have a story to explain why you can't see one of the sisters (she died, or was taken by Orion). It is planned to compare stories around the world, to see if we can sequence how the story travelled our planet.

Some stargazers see a canoe, others, a hunter's belt – what do you see?



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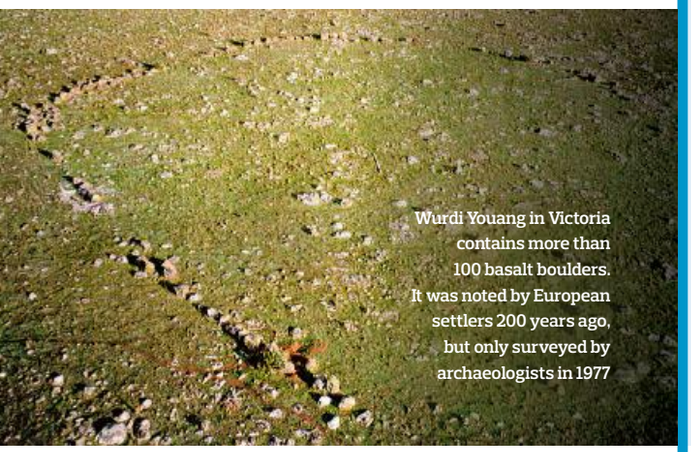
Wurdi Youang stone circle is sometimes dubbed the Aboriginal Stonehenge, but could in fact be much older

dubbed the Aboriginal Stonehenge but could be much older than the Wiltshire circle. It has been carefully built to indicate the direction of the setting sun on midwinter day and midsummer day, and is accurately aligned on the midpoint of these two sunsets – ie, due west. There is no doubt these directions are intentional, and are not just a chance alignment, so the builders found marking these directions sufficiently important to warrant moving tonnes of rock to do it. They understood the motion of the sun sufficiently well that they were confident in this task.

How far back does this knowledge go? We don't know. The Aboriginal people arrived in Australia at least 50,000 years ago, and were almost untouched by the outside world until the British arrived in 1788, so this expertise could reach very far back indeed. But, sadly, we haven't yet found any way of dating the songs or stories, or the astronomical structures like Wurdi Youang. But as we learn more about this ancient heritage, at some point we may find out how old Aboriginal astronomy really is. It's possible they really are the world's first astronomers.

Stargazing Live is on BBC Two on 28–30 March



Wurdi Youang in Victoria contains more than 100 basalt boulders. It was noted by European settlers 200 years ago, but only surveyed by archaeologists in 1977

Look up at the sky from the Australian bush on an autumn evening. The sky directly above you blazes with the vast band of light of the Milky Way, stretching from horizon to horizon. Within it you can see dark clouds, caused by clouds of interstellar dust in the galaxy, in which new stars are being born. In the south, next to the Southern Cross, is a particularly prominent one, known to astronomers as 'the coalsack'. This is the head of the Emu in the Sky. To see the rest of the Emu, you need to realise that this 'constellation' is not made by joining the dots between stars like European constellations. It's the opposite of that, and is marked by the dark spaces between the stars. Look again at the coalsack, and you can see the dark beak of the Emu. Follow the dark clouds of the neck and body down to where the Emu's legs extend to the opposite horizon. Real-life emus today are large flightless birds. But stories say that back in the Dreaming, the emu used to fly, which is why the legs of the Emu in the Sky stream out behind him.

North of Sydney, in Ku-ring-gai Chase National Park, is a beautiful piece of rock art: an engraving of an emu, made perhaps thousands of years ago. Unlike a real emu, his legs stream out behind him. Could this be a picture of the Emu in the Sky? Well, the autumnal Emu in the Sky hangs right above this portrait on the ground in a perfectly matching orientation. And the emu is associated with an initiation ceremony in which Aboriginal boys become men, and this engraving is in a sacred initiation site. So it's quite possible that this is humanity's oldest picture of the sky.

Words: Ray Norris. Photographs: Alamy, iStock, Ray Norris, Aboriginal Affairs Victoria

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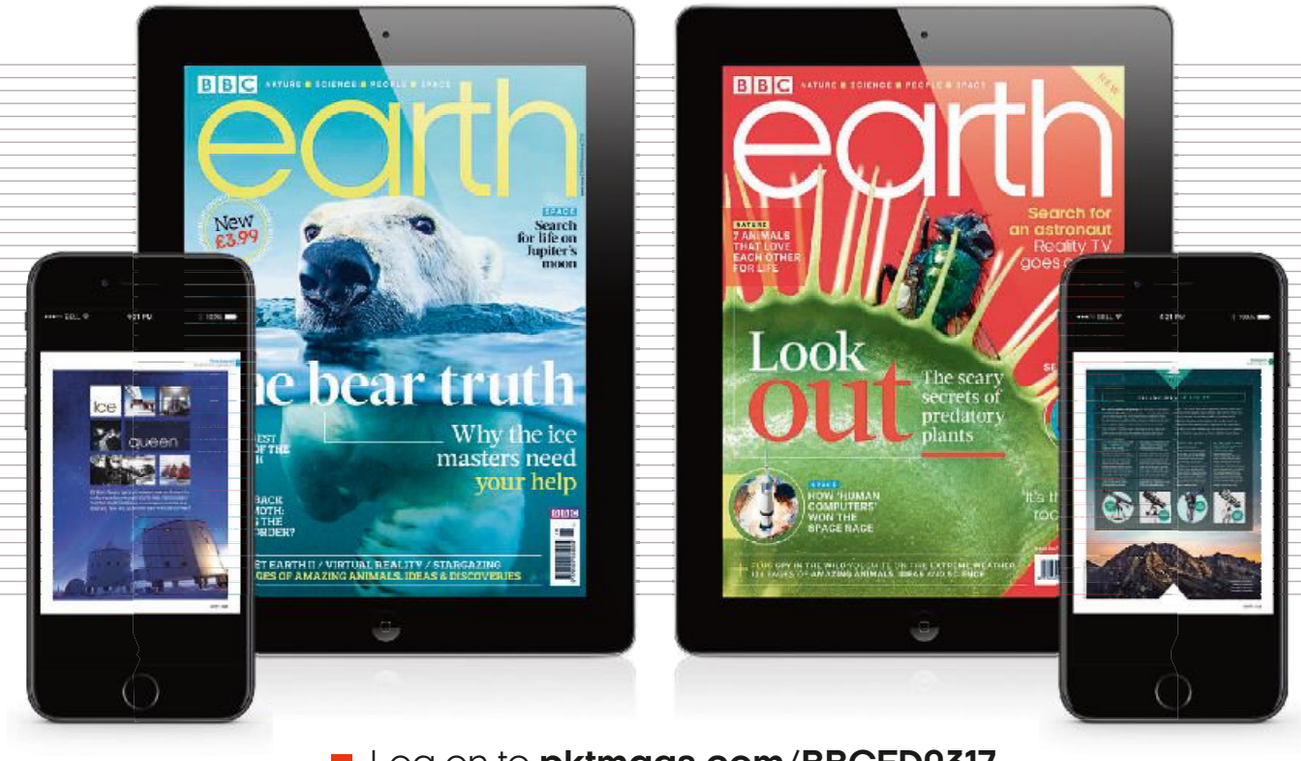

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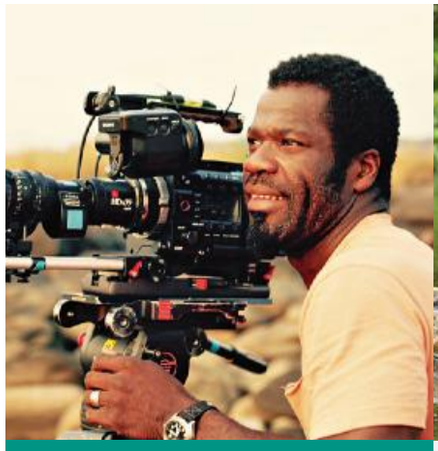
VIANET D'JENGUET

'My mum said, "Nothing is impossible if you want to do it"'

As a young boy growing up in the Republic of Congo, Vianet D'jenguet thought his dreams of being a wildlife cameraman were just that. Thankfully his mum gave him the boost he needed



Cameraman Vianet was persuaded to appear in front of camera for his documentary *My Congo*. Below: his beloved forest elephants

Growing up in bustling Brazzaville, capital of the Republic of Congo, Vianet D'jenguet didn't get to see much in the way of wildlife. Birds and butterflies fluttered and flew around his family's backyard, but there were no close encounters with the country's chimps, gorillas, leopards or hippos.

Instead, it was a trip to the city's zoo that sparked what would prove to be a lifelong obsession, for it was there that Vianet set eyes on his country's elusive forest elephants. As he tells it, it was love at first sight.

'They're just ace,' he says. 'Their bodies are built for the forest, as they have the strength to crash through the undergrowth easily. Yet they can also move very quietly... They're one of the most graceful animals on the planet.'

Like so many of his filmmaker colleagues, Vianet's early passion for the natural world was combined with an interest in photography. But, as a young boy in Africa, a career in filmmaking seemed out of reach. 'I kept going on to my mum about it and she stopped me once and said, "Why don't you just go and learn about it?" I said to her, "It's an impossible world to enter." And she said, "Nothing is impossible, my son. If you want to do it, you can do it."'

When Vianet was a teenager, his father, a doctor, took a job in France and the family moved to Paris. Vianet gained a degree in electronics before going to work as assistant photographer in a portrait studio. But in 2003 he decided it was time to follow his dreams.

Relocating to Britain, he dedicated his time to learning English; he also signed up for a degree in moving image production at Leeds Metropolitan University. Three years later he graduated with a first-class degree (distinction) and landed a job as a camera assistant/focus puller on the BBC's *Casualty*. Three years after that he became a shooting researcher on the Natural History Unit's David Attenborough-narrated *Africa* series.

'It took years to prove myself and get decent jobs,' he reflects. 'The standards


Wadi Rum
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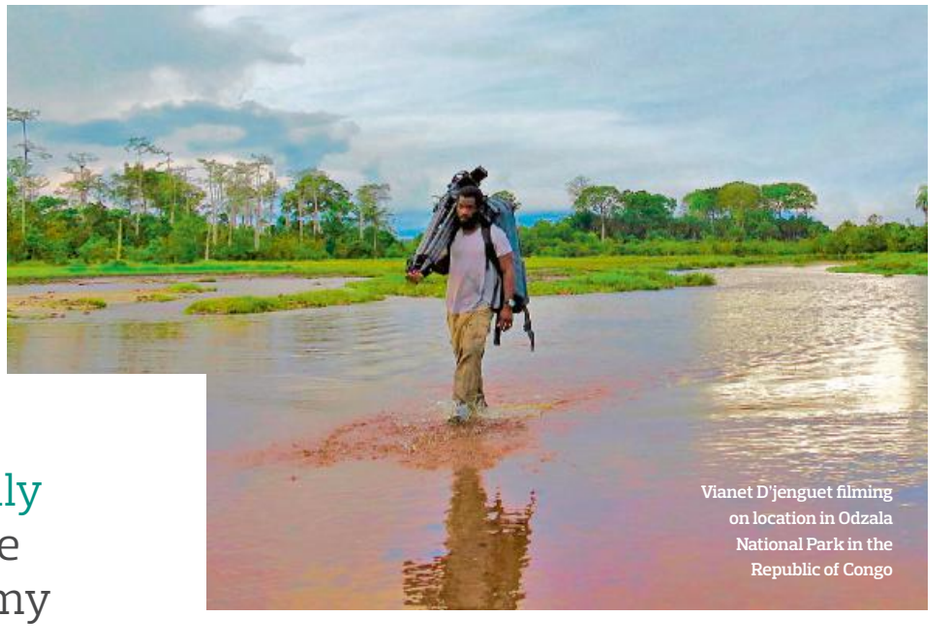
are high across the board and there are many sacrifices you have to make to gain experience and learn the ropes.'

However, his determination was to pay off. Discovering that Europeans often mistook the Republic of Congo for its neighbour, the Democratic Republic of Congo (DRC), Vianet decided to make a film that would put the record straight.

'I was really desperate to place my country back on the map. I wanted to show the wonderful animals and diversity in the landscape; the lovely, beautiful people – that was really what was in my heart.'



Vianet D'jenguet filming on location in Odzala National Park in the Republic of Congo

> 'I was really desperate to place my wonderful country back on the map'

Having hit on the idea for what was to become the 2016 BBC documentary *My Congo*, Vianet's first step was to return to his homeland on a recce he funded himself. Back in Bristol, he presented his footage to Doug Mackay-Hope, a producer and director on the BBC *Natural World* wildlife series, and was pleased to receive an enthusiastic response. But Doug had a suggestion, too: that Vianet, as well as being behind the camera, should appear in front of it. (Very) reluctantly, Vianet agreed.

'Many cameramen would never dream of doing that: it's just not our thing. When I saw myself I freaked out: ''What?! This is what I sound like, this is what I look like?'' It was terrible!' he says.

Not surprisingly given his charm and infectious enthusiasm, the viewers of *My Congo* disagreed. In fact, as Vianet recalls, he found the response was overwhelming. 'It was such a proud moment,' he confesses. 'I really wished my mum was alive to see it because she inspired me a lot.'

My Congo is a film full of unforgettable encounters, not least between Vianet and his beloved forest elephants. But one meeting in particular stands out. Having travelled back to his great-grandfather's home town, Vianet arranged to speak with some of the indigenous forest people living there. To his amazement he discovered that they still remembered and honoured his ancestor, who, instead of succumbing to a land-grab by Europeans, had fought until death to remain in the forest and protect their way of life.

The Republic of Congo, as Vianet explains in his programme, was the first country in Africa to give its indigenous people rights. Knowing that his forefather played his part in that is something that Vianet treasures, but he is also intensely aware of how many other native peoples around the world remain under threat.

'With my work I'd like to carry on with my great-granddad's legacy,' he explains. 'I love giving a voice to the voiceless: people and animals. It's all I care about. It makes me feel that making films is worth doing.'

Bringing more of the Congo's magic to our screens is an ongoing mission for Vianet. 'There were so many species and places we didn't have space to include in the programme: air-breathing lungfish; electric catfish; giant sea turtles...' Not to mention the Mokèlé-mbèmbé, a legendary creature that is supposed to reside, Loch Ness monster-style, in the depths of the remote Lake Tele.

'The footage I gained from that first trip was just the start of my journey of discovery,' Vianet concludes. We expect we're not the only armchair explorers eagerly awaiting the next instalment.

| SHORT CUTS |

What are your hobbies?
I love fly-fishing for rainbow trout in Wales and playing Scrabble – I have never lost!

What's been your scariest moment?
When we were chest-deep in a swamp in the Congo and our guide decided to tell us about the water cobras...

Who do you look up to?
My great-granddad. I know he wasn't a famous person but he is my hero.

Favourite place other than the Congo?
Madagascar: more than 80 per cent of the species are endemic, which is mind-blowing. They have the most beautiful primates, too, such as the indri (right).

Words: Stephanie Cross. Photographs: BBC Pictures, iStock, Josh Helliker

Each lightning bolt can contain up to a billion volts of electricity – and about 100 lightning bolts hit the Earth's surface every second

Lightning is one of our most theatrical weather events, with summer storms bringing electrifying displays. But how much do we know about why these flashpoints occur?

From Harry Potter's scar to its starring role in *Back to the Future*, lightning is a symbol of drama. In films and TV programmes it signals the arrival of a violent or explosive crisis point. By tradition, religion has claimed lightning as a sign of heavenly wrath – the destructive power and the beauty of a lightning fork make it easy to imagine Zeus or Thor hurling bolts down to Earth.

Most of us know that thunder and lightning are essentially one and the same. That, because light travels faster than sound, there's a delay between seeing the lightning and hearing the thunder. The booming noise is the channel of heated air that formed around the lightning bolt closing up again.

This might sound confusing. But have you ever stopped to think how the lightning occurs in the first place? For centuries it was seen as an example of magic. In the 18th century, when Benjamin Franklin and other early scientists began experimenting to find out more about lightning, they wondered if it was a fluid.

Our knowledge has grown, but it's a complicated process that's still not fully understood. Over the page we look at the theory of how clouds become so highly charged with static electricity that they can treat us to a cracking display.

VERY, VERY

frightening?

LIGHTNING CLOUDS

The massive, fluffy mushroom cumulonimbus clouds, nicknamed 'thunderheads', are the ones usually responsible for lightning and other severe weather, such as tornadoes. Anvil-like in shape, they can reach up to 14,000m in altitude.

TURBULENCE

Strong updrafts and downdrafts swirl around in a storm – the updrafts whisking small water droplets up above freezing level. Meanwhile, downdrafts carry hail and ice back towards Earth. On the way, water droplets and hail collide to form graupel (soft hail).

SEPARATE CHARGES

When graupel collides with additional water droplets and ice particles, this creates enough friction to sheer off electrons from the particles travelling upwards. These electrons collect on the particles heading downwards. Electrons carry a negative charge and collect at the base of the cloud, while the top of the cloud becomes positively charged.

Words: Matilda Battersby. Photographs: Alamy

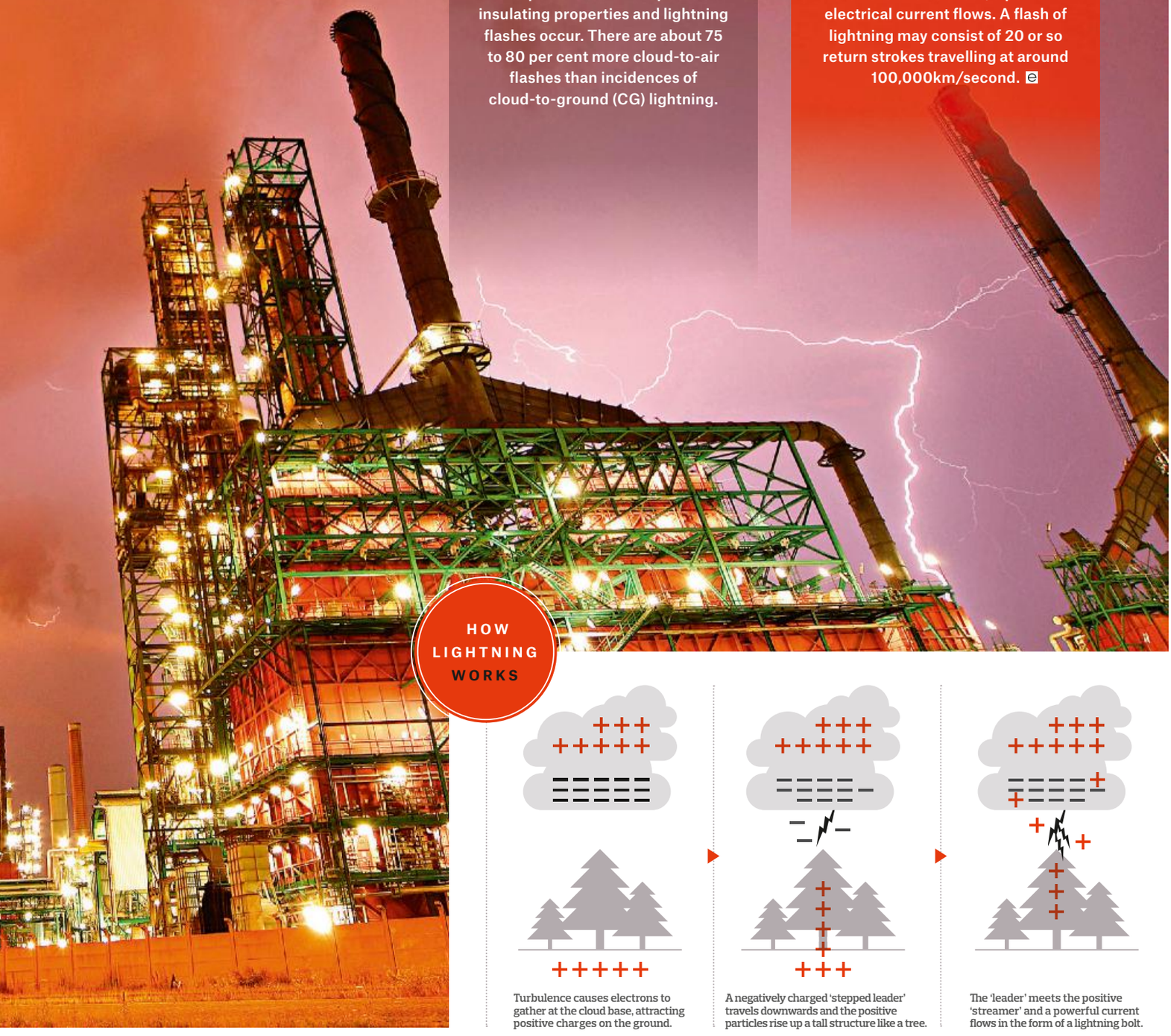
A lightning bolt is hotter than the surface of the sun – and, yes, it can strike twice...

STATIC

As the positive and negative charges separate, an electric field is generated between the top of the cloud and its base. However, this stays inside the cloud thanks to the atmosphere, which is a very good insulator. It takes a huge charge to build up before any lightning starts. When the charge is strong enough, the electric field overpowers the atmosphere's insulating properties and lightning flashes occur. There are about 75 to 80 per cent more cloud-to-air flashes than incidences of cloud-to-ground (CG) lightning.

GIANT SPARK

CG lightning happens when a cloud base's negative charge attracts a buildup of positive charge on the ground. As the difference in charges builds, positively charged particles rise up tall structures such as trees. A 'stepped leader' of negative charge zigzags down – as it nears the ground, a positively charged 'streamer' reaches up. When the two connect, a powerful electrical current flows. A flash of lightning may consist of 20 or so return strokes travelling at around 100,000km/second.



HOW LIGHTNING WORKS

Turbulence causes electrons to gather at the cloud base, attracting positive charges on the ground.

A negatively charged 'stepped leader' travels downwards and the positive particles rise up a tall structure like a tree.

The 'leader' meets the positive 'streamer' and a powerful current flows in the form of a lightning bolt.

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DOWN THE MIGHTY RIVER

Steve Backshall fulfilled a lifelong ambition when he kayaked down New Guinea's Baliem River and finally got to see a bird of paradise. He tells Dawn Emery about his adventures, including an encounter with this water dragon – and a night with a 200-year-old roommate

Wildlife television presenter Steve Backshall, known for programmes including *Deadly 60* and *Big Blue Live*, is used to being greeted warmly on his travels. But his first encounter with some Yali tribal people on his latest expedition to Papua in New Guinea was 'genuinely scary'.

'Some men came down to the riverbank with spears, and bows and arrows in their hands and they were very grim-faced,' says Backshall, who was filming the new two-part television documentary *Down the Mighty River*. 'I have never had a situation like that before, where someone has refused to shake hands. We were a long way from anywhere familiar at that point.'

The Yali people live in an inaccessible but fertile valley in the highlands of a great mountain massif in the centre of New Guinea, a large island – the second biggest in the world – in the southwest Pacific. The Yali and other highland tribal people in Papua, such as the Dani and the Lani, were uncontacted until less than 100 years ago. Every tribe evolved in isolation, living in a non-monetised economy dependent on subsistence agriculture with minimal contact even with neighbouring tribes, and developing their own distinct artistic style, language and culture.

'It's not TV hyperbole [to say] they do have a recent history of headhunting [the practice of taking and preserving a person's head after killing them] and there are wars between tribes that have gone on for generations,' says Backshall.

The presenter's natural diplomacy and ability to speak a little Bahasa, the Indonesian language, helped diffuse the hostility. 'The people of Papua have so many reasons to distrust outsiders,' he says. 'All they know of us is that we turn up, take their raw materials, all of the gold and copper, and then disappear. You have to make a real attempt to understand their distinct culture and be respectful.'

Backshall's nerve-racking encounter was just one adventure on an ambitious trip in which he and his team, including remote-area medic and former marine Aldo Kane, attempted to become the first-ever people to travel

A Dani warrior plays a pikon mouth harp at the annual Baliem festival featuring mock battles between the Dani, Yali and Lani peoples

Crocodiles are ever-present in the Baliem Valley – Steve Backshall is shown the skull of a croc that had killed 17 people

'It was an expedition that had absolutely everything. When they brought out this skull of a saltwater crocodile, my jaw hit the floor'

Backshall with the expedition's medic Aldo Kane. They were in New Guinea to attempt to kayak the Baliem River

the full length of the 400km Baliem River, one of the wildest places on the planet.

'It was an expedition that had absolutely everything,' says Backshall. 'Grandeur, extraordinary anthropology, fabulous geology, landscapes and adrenaline... it's a pretty heady combination.' Backshall was seen trembling both before and after he kayaked along some of the river's white-water rapids. 'I've been kayaking all my life but the white water was bigger than I hoped it would be,' he says. 'Nothing compares to that zing of adrenaline you get when you smash through your first-ever class-five rapid.'

New Guinea's landscape features mountain ranges formed by the Australian and Pacific tectonic plates squeezing together, alongside massive caverns – Backshall visited one 'ridiculously beautiful' cave that was more than 100,000 cubic metres (the size of the Albert Hall), as well as the

Did you know?

- New Guinea has the greatest number of active languages in the world – 820 at the last count.
- That equals one language spoken for every 8,563 people on the island.
- Traditionally, personal wealth in New Guinea is not measured by what you possess, but by how much of it you have shared. The more people indebted to you, the richer you are.

Children sit beside the Baliem River, a quieter stretch of a torrent that's known – and feared – for its churning white-water rapids. **Far right:** the mummified remains of an elder. **Top right:** a water dragon

world's largest gold mine and third-largest copper mine. 'There are mountains longer and higher than the Alps,' says Backshall. 'And they are full of caves, of which only a tiny percentage have been explored. If you're a caver, this part of the world is the Holy Grail.'

Fantastic beasts

Wildlife in the region includes colourful birds of paradise (only found on the island's central highlands, as well as in parts of Indonesia and Australia), flightless cassowary birds, water dragons, and tree-dwelling kangaroos and possums. 'And there are bizarre animals like echidnas, which lay eggs and look like a massive fat hedgehog with a snout,' says Backshall.

'It was sobering to see how different their lives are, having to deal with the threats from wildlife as part of daily life'

'We'd pull up our boats, set up a camp and I'd spend a few hours looking for animals.'

For Backshall, seeing the bird of paradise up close was a lifelong dream. 'I had an encyclopaedia dedicated to the birds of the world, and the pages about the bird of paradise were pretty much worn through. I was obsessed with them. I never thought I'd get a chance to see one. It has this most incredible glossy colour. It's a bird with a very big voice and, every once in a while, he's kind of letting rip. He's screaming to all the females saying, "I'm the most beautiful boy on the block."'

Some of the people Backshall met showed him the skull of a saltwater crocodile that had measured almost 5m long and had killed 17 people. 'When they brought out this skull, my jaw hit the floor,' he says. 'It was a sobering realisation of how different their lives are, having to deal with this kind of threat as part of daily life.' He was also shown the skin – unrolled and presented as a great trophy – of a recently hunted crocodile, which, as an ardent conservationist, Backshall found difficult to look at.

Another memorable moment came when Backshall stayed in a Dani village in the Baliem Grand Valley, and he was permitted to sleep next to the 200-year-old mummified remains of a young tribal chief and warrior, Agat Mamete Mabel – a great honour for the Dani to bestow. 'It was quite extraordinary,' says Backshall. 'They had smoked their ancestor over a fire for six months. He was in this hunched, foetal position and looked like very dark, tanned leather.' It is a centuries-old tradition for the

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Sighting a bird of paradise was a lifetime ambition for Backshall. **Left:** the Baliem River is located in the central highlands of Papua on the island of New Guinea

bodies of venerated ancestors to be dried in the sun and drained of body fat before being preserved with smoke. Keeping the bodies of ancestors is thought to confer blessings and prosperity on the living and is a way of paying respect.

'It's not common any more,' says Backshall. 'When Christian missionaries first started coming here in the 1950s, it was a practice they most tried to get rid of, persuading people to bury their dead instead, and a lot of mummies were burnt.'

Trying to get to sleep next to a mummy is perhaps not an overly relaxing experience. 'It *was* one of the worst night's sleep I've ever had but not because of the mummy,' says Backshall. 'The hut was filled with the biggest mosquitoes I've seen in my life, so I lay there with my Gore-Tex jacket wrapped around my head, trying not to be eaten alive.'

Men in the villages sleep in separate huts to the women; one man told Backshall how his four wives slept in the same hut. 'They were like, "How many wives have you got?" And I'm like, "Erm, only the one,"' laughs Backshall, who married double Olympic gold medallist rower Helen Glover last September.

Many people living in Papua have a more urban lifestyle these days but in rural areas people still keep pigs, and grow sweet potatoes, taro (a nutty-tasting root similar to the white potato) and yam. Backshall and his team ate local foods when staying in the villages, but survived on rations of freeze-dried food, which they'd brought with them, when camping out next to the river.

Backshall has noticed some positive differences since he first visited the island in the 1990s. 'I saw less environmental damage this time,' he says. 'There are fewer villages now, as people are moving to the towns. But the people we met were fiercely proud of their region and couldn't be nicer. They seem to have got it right in a lot of ways. I didn't notice that they were massively covetous of the modern world. The people I met didn't seem desperate for mobile phones and televisions.'

Viewers will see that Backshall's expedition didn't all go to plan. 'There were frustrations and challenges,' he admits. 'But expeditions are not meant to be easy.' And he's eager for more adventures. 'There are still little-known corners of the planet, but it's getting rarer to find something that hasn't been attempted before,' he says. 'I have a list of expeditions as long as my arm. I just need to convince someone to let me do them.'

Down the Mighty River **is on BBC Two this month**

Photographs: Alamy, BBC Pictures, Getty, iStock

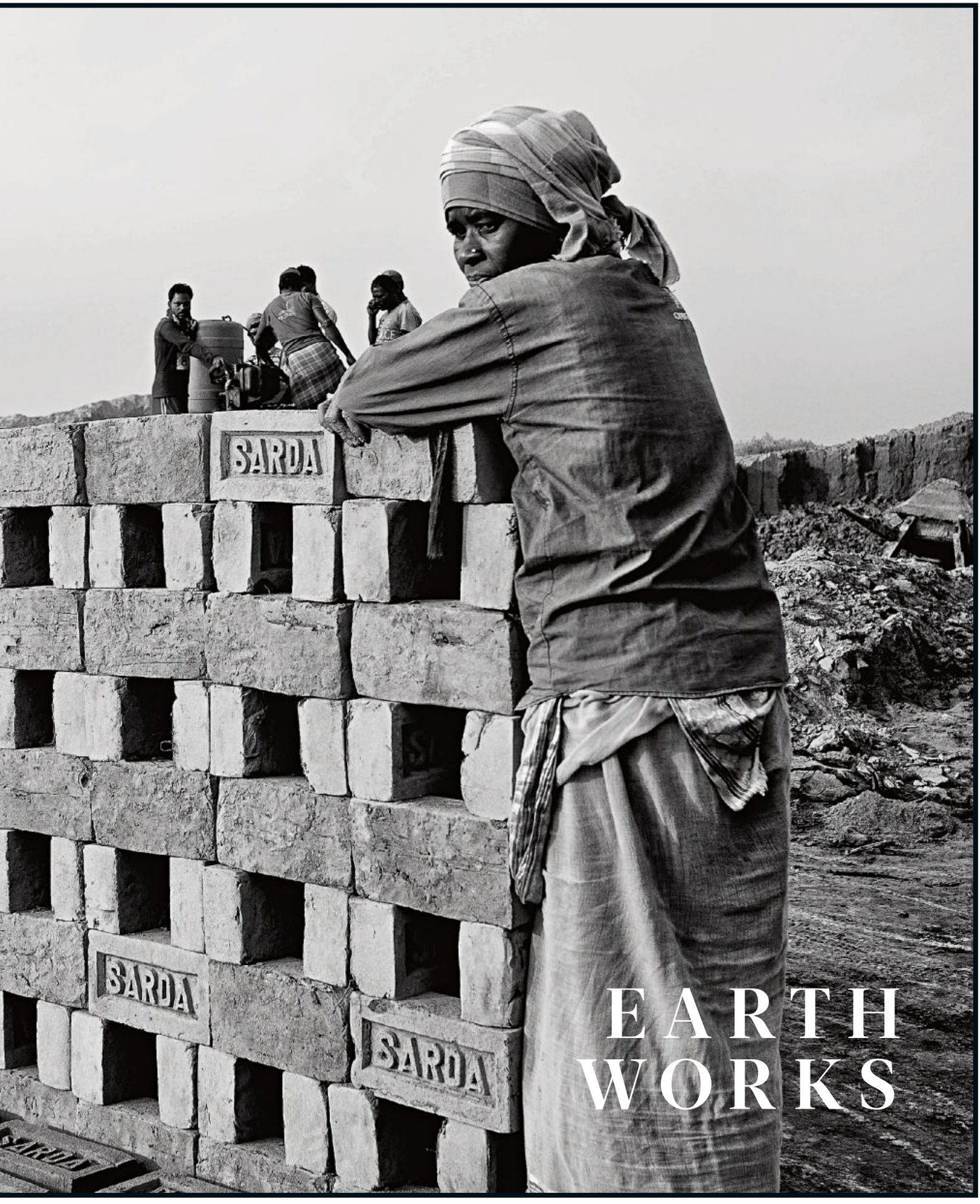
The flightless cassowary is the largest bird on the island. It is also the most dangerous: it can deliver a swift karate kick and has dagger-like claws. **Left:** egg-laying echidna are another of the island's peculiar creatures

Photographer Jon Nicholson travels to West Bengal, where an entire industry is built on the gift the monsoon rains bring

If you worked at this brickworks in Minakha, near India's second-biggest city of Kolkata, you might produce as many as 1,500 bricks a day. They are made using traditional methods, from clay that is dumped here when a tributary of the Ganges floods during the three-month monsoon season.

After the waters retreat in September, the brick-makers, who live in nearby villages, arrive to start work, extracting clay from the earth, shaping the bricks by hand and firing them in kilns.

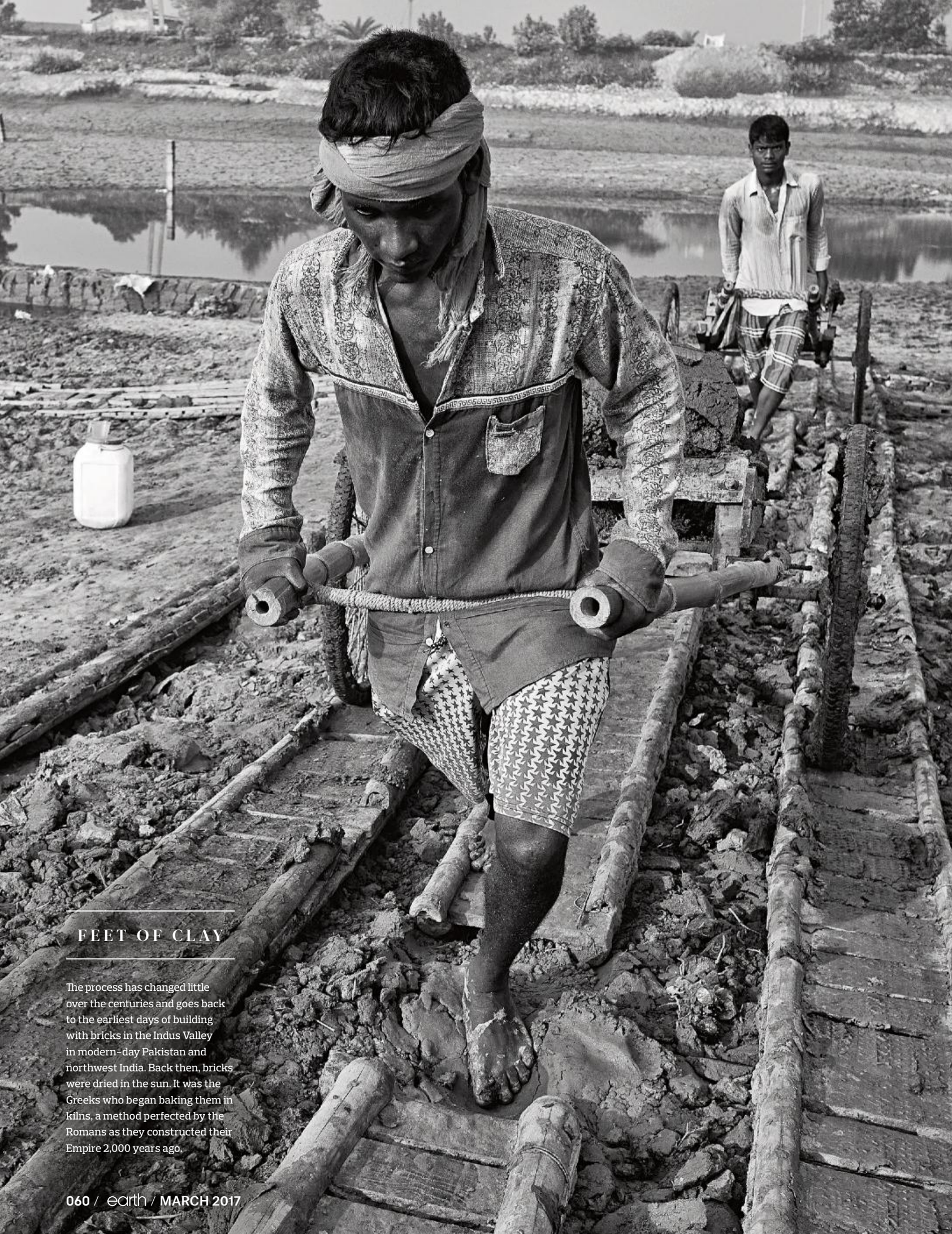
The industry provides work for around 10 million people country-wide, but in Minakha it has some unfortunate side-effects, as the water that brings the clay downstream is full of toxins, which, when the bricks are fired, are released into the atmosphere.



EARTH WORKS

FIELD DAY

Clay is dug up and carried away to be moulded into blocks and stamped with the manufacturer's name. The bricks are then left to dry before being fired in a kiln using coal as fuel. Around 250 billion bricks are made in this way in India every year



FEET OF CLAY

The process has changed little over the centuries and goes back to the earliest days of building with bricks in the Indus Valley in modern-day Pakistan and northwest India. Back then, bricks were dried in the sun. It was the Greeks who began baking them in kilns, a method perfected by the Romans as they constructed their Empire 2,000 years ago.

FEELING THE BURN

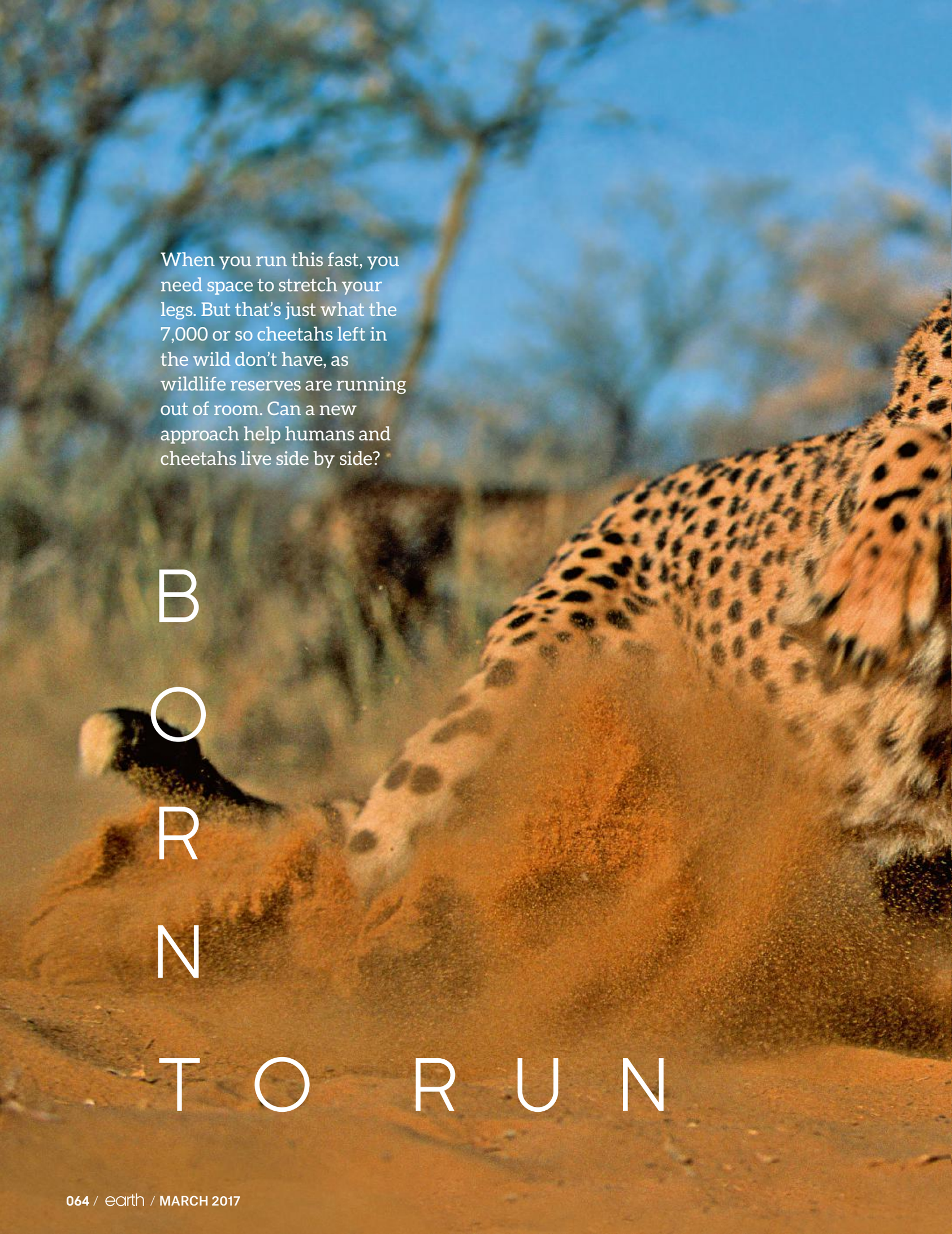
When the bricks are fired, toxins from the river water that have permeated the clay, and therefore the bricks, are released, together with the greenhouse gas carbon dioxide. Kiln stacks (such as the one pictured below) have to be built high enough for the wind to help disperse the pollutants. However, if the weather is still, emissions aren't blown away and can sink to ground level, causing breathing difficulties for some people. The pollutants are also threatening the precious mangrove forests that lie 80km north of Minakha in the Sundarbans, a group of islands in the Bay of Bengal.

In a bid to help reduce the environmental impact, a team at the Massachusetts Institute of Technology (MIT) has come up with an ingenious solution. Aware that India's paper mills produce vast quantities of waste fly ash as they burn materials to generate energy, the engineers reasoned they could solve two issues by making bricks out of the fly ash. They have been testing out this possibility in the city of Muzaffarnagar in Uttar Pradesh. 'We're field-testing the durability of the bricks,' says assistant professor Elsa Olivetti. 'We built a couple of walls seven months ago, which are still looking good, and we're working out how to optimise the mix.'

LOOKING TO THE FUTURE

'I've talked to brick-makers around the world and they agree that making a brick is an art form,' says MIT's Elsa Olivetti. But a balance must be struck between protecting the environment and supporting livelihoods. A less damaging way of making bricks, such as MIT's proposal to use fly ash, could be one way of helping to safeguard fragile ecosystems.

Words: Carolyn Fry. Photographs: Jon Nicholson



When you run this fast, you need space to stretch your legs. But that's just what the 7,000 or so cheetahs left in the wild don't have, as wildlife reserves are running out of room. Can a new approach help humans and cheetahs live side by side?

BORN TO RUN

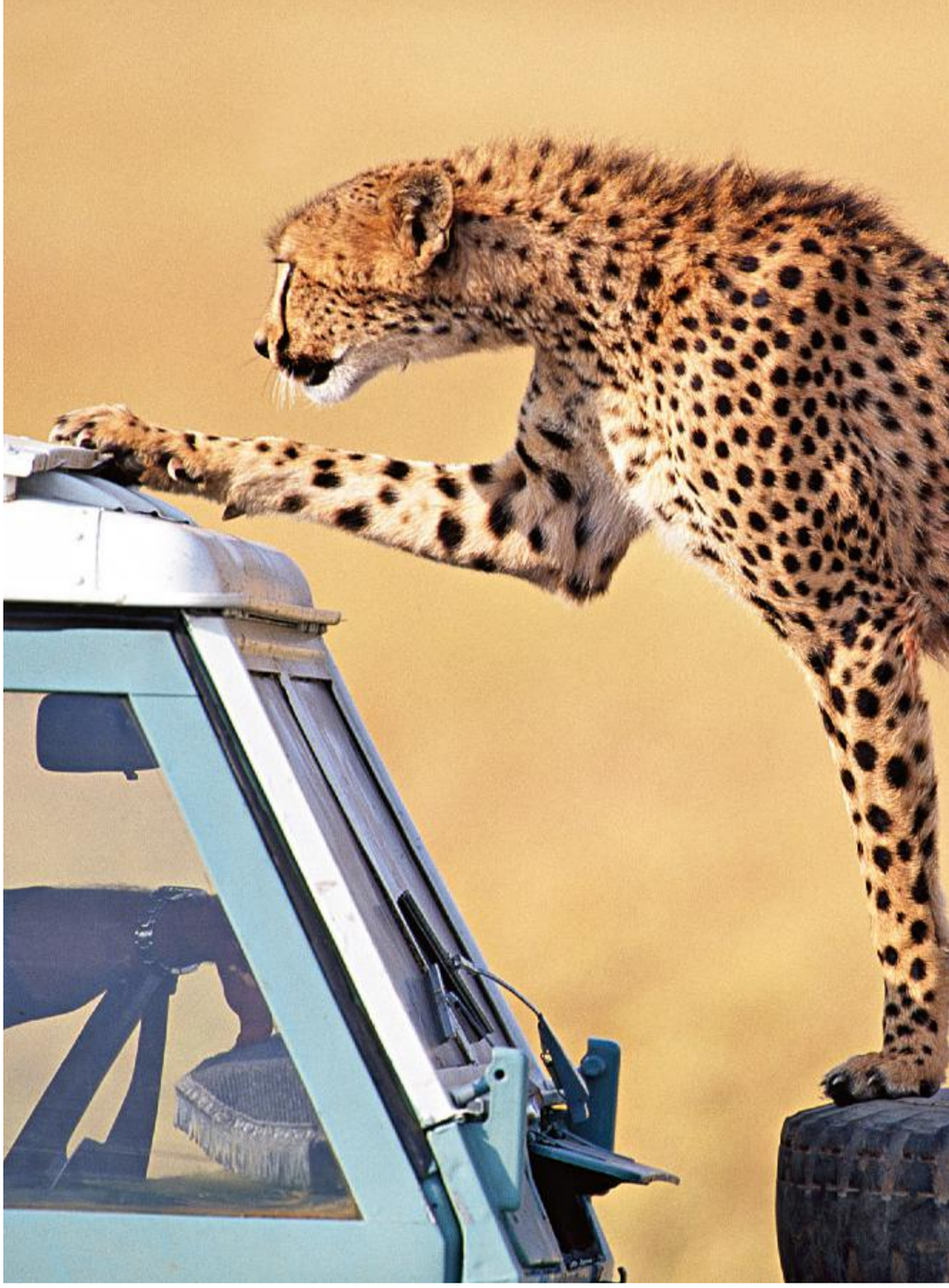
The world record for the fastest 100m is 5.95 seconds. It was set by Sarah, an 11-year-old cheetah from Cincinnati Zoo, in 2012. Put her up against the fastest human on Earth, Usain Bolt – whose 100m record is 9.58 seconds – and she'd be over the finish line, hurtling along at 98km/h, before he was barely into his stride.

With tyre-tread paw pads and running-spike-style claws that, unlike those of other cats, don't fully retract, cheetahs are made for speed. But it's the acceleration that cheetahs such as Sarah can achieve that truly astounds: 0 to full speed in three seconds, faster than many a sports car. Every centimetre of their frames, from their large nasal passages that maximise air intake, to their rudder-like tails that help them steer at full pelt, is an adaptation that helps them to explode after their prey like feline bullets. With their compact heads, skinny legs and spring-like spines, they're living, breathing examples of how nature can rival the greatest achievements of human engineering.

'It does take your breath away,' says Dr Sarah Durant of the Zoological Society of London and the Wildlife Conservation Society, who has watched cheetahs hunting for nearly 30 years. The speed comparison she draws is that 'If you were driving from a slip road onto a motorway, the cheetah could be overtaking you.'

Just 7,100 cheetahs now remain in the wild, according to a new study by Dr Durant and 53 other experts. A hundred years ago that figure was more like 100,000, spread across much of Africa, the Arabian Peninsula and into India. The species has now disappeared from 91 per cent of the area it once inhabited.

Today, most cheetahs – around 4,000 of them – are concentrated in a population that



Left: cheetah paws are designed for sprinting, with tough pads and unretractable claws for grip. **Below right:** black tear marks on their faces are thought to help cut sun glare during hunts

spans six countries in southern Africa: Angola, South Africa, Botswana, Mozambique, Namibia and Zambia. Another 1,400 or so live in an area straddling the Kenya–Tanzania border, while the rest exist as 31 pockets of 200 or so individuals elsewhere in central, southern and eastern Africa as well as Iran, home to the last three groups of Asiatic cheetahs. One of five subspecies (the others are the South African cheetah, Northwest African cheetah, Sudan cheetah and Tanzanian cheetah), these critically endangered cats likely number fewer than 50 in the wild, with just two in captivity.

These numbers are dire, but Durant's study's mathematical models suggest they could get a lot worse, perhaps dropping by half again over the next 15 years. Already, Zimbabwe has seen its cheetah population plummet from 1,200 to 170 in the last 16 years – an 85 per cent loss.

Lone rangers

To understand why cheetah populations are so fragile, you need to realise how different they are to the robust lions, tigers and leopards of the *Panthera* genus. On the African plains, lions often steal cheetah kills and devour their cubs – up to 90 per cent die before they reach three months, research shows.

In fact, as the sole member of the *Acinonyx* genus, cheetahs are not much like other big cats at all, Durant says. 'They have a weird social system where females range across big areas. The males have small territories.' A female can range over 3,000km^2 – twice the size of Greater London. One tracked in the Sahara roamed across 1,500km^2 in just two months. They also like to stay out of each other's way; you rarely find more than two in any 100km^2 area and in places like the Sahara, you might only find one per 4,000km^2.

These huge space requirements mean even the biggest wildlife reserves can only harbour limited numbers – the Serengeti in Tanzania has room for just 300 cheetahs. Over three quarters of the areas they inhabit lie outside protected zones. There, these shy, elusive cats are even harder to monitor and much more at risk. Now Durant is calling for their status to be upgraded from 'vulnerable' to 'endangered' on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

Cheetahs are particularly vulnerable to losing their habitats to farming and human expansion, which also reduce the numbers of their prey, such as gazelle, antelope and impala. The result makes them more likely to attack livestock and, in turn, be killed by farmers.

Cheetahs also make easy targets for poachers outside protected areas. Their spotted skins are coveted throughout Africa,

Cheetahs and humans can survive and thrive together if we can create the right conditions – and change is in the air

Words: Nick Funnell. Photographs: Alamy, iStock, Zoological Society of London

while live cubs can command four-figure sums in the Middle East, where pet cheetahs are status symbols. Most trafficked cubs – around 85 per cent, according to the Cheetah Conservation Fund (CCF) – fail to survive.

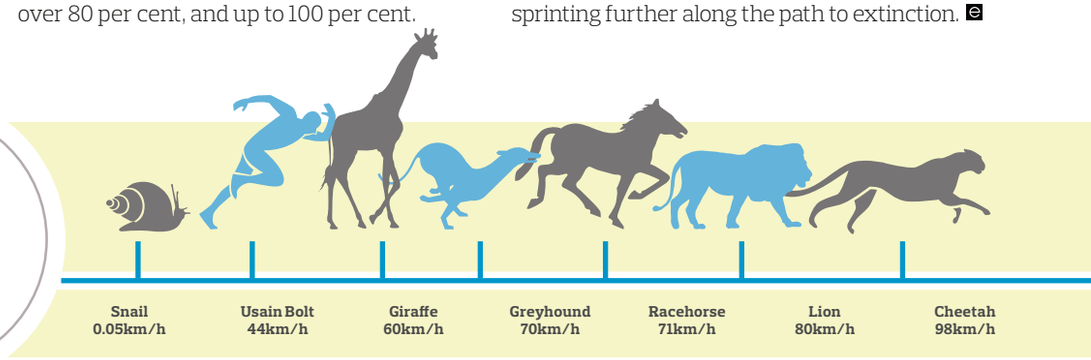
Saving cheetahs will clearly take more than just watching over them in wildlife reserves. Nothing short of a whole new approach that encourages humans and cheetahs to live side by side is needed, Durant believes – no mean feat in poor areas where farmers are likely to view them as a threat to their herds.

'We're not pretending it's easy,' says Durant. Financial incentives for communities that protect wildlife or schemes to allow farmers to charge more for goods from well-conserved areas could be ways forward. Keeping cheetahs away from livestock is another – the CCF says its long-running programme to place guard dogs with Namibian farmers has helped reduce livestock loss from all predators by over 80 per cent, and up to 100 per cent.

A change does seem to be in the air. The decision by the 180 nations attending the Convention on International Trade in Endangered Species of Wild Fauna and Flora conference in Johannesburg last autumn to stem the illegal live cheetah trade was a hugely positive step and prompted the United Arab Emirates to pass a law banning people from keeping wild animals as pets.

There's certainly more to do. But the good news is that humans and cheetahs can survive and thrive together if we can create the right conditions. As long as we can conserve wildlife corridors that connect their habitats, cheetahs should be able to maintain gene flow between groups and recolonise new areas. Growing human populations will not make any of this any easier. But if people can be persuaded to find a little room in their worlds and in their hearts for these shy, fragile cats, there's a chance to prevent them from sprinting further along the path to extinction.

UP TO SPEED
Who can run the fastest?



The cheetah takes strides of up to 7m – the same as a decent human long jumper's leap. In full flight, they do this four times a second

Did you know?

- Cheetahs can't roar like lions, but purr like domestic cats.
- Mothers bring live prey for their cubs to practise hunting.
- Cubs are born with silvery mohawks for camouflage and to mimic the aggressive honey badger, warding off predators.
- William the Conqueror kept cheetahs to take out hunting.

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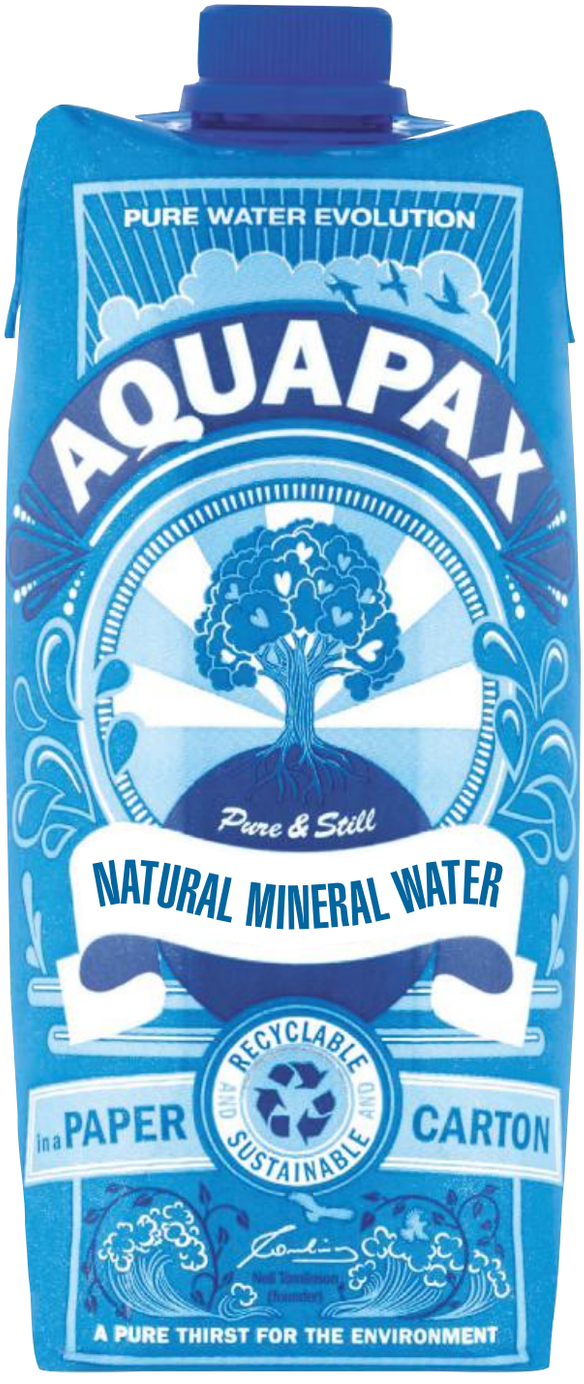

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SO YOU WANT TO WORK IN PARADISE?

Azure seas, white-sand beaches, swaying palms… marine conservationists work in some breathtaking locations, but away from the spectacular sunsets is the serious job of protecting our sea life. We find out how you could get involved

Blacktip sharks are managed by conservationists in many parts of the world because they are vulnerable to being caught in fishing gear

Visiting tropical beaches is all in a day's work for Martin Callow. A marine conservationist, his career has taken him to the kind of places most of us only dream of visiting, such as the Seychelles (including the remote coral atoll of Aldabra, home to 152,000 giant tortoises), Fiji, Belize and Gabon. He's currently the marine director of the Wildlife Conservation Society (WCS) in Myanmar, a varied role that sees him juggling practical conservation work with management responsibilities.

'Last week, I flew to Manaung Island in Rakhine State, northern Myanmar, which has barely had anyone visit from the Western world,' he says. 'We were up at 5am, visiting fish markets and talking with communities about problems with their fisheries, wildlife catches, economics and social challenges. And in two weeks I'm going to Bali to lead a Myanmar delegation at the World Ocean Summit. There's no typical day; sometimes I can be in the field getting smelly with fish, others I can be in a suit in front of ministers.'

Island idylls

Callow joined WCS a decade ago. He has headed up the organisation's Fiji programme and helped developed its presence in Europe. In Myanmar, having devised a conservation strategy and recruited a local team, he now works with his colleagues to promote healthy, sustainable fisheries; develop protected marine areas; protect iconic species (including the Myanmar dugong, sharks and rays); and develop partnerships with other civil society and private sector organisations.

While the life of a jet-setting marine conservationist sounds glamorous, Callow points out that many of the ocean and coastal habitats he visits are far from pristine, and that much of his work revolves around inspiring people to look after the environment better. That can be tricky when people have such a tight dependence on natural resources. 'It's beautiful seeing stunning coastal vistas and underwater habitats but we also often encounter degraded coral reefs, depleted fisheries and damaged mangroves,' he says. 'It can feel like you're taking one flipper kick forward and two back at times.'

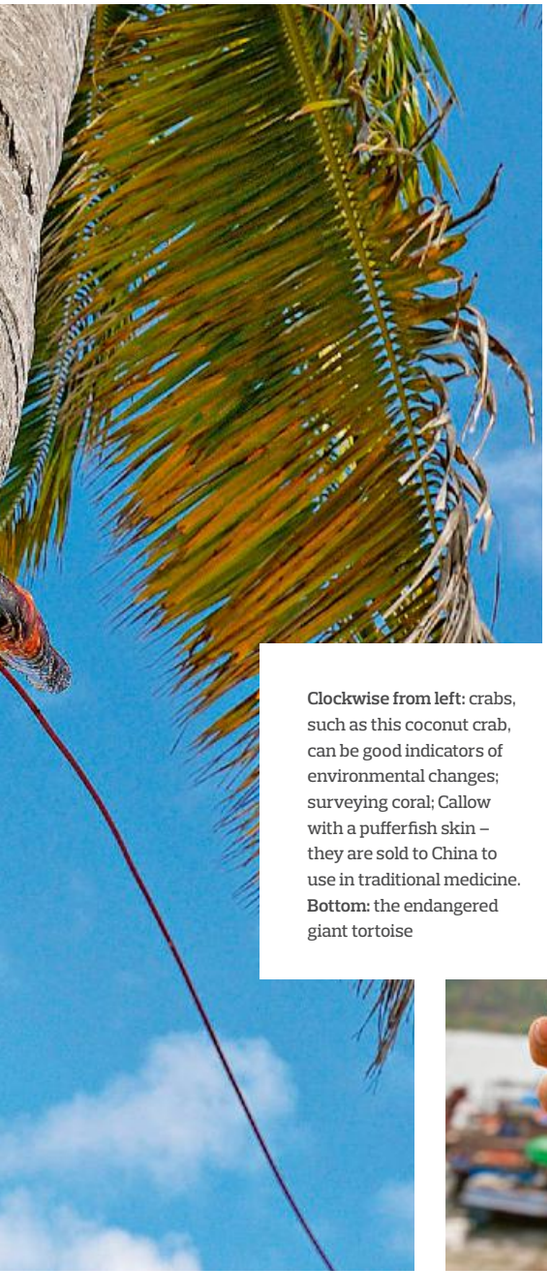
He is encouraged, however, by the fact that there is greater interest in marine conservation now than at any other time in his 20-year career. The UN's Sustainable Development Goal 14 is focused solely on sustainably managing and protecting ocean ecosystems, there are conservation targets in place, and there is more money available than ever before. 'People are understanding that climate change, overfishing, coastal development and pollution from plastics are

HOW TO GET INVOLVED

Marine conservation is highly competitive (who wouldn't want to work at the beach?), so you need to be dedicated to be in with a chance. Martin Callow studied for a degree in Environmental Sciences and an MSc in Applied Marine Science, both at the University of Plymouth. 'I was very persistent,' he says. 'I had my sights set on it and pushed to get there.

'Volunteering is also very important to demonstrate your commitment and your desire to learn.' Callow's early work in the Seychelles came from volunteering with the Royal Geographical Society (with the Institute of British Geographers). 'But getting a good education is key,' he says. 'You're not going to go far without putting the effort into university.' **You can find out about wildlife volunteering opportunities near you at wildlifetrusts.org.**

'I can be in the field getting smelly with fish, or in a suit in front of ministers'



Clockwise from left: crabs, such as this coconut crab, can be good indicators of environmental changes; surveying coral; Callow with a pufferfish skin – they are sold to China to use in traditional medicine. **Bottom:** the endangered giant tortoise

Did you know?

- Dugongs (below) are one of four species from the Sirenia family. They got their name from being mistaken (from a distance) for the **sirens of mythology** by sailors.

- The **world's oldest living animal** is a 184-year-old giant tortoise from the Seychelles.
- In Ancient Greece, **venom from stingrays** (below) was used as an anaesthetic by dentists.

- The Cookiecutter shark grips its prey with its teeth then **spins 360° to remove a neat circle of flesh**.
- Flamboyant cuttlefish (below) can't swim long distances; instead they **'walk' along the ocean floor**.

now having significant impacts and that we need to think a bit smarter,' he says.

Callow is aiming to capitalise on business's new interest in marine conservation when he takes up a new job in the Seychelles in a month's time; he'll be leading a multi-million-dollar trust fund that will help the country to protect 30 per cent of its ocean and sustain its fisheries through innovative financial investments. He's excited to be returning to the Seychelles, where early on in his career he ran a successful marine conservation programme that was eventually handed over to the islands' government. 'Then, I was counting corals and fish underwater, and now I'm going to be counting money above water to help save those corals and fish,' he says.

Best bit: 'Working and living in the Seychelles where I cut my marine conservation teeth – particularly working with dedicated local partners and amazing scientists, and visiting Aldabra, which is one of the most beautiful places I've ever been. Fish thrive there, giant tortoises still roam and flightless birds walk around without fear. It was a great privilege.'

Worst bit: 'That's tough! But one thing that can keep me awake at night is the report writing. Fortunately, I work with a dedicated team and we are able to be honest about the challenges as well as demonstrate our progress.'

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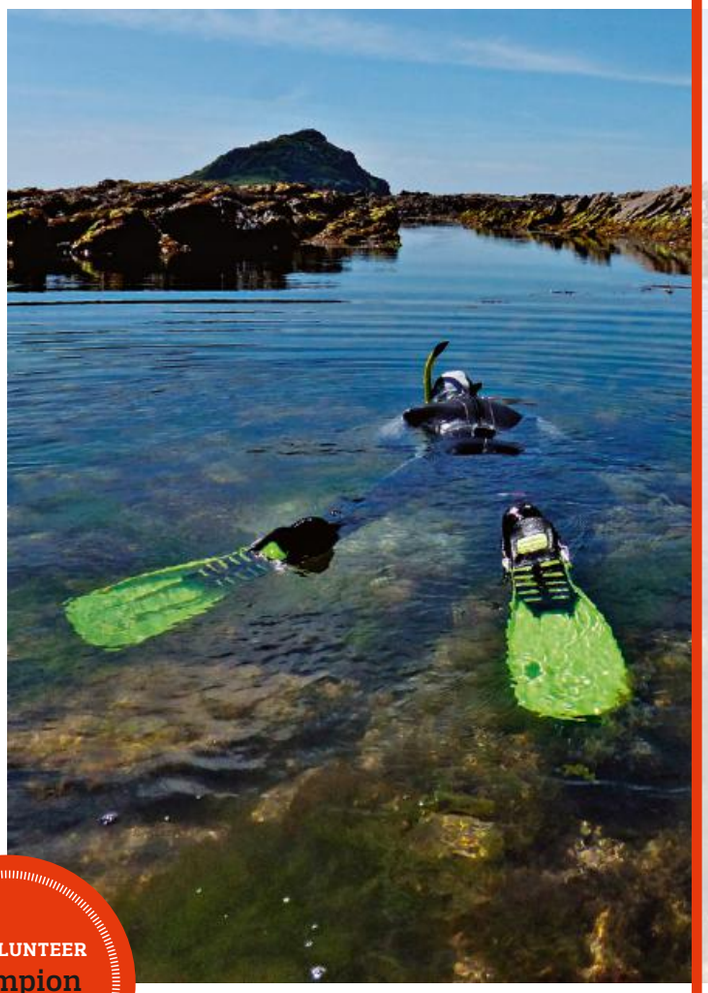
Left: John Hepburn volunteers for the Marine Conservation Society. **Right:** tagging nursehound (a type of catshark) egg cases at Wembury Point in Devon



As his 30-year career in the Navy drew to a close, John Hepburn started thinking about what to do next. He was driving down a steep, fog-shrouded hill in Oman when he had what he describes as an 'aha moment'.

'I realised that the reason I was taking my life in my hands and driving down this dangerous road was actually because I wanted to see the sea,' he explains. 'I knew then that whatever I did after the Navy had to involve the sea and ships and the people that worked on them.'

After retiring, Hepburn found work in the maritime industry but also began volunteering at Wembury Marine Centre, near Plymouth, where he discovered more about the marine environment and conservation. The combination of working for Sea Vision UK to raise awareness of the sea's importance to the UK, and learning about marine biology made Hepburn realise that people need to understand both. 'The maritime industry and marine conservation are two sides of the same coin,' he says.

THE VOLUNTEER
Champion of the sea

Charity work

This realisation prompted him to get involved in more volunteering opportunities. He began working with the Plymouth charity Millfields Inspired, going into schools to teach Year 5 pupils about beach litter and shipping. 'If you tell people you're going to talk with them about maritime careers, you don't get much response, but if you tell them they're going to save the planet, you do,' he says. 'So I talked about beach litter then put in a sneaky message about careers. My self-imposed mission is to bring the marine and maritime fields together and make sure we work for a better "one ocean". We have one planet and one ocean, and we're all in the same boat on it together.'

Hepburn's teaching sessions brought him into contact with the Marine Conservation Society (MCS) and he began work as one of their Sea Champions, helping them develop partnerships, and undertake surveys and research. In 2016, the Society awarded him the MCS Award for his efforts.

Under the Sea Champions banner, Hepburn currently runs various MCS workshops in schools around the country. Most recently he visited the schools his grandchildren attend in Croydon, to run some workshops on 'aliens of the deep'. After learning how life adapts to the extreme environment of the deep sea, the children were asked to design their own alien. 'My grandson, Tom, decided that his fish would have a bottom disguised as a mouth, so if any predator came to attack it, it would poo and swim away. It was brilliant, as that's essentially what a cuttlefish does; it squirts ink and makes its getaway.'

Best bit: 'I love being near the water and showing people the sea life that exists beneath the surface. I get a kick out of knowing people are enjoying something that they previously didn't realise was there. And I get to hang around with lots of young people, which is nice when you're 65ish.'

Worst bit: 'There are no bad bits – although going for a two-hour snorkel in the winter to monitor catshark egg cases can be pretty cold.'

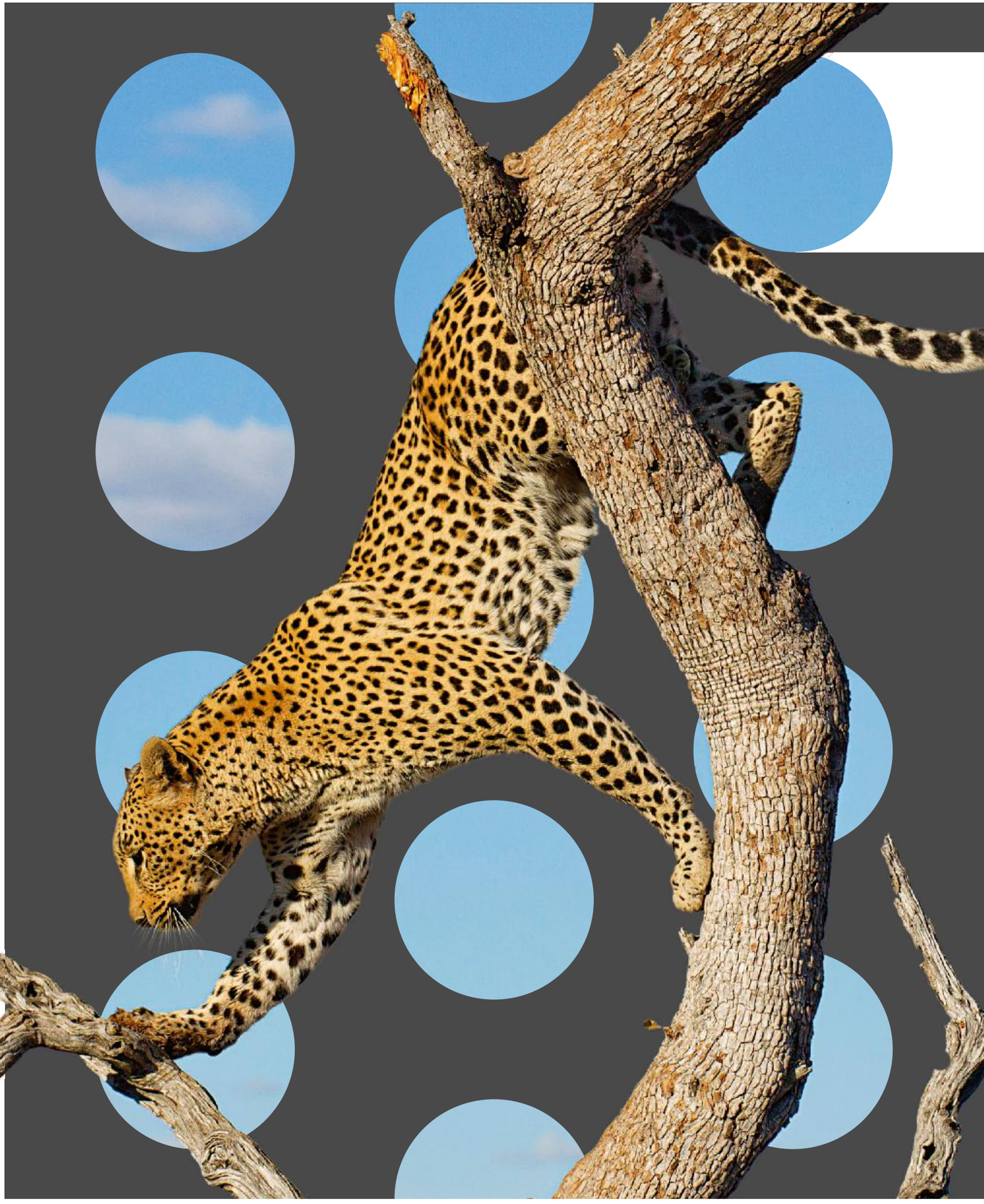
'WITHOUT WILDLIFE, THE BEACH IS JUST A PLACE TO SIT'

'I like the beach because we look in rock pools to see creatures and find shells, and we watch sea birds like kittiwakes. I like snorkelling and seeing different fish. I also like to think of the sea creatures swimming in the sea and I would like to see whales and dolphins one day.

'I think that being a marine conservationist would be a good career, as I would like to save wildlife in the sea and make a difference. If we keep overfishing, sharks will die and turtles will die. It is a good idea to look after the sea because otherwise there will be no coral, no sea creatures, just sea with nothing in it and no purpose to go in the sea or go snorkelling. Without wildlife, the beach is just a place to sit down. I do not want any of the world's creatures to disappear forever, as they would never come back.'

Heather Laker, aged 8

Words: Carolyn Fry. Photographs: Ben Stobart, Eleanor Briggs, Cat Gordon, Alamy, iStock



Alan Turing (right) suggested that patterns, such as a leopard's spots (left), result from individual cells reacting in a predictable way

Spot the difference

It has been 60 years since Enigma codebreaker Alan Turing came up with a theory for why the leopard has its spots. As stem cell research proves him right, we look at how patterns in nature can be explained by mathematics

It's a rare sort of mind that looks at the visual hotchpotch of a spotted, speckled and striped leopard's pelt and finds a means of applying order to the shapes through mathematics.

The apparent randomness of the patterns that appear in nature – a zebra's zigzagging stripe or the labyrinthine mosaic of a giraffe's skin – are accepted without question by most of us.

But Alan Turing, the prolific mathematician best known for helping to break the Enigma code at Bletchley Park during the Second World War, and for writing a scientific paper that would form the basis for modern computing – was not content with simply marvelling at the miracle of nature.

In 1952, Turing published a ground-breaking paper called 'The Chemical Basis of Morphogenesis' – his last work before his apparent suicide just before his 42nd birthday – containing an elegant mathematical schema for the formation of the patterns found in animals and plants.

The patterns were far from random, he argued, and were the result of interacting chemicals that spread among groups of otherwise identical cells.

He coined the term morphogen (morpho, from the Greek for 'form', and gen, from the Greek for 'to beget'), meaning shape-formers. Turing was deliberately vague about what these morphogens were. They could be hormones, perhaps, or genes, the chemical nature of which, in the 1950s, was still to be unravelled. The main idea was that they diffuse and react with each other: this is now called the reaction-diffusion process.

His theory – laid out in beguiling mathematics – had it that within tissue or cells there are two morphogens that act on one another: one creates the other, and makes more and more of itself, and the other, second chemical limits the creation of the first. Both diffuse, or in other words, spread out, at different rates.

It has been compared to a predator-prey situation; the idea that, repeatedly in the development of a biological entity, two chemicals can work in tandem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both independently and in competition. It's as if one is chasing the other away.

At the most basic level, patterns emerge from randomness as varying concentrations of colour-activating and colour-inhibiting chemicals interact. Dark spots form and, in turn, the spots merge into stripes as the colour-activating tissues become more concentrated. Seen on creatures ranging from zebras to seashells to giraffes, they have come to be known as Turing patterns. In recent years, scientists have found Turing patterns in wind-blown sand, attributing the ripples to the same reaction-diffusion process, and even human communities, suggesting that phenomena such as crime hotspots can arise from social feedbacks on behaviour and movement that are similar to the push-me-pull-you process Turing identified.

Proving the theory

For three decades, Turing's theory on morphogenesis was largely ignored by biologists. But the combined arrival of powerful computers and the dawn of modern molecular cell biology, as well as the work of two generations of scientists who took Turing's theory seriously from the 80s onwards, have contributed to proving it.

Jeremy Green, professor of developmental biology at King's College London, and his team provided one of the first non-theoretical proofs of Turing's ideas in 2014, when they discovered that the ridges on the roof of a mouse's mouth acted like stripes or spots in morphogenesis. They identified the two chemicals needed to produce this – and proved in mice that it works.

'It's been possible, but only in very recent times, to really test Turing's theory,' Professor Green says. 'There are a relatively limited number of examples where people have done that in a rigorous way – skin being one, my research into the palate being another, and left-right asymmetry in fish being the third. Turing was right and we've now got the names [for the shape-formers].' Broadly speaking, the morphogens in this case turned out to be protein growth factors, of which there are six main ones. 'Each one of those six can come in a bunch of different flavours,' says Green – so determining what the job of each morphogen is will be critical, as scientists come to programme stem cells to do certain things in the body.

It might be counterintuitive to many of us, but it makes sense that a mathematician would look at patterns in biology and try to formulate an equation for their existence. It's only now that scientists are realising quite how far ahead Turing's thinking was.

THE SCIENCE

'The miracle of spontaneous self-organisation into pattern is not miraculous, it's chemistry,' says Professor Jeremy Green.

'Turing's scheme was: you have two chemicals in a tissue, which both can diffuse – so in that way, there's nothing weird about them, they don't break the laws of physics – but they have to interact with each other in a certain way.'

Professor Green explains how designs such as fur patterns result from this interaction between individual cells, as one chemical activates a change, such as colour, and one inhibits it.

'Let's give them names,' he says. 'We'll call them the Activator and the Inhibitor. So, the Activator causes production of the Inhibitor. The Activator also, and this is very important, triggers production of more of itself. The Inhibitor, as the name suggests, inhibits production of the Activator.'

Patterns are produced by varying concentrations of the reactive chemicals. 'The variation comes from the distribution. Let's say, by chance, there's a little bit more of the Activator: you get this snowball effect as it makes more of itself.

'The Inhibitor doesn't build up as quickly, certainly not as fast as the Activator. Which means you get a peak of Activator.

'Right where the peak is, the Activator is "winning". What you've now got is a spot of Activator surrounded by a ring of Inhibitor. Now, if you imagine that happening everywhere in an animal, then you're going to have a distribution of spots or, depending on the concentration of Activator, stripes. Voila, that's it. It is amazing. But it's as simple as that.'

Spots

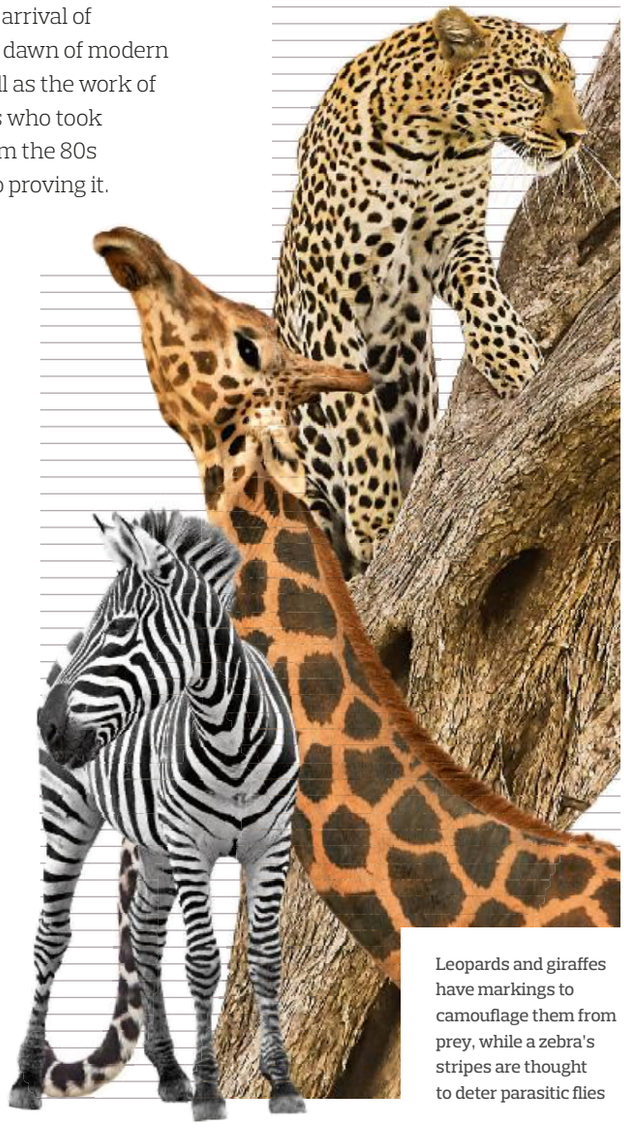
The distinctive markings on leopards is an example of how differently morphogens behave according to surface area. Where they have greater space, spots will form. Where the area is smaller (as on a leopard's tail) the concentration will be greater, so the spots will merge and form stripes.

Stripes

As mammals such as zebras or tigers age, their stripes keep getting bigger, retaining the same spacing but increasing in number. These patterns are examples of self-organising Turing patterns, as the reaction-diffusion system continues for the lifespan of the animal as it grows.

Dappling

Turing's theory proposed that interacting morphogens could give rise to dappled patterns, and could account for the markings on animals such as giraffes. The idea is that morphogens influence melanin distribution, producing variations in colour and dappling, depending on the subspecies.



Leopards and giraffes have markings to camouflage them from prey, while a zebra's stripes are thought to deter parasitic flies

Words: Matilda Battersby. Photographs: Getty, Alamy, iStock

Cormorants roost on rusting cranes in the Chernobyl exclusion zone

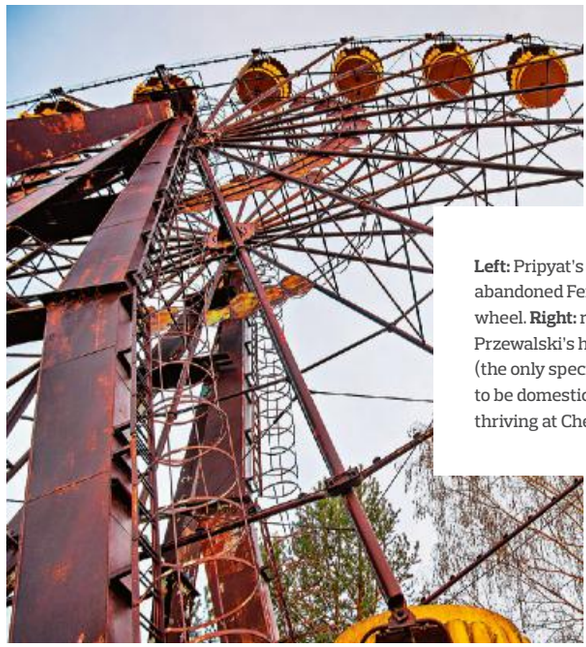
OUT OF

THE ASHES

Three decades after the world's worst nuclear accident, the area around Chernobyl seems to be teeming with life. Is nature bouncing back? Katie Stacey reports

When the Chernobyl Nuclear Power Plant's fourth reactor exploded on 26 April 1986 it released 400 times more radioactive material than the atomic bomb dropped on Hiroshima. Many predicted that the 2,600km^2 exclusion zone in Ukraine, which spills over the border into Belarus, would be a dead zone for lifetimes to come. But, in striking contradiction to the scientific prognosis, the site of the world's most catastrophic nuclear accident is proving to be a habitat valued by wildlife.

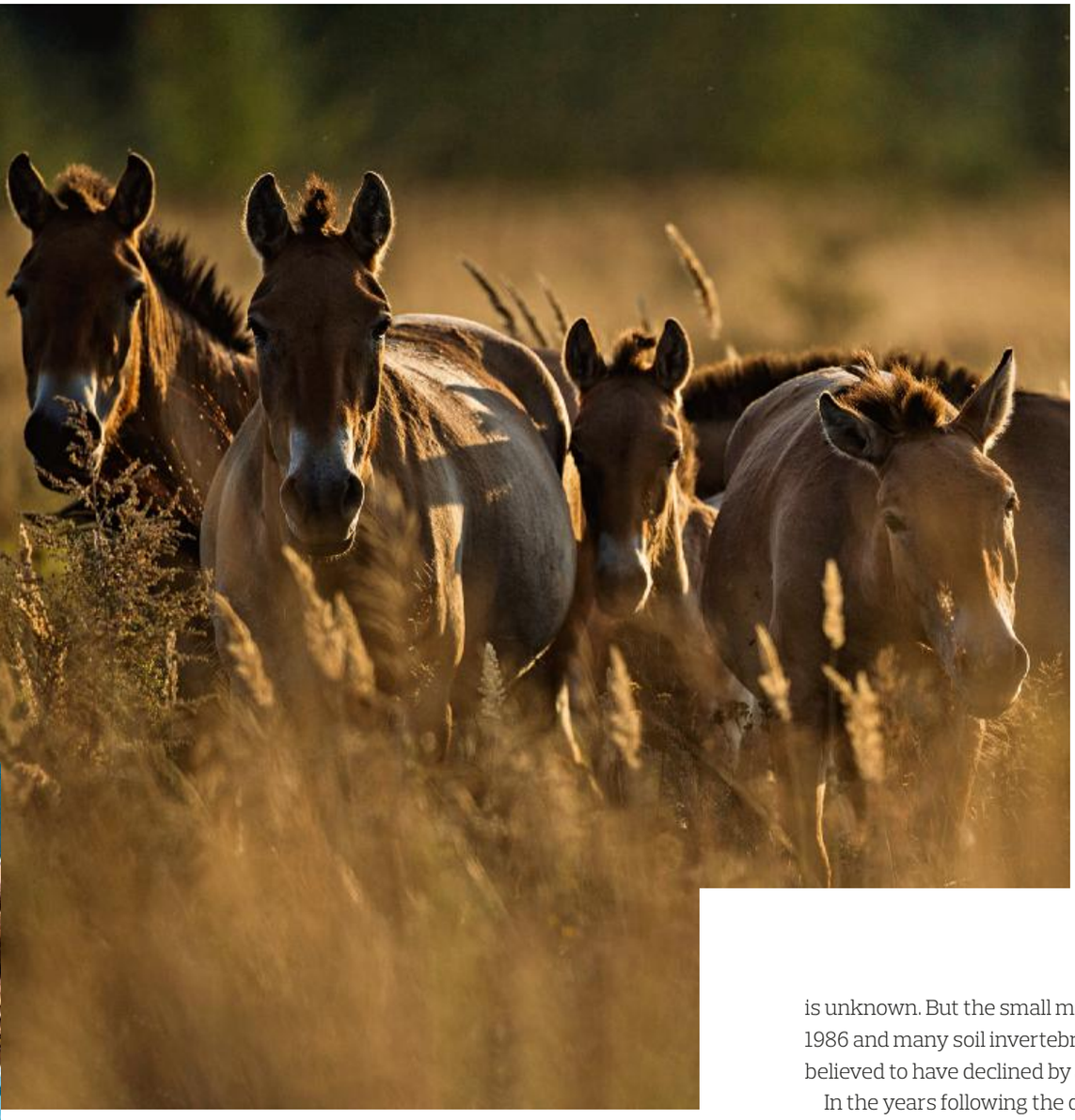
For years, stories of two-headed catfish, piglets with dipygus (a congenital deformity where the pelvis and legs are duplicated) and hyper-aggressive wolves, were synonymous with the disaster. In 1988, a scientist showed Mikhail Gorbachev, former president of the Soviet Union, a photo of an eight-legged calf to suggest the impact radiation was having on animals. After the explosion, 28 people went on to die from radiation sickness, and it's estimated the toll of premature human deaths will top 4,000, mostly from cancers developed subsequently. The exact number of animals killed



Left: Pripyat's eerie abandoned Ferris wheel. **Right:** rare Przewalski's horses (the only species never to be domesticated) are thriving at Chernobyl

IN THE DESERTED VILLAGES AROUND THE EXCLUSION ZONE, THE YEARS OF ABANDONMENT ARE EVIDENT. THE VILLAGERS WERE TOLD THE EVACUATION WOULD LAST ONLY THREE DAYS

Empty buildings have become colonised by all manner of creatures. Birds' nests sit in windowsills, bees nest in holes in the walls and mice scurry about



Did you know?

- In the weeks after the Chernobyl explosion, traces of **radioactive deposits were found in almost every country in the northern hemisphere**. Thousands of UK farms were affected, and controls that required some farmers to test their livestock's radiation levels were not lifted until 2012.
- The town of Pripyat was built in 1970 for the workers of the power plant. Its **49,000 inhabitants were evacuated the day after the incident**, forced to leave most of their possessions behind – including pets, because their fur may have contained radioactive dust.
- **More than 10,000 tourists visit the exclusion zone** with specialised tour operators every year, but they are forbidden from touching anything and are scanned for high radiation levels before they leave.

WHAT HAPPENED AT CHERNOBYL?

- A nuclear reactor exploded at the Chernobyl power plant at 01:23am on 26 April 1986.
- Sweden sent the world the first alert on 28 April, having detected radiation 1,100km away.
- Soviet officials admitted to 'an accident' at 9pm on 28 April.
- In total, more than 336,000 people were evacuated.
- Plant chiefs were convicted of breaking safety rules and jailed.
- Up to 8 million people are thought to still live in contaminated areas in Ukraine, Russia and Belarus.

is unknown. But the small mammal population plummeted in 1986 and many soil invertebrates died, with some species believed to have declined by as much as 30-fold.

In the years following the disaster, it was impossible to imagine a future Chernobyl as anything but a desolate wasteland. The Red Forest, a collection of pine trees covering an area of 4-5km^2 close to the reactor, was so named because, just days after the explosion, the high levels of radiation killed the chloroplasts that make them green, turning them a bright ginger colour. Other surviving flora were left compromised and, in the intervening years, reports came of trees outside the exclusion zone dying, too.

Today, construction workers are erecting a £1.3billion steel arch to cover the remains of the reactor (see over the page). By the time it is complete this autumn, it should ensure the site is airtight into the next century.

There is disagreement among scientists as to the level of ill effects of radiation on animals and plants, and the impact this has had on wildlife around Chernobyl. Some argue that there are still fewer variants of species and higher numbers of deformities among animal populations in the zone. There have been studies into the effects at genome level, with the suggestion that it is still too early to predict what the impact in evolutionary terms might be, however invisible to us now.

Professor Nick Beresford of the Centre For Ecology and Hydrology in Lancaster has been visiting Chernobyl for

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A common buzzard perched on a post. They feed on the small mammals and birds that are now abundant in the zone

THE 2,600KM² ZONE AROUND CHERNOBYL IS NOT THE BARREN LAND WE EXPECTED – IT'S A WORLD OF LUSH GREEN

20 years, and says wildlife is as abundant in the Belarusian exclusion zone as it is in national parks.

Using 42 camera traps, which have been in place for a year, Professor Beresford has catalogued the presence of the European badger, Eurasian lynx, grey wolf, raccoon dog and wild boar. He has also captured photographic evidence of the first brown bears to return to the Ukrainian zone for more than 100 years, as well as the first evidence of European bison setting foot on the Ukrainian side of the zone. Dr Sergei Gaschak, scientific director of the Ukrainian government's Chernobyl Radioecology Centre, has counted hundreds of vertebrate animal species in the zone.

'[Chernobyl] is teeming with wildlife,' says Professor Beresford. 'There is quite a lot of contention [in the scientific community] over the exact impact of radioactive material on animals,' he cautions. 'But, just because wildlife is abundant, doesn't mean radiation has no effect.'

I wanted to see the change nature was going through in the radiation-ravaged Chernobyl area for myself. In September last year, I boarded an old Soviet school bus and rattled my way with my partner, photographer Luke Massey, from Chernihiv in northern Ukraine to the scene of the power-plant disaster. Ukrainian officials have estimated that the presence of radioactive isotopes caesium-137 and strontium-90, with half-lives of 30 years, and plutonium, which hangs around for millennia, means the area will not be safe for human habitation for 20,000 years.

Entering the 2,600km² zone that circles the plant on the Ukrainian side of the border with Belarus, we saw it was not the barren land that we were expecting. The area, which is roughly the size of Luxembourg, is a world of lush green. With the evacuation of people, farming stopped

CHERNOBYL'S STEEL TOMB

The Chernobyl power station is being encased in a new shelter bigger than London's Wembley Stadium. This 36,000-tonne behemoth replaces the original 1986 'sarcophagus' and is designed to prevent radiation leaks for the next 100 years.

The first shelter was built over the course of 200 days in the aftermath of the disaster. It was dangerous work and the construction team could only be on site for short bursts before having to retreat and dispose of their clothes due to the risk from radiation. But that sarcophagus was never intended to last, and the fact that wild birds could fly in and out of holes in it, as seen in the BBC Horizon documentary *Inside Chernobyl's Sarcophagus* – meant plans for a new one were launched in the 1990s.

Taller than the Statue of Liberty, the New Safe Confinement shelter is the largest land-based object ever moved by humans and it has been more than two decades in the making.

What relevance does the new shelter have for wildlife? 'The original sarcophagus was likely letting small mammals and birds in and out, so the main impact [of the new one] on wildlife will be to stop this exposure route,' says Professor Beresford. Well, it will almost certainly be better at keeping them out of ground zero.

Rusted bumper cars at the amusement park in Pripyat, which had been due to open just days after the incident occurred

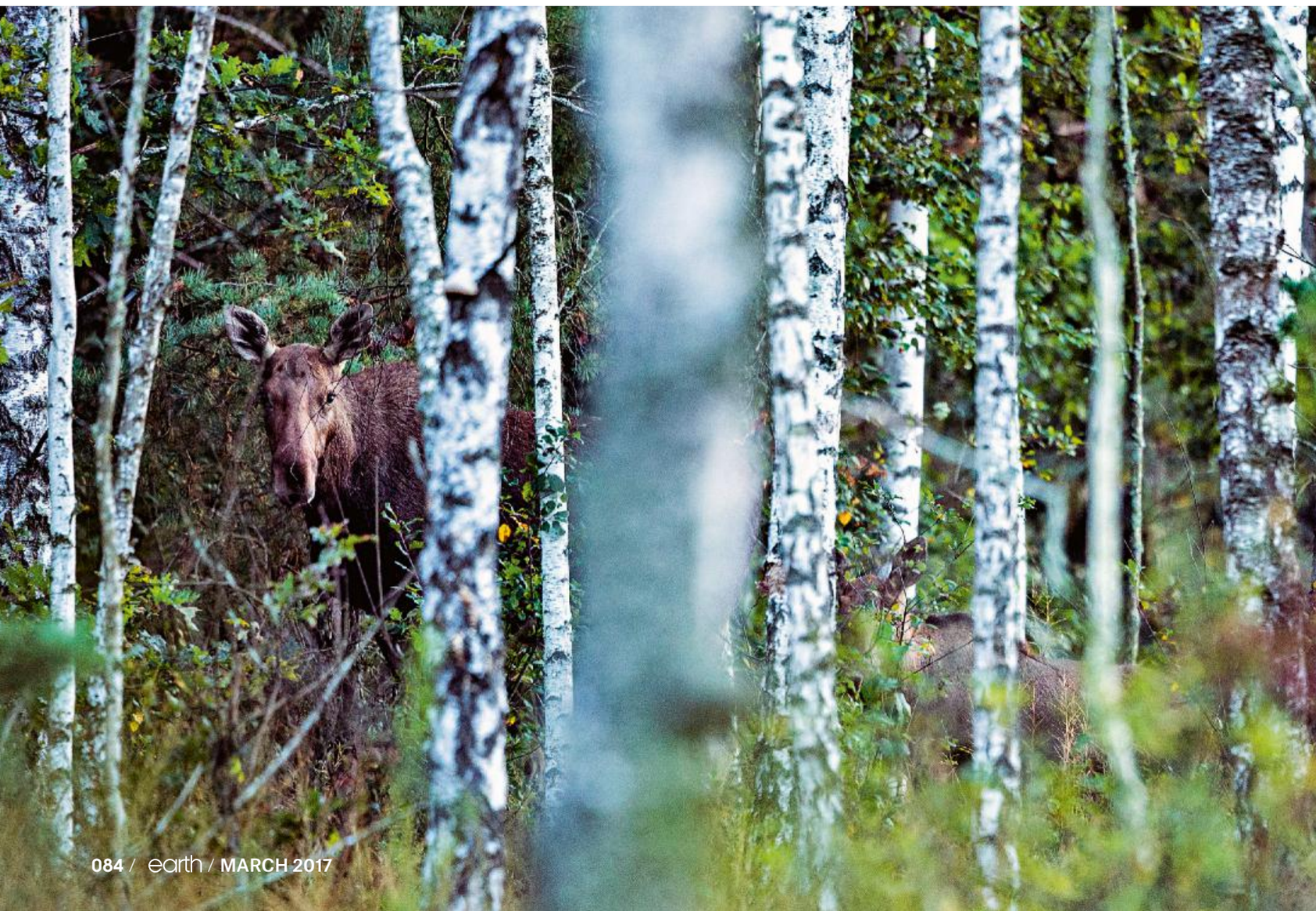
and plants and animals began colonising the land almost immediately. In the ghost town of Pripyat, just 3km from the power plant, we saw a kestrel perched on top of a building, seeming to survey a frozen Ferris wheel and the skeletons of rusted dodgem cars that lay below – eerie reminders of the amusement park that never got to open its gates. Here, and in the deserted villages around the exclusion zone, the years of abandonment are evident. Vegetation grows unchecked: concrete crumbles beneath lichen, moss covers cracked asphalt roads and trees grow straight and tall through stairwells and rooftops.

'CHERNOBYL IS TEEMING WITH WILDLIFE. BUT, JUST BECAUSE WILDLIFE IS ABUNDANT, DOESN'T MEAN RADIATION HAS NO EFFECT'

Eurasian beavers swim in the power plant's former cooling ponds; white-tailed eagles and migrating ospreys hunt for fish. Grey wolves explode from reed beds as we pass, gangly bow-legged elk lope through the woods, and out on the grasslands, red and roe deer graze alongside rare Przewalski's horses. These endangered creatures – the only true wild horses left in the world – are thriving in the exclusion zone, having been introduced to boost biodiversity in 1998. Hares, rodents and small birds live in the fields, which attracts raptors such as golden eagles and goshawks, and great grey and eagle owls.

It isn't just wildlife that has made its way back to the zone. Around 400 people, described by the Russian poet Lina Kostenko as the 'native people of the atomic reservation', have defiantly returned. Marie Ilchenko, 74, came back with her husband and mother to their village 30km from the reactor just one year after the explosion. In 1986, the authorities had said the evacuation would last only three days. When it

Elk population density in the forests around Chernobyl is now comparable to those in nature reserves in nearby Belarus



became clear that there were no plans for anyone to return, Ilchenko and her family took matters into their own hands. 'We were put in houses with strangers in faraway villages, with people who were afraid of us, who thought we were contaminated,' says Ilchenko. 'But I don't see the radiation, I don't smell the radiation, I don't taste the radiation – it doesn't affect me,' she says. Yet the evidence of those who lost their lives and livelihoods to the disaster remain in the deserted towns and villages: boots propped by the door awaiting their next outing, schoolrooms with books laid out for the following lesson and half-empty pill bottles in rusting bathroom cabinets.

Nature has reclaimed Chernobyl. With the Ukrainian government hoping to turn part of the zone into a nature reserve, the animals look set to stay. There's no conclusive proof that it's the absence of humans that has led to the rewilding of Chernobyl. A 2015 study, led by Professor Jim Smith of Portsmouth University, argued it was, but more research is needed. The challenge is whether wildlife can overcome the presence of radiation and humans can minimise our impact sufficiently to support the unique ecosystem that has emerged from the ashes.

Photographs: Luke Massey, Shutterstock

Marie Ilchenko returned with her family to their village 30km from the reactor just one year after the explosion

OPINION

Is nature better off without us?

The International Union for Conservation of Nature believes that human activity is diminishing biodiversity by at least 1,000 times the natural rate. Habitat loss, invasive species, climate change, over-exploitation of resources, pollution and disease are all taking their toll. With the human population projected to hit 9 billion by 2050, it's not looking good for the animal kingdom.

A controversial suggestion from scientist and environmentalist James Lovelock is that nuclear waste could be dumped in areas that need protection, to keep humans away. 'One of the striking things about places heavily contaminated by radioactive nuclides is the richness of their wildlife,' wrote Lovelock in his 2007 book *Revenge of Gaia*. He argued that animals and plants don't see radioactivity as a danger and that farmland and construction sites are a far bigger threat to ecosystems. In his opinion, tropical forests and other valuable habitats at risk are the perfect places to dispose of nuclear waste to stop us living there – and to let the wildlife move in.

What do you think of this argument? Email us at bbcearthmagazine@therivergroup.co.uk

Time shifts a gear when the clocks change in March. But what impact does this have on our daily lives and is there a downside to that extra hour of daylight?

More than 1.5 billion of us time travel twice a year, as people in the northern hemisphere advance 60 minutes in spring and travel back an hour in autumn (while some countries in the southern hemisphere reverse this trick). The twice-a-year timeshift has been a part of life in some countries of the world for 100 years now, and this year more than 75 different countries will be observing Daylight Saving Time (DST).

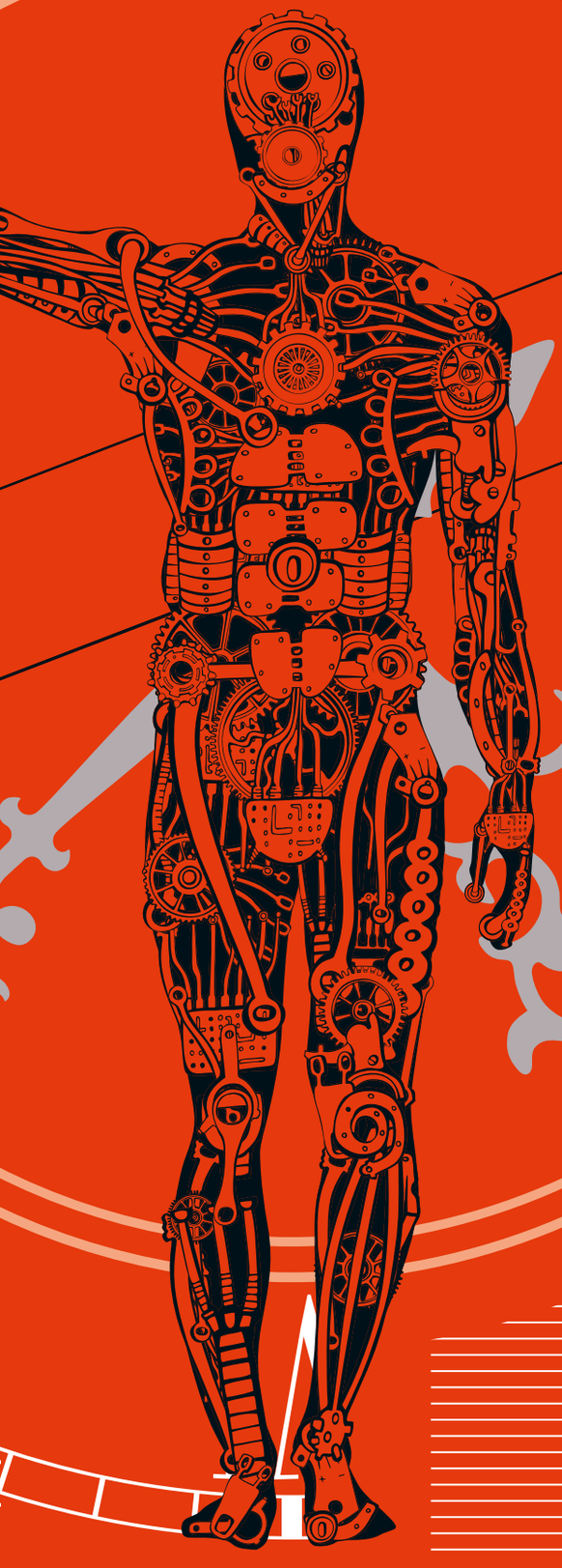
DST was first mooted in a tongue-in-cheek article by the statesman, scientist and inventor Benjamin Franklin in 1784, when he woke by chance at 6am to find his room 'filled with light', and realised how many candles he'd wasted working late and sleeping until noon.

This month, schoolchildren across the UK are taking part in an experiment to test what impact the clocks going forward has on our bodies, for the BBC's ongoing Terrific Scientific project.

The effect of changing time on our internal body clock is a question scientists have been interested in for a while. Many of us have experienced how jetlag can exhaust and disorient us, and the impact on health of overnight shift work, and its links to cancer and other illnesses, is well known. But the Terrific Scientific project is the first time the impact of DST has been monitored in children on this scale.

So where is the body clock, exactly? It has been located to two clusters of 10,000 nerve cells, about the size of a pinhead, at the base of the brain. It stays in sync with the cycle of light and dark, and sends out what Dr Michael Hastings, neuroscientist at MRC Laboratory of Molecular Biology, calls 'circadian time signals, a biological equivalent of Big Ben's chimes, encoded as a rhythm in electrical activity that orchestrates our daily life'.

So, as the clocks go forward, we take a look at how our body clocks and our timeshift habit interact.



THE CLOCKS

CIRCADIAN CLOCK

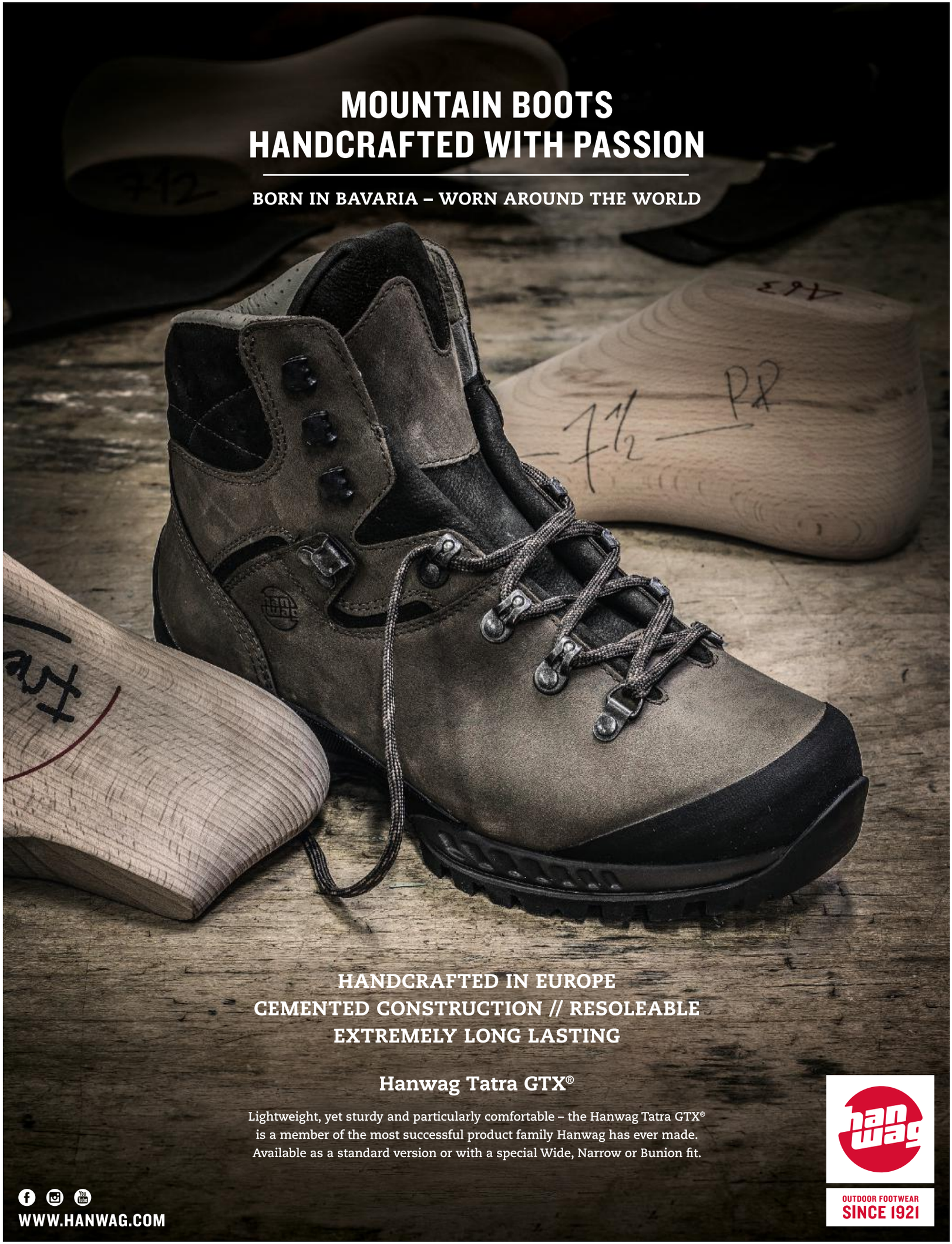
The term 'circadian' refers to natural biological processes that occur on a 24-hour cycle – and it's not just humans that have this internal clock. It has been widely observed that plants, animals and micro-organisms are governed by the rhythms of night and day. The change in light levels tells creatures, from birds to beetles, when to eat, sleep and reproduce. Studies so far suggest that Daylight Saving Time can disrupt circadian rhythms in humans but the effect only lasts a few days.

POWER DOWN

Getting up an hour earlier in March increases so-called 'cyber-loafing' in the office, according to a 2012 study out of Penn State University. It found that web searches related to entertainment rose sharply the Monday after the clocks changed – our tired brains apparently craving celebrity gossip.

ADDING INJURY TO INSULT

Research in 2014 reported a 24 per cent spike in the number of heart attacks the Monday after the clocks went forward, among hospital admissions in Michigan, US. Meanwhile, a separate study, published in the *Journal of Applied Psychology*, found mine workers had 5.7 per cent more workplace injuries in the week after the clocks went forward than during any other time of the year.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COLD CALL

Russia implemented permanent 'summer time' in 2011 – which turned out to be great in warmer months but desperately cold and dark in winter, when the sun rose at 11am in Moscow. After widespread protests Vladimir Putin abolished DST entirely in 2014.

ENERGY SAVER

As the global demand for energy increases, changing the clocks to utilise daylight is seen as an environmental and economical means of saving electricity. It results in around 2 per cent less energy consumption in the UK, and 0.5 per cent in the US.

TIME IS MONEY

Not only are we saving on energy resources by using the daylight we might otherwise sleep through, but the extra hour also encourages us to spend money – which is good for the economy. A 1999 study estimated that DST increases the revenue of the European Union's leisure sector by about 3 per cent, as lighter evenings get us outdoors in restaurants and bars. Ka-ching!

Since abandoning DST in 2014, Russia now has 11 time zones – matching the local time to the rise of the sun
Below left: daylight saving can lead to fewer road accidents as visibility is better for longer

LIGHTER EVENINGS ARE STATISTICALLY LINKED TO A DECREASE IN CRIME LEVELS

FUN IN THE SUN

Getting out into the sunlight (sensibly) has many tangible health benefits, not only boosting our vitamin D levels, but also getting us exercising and socialising more and so giving us a greater overall sense of wellbeing. There is much to be said for not frittering away those bright mornings lying in bed.

DAYLIGHT ROBBERY

Lighter evenings are statistically linked to a decrease in crime levels. A study by the Brookings Institute reported a 7 per cent drop in crime in the US when DST was extended by four weeks in 2007 as part of a government trial. It saved an estimated $59million (£47million) from robberies not committed.

Did you know?

- More than **half of the UK public would support moving the clocks forward** one hour year-round to be in line with Continental Europe.
- This year **Turkey isn't observing DST**, with ministers saying it'll lead to 'less confusion'.
- William Willett (below) first introduced the idea of British Summer Time (BST) in 1907. His **pamphlet 'The waste of daylight' encouraged people to get out of bed earlier** by changing the clocks. He died of flu in 1915 – a year before the UK adopted BST.

SAFETY FIRST

An increase in fatal road accidents is often reported the Monday after DST begins. Scientists in Canada charted an 8 per cent increase in traffic accidents after the start of DST, which they put down to the loss of one hour's sleep. They also found a corresponding decrease after the clocks went back again in autumn.

SPRING BACK

In the southern hemisphere, DST-observing countries, including Brazil and Australia, put their clocks an hour forward between September and November and move them back again in March and April.

HALF TIME

A 30-minute time adjustment was used in New Zealand in the first half of the 20th century, and clocks on Australia's Lord Howe Island are moved half an hour. The first person to come up with the idea of daylight saving in the UK, William Willett (see Did you know?, left), suggested moving the clocks in increments of 20 minutes over four weeks.

CLOCKING OFF

All European DST countries change their clocks on the last Sunday in March and the last Sunday in October, according to an EU directive. Once the UK leaves the EU, the directive will no longer apply.

Words: Matilda Battersby. Photographs: Alamy, Shutterstock

Baby love

Nothing goes viral faster than an adorable baby animal video. So what is it that triggers the 'aaah' response? Angela Saini asks if there's a code for cuteness, and reveals why some young animals tug at the heartstrings more than others

Those big, shining eyes, that button nose, that soft new fur – few people can resist a cute baby animal. Even creatures that are terrifying as adults, including lions and panthers, somehow begin life as aww-inducing cubs. There are those who look at baby hippos and just want to scoop them up into a cuddle. So how is it that the same fierce or wild animals we would never dream of choosing as pets pull on our heartstrings quite so much when they're born? Why are they immortalised in Disney films like *Bambi* and *Dumbo*, and Japanese toys like Hello Kitty? And why nowadays do puppies and kittens flood our social-media timelines?

There are deep psychological reasons why humans find babies of all species so cute. Scientists believe that the powerful nurturing instinct we have for our own children spills over into an affection for anything that even loosely resembles them. 'People are also animals, and our infants and young children – like the infants and young of most species – have certain consistent traits,' explains David Barash, psychology professor at the University of Washington, who studies human and animal behaviour.

In 1943, Austrian ethologist and zoologist Konrad Lorenz was the first to suggest that all infants have certain features in common that are universally appealing. They include a large head relative to the body, chubby cheeks, a high forehead, a small nose and mouth, and rounder bodies. We simply can't help but gravitate to anything that fits this cute blueprint, described by Lorenz as the 'baby schema'.

Certain behaviours also seem to have a common appeal. For example, one reason why baby chimps and monkeys attract crowds at zoos is because they can behave just like playful infants. Even a baby elephant, which appears to have little in common with human babies physically, has a clumsy gait that perhaps reminds us of an unsteady toddler.

Study after study has confirmed that humans prefer pictures of infants over those of grown-ups, and scientists at the University of Lincoln have calculated this strong drive becomes hardwired into us by the age of three. Culture, too, backs up this preference, as abstract representations of the baby schema can be found all over the world in cartoons and toys.

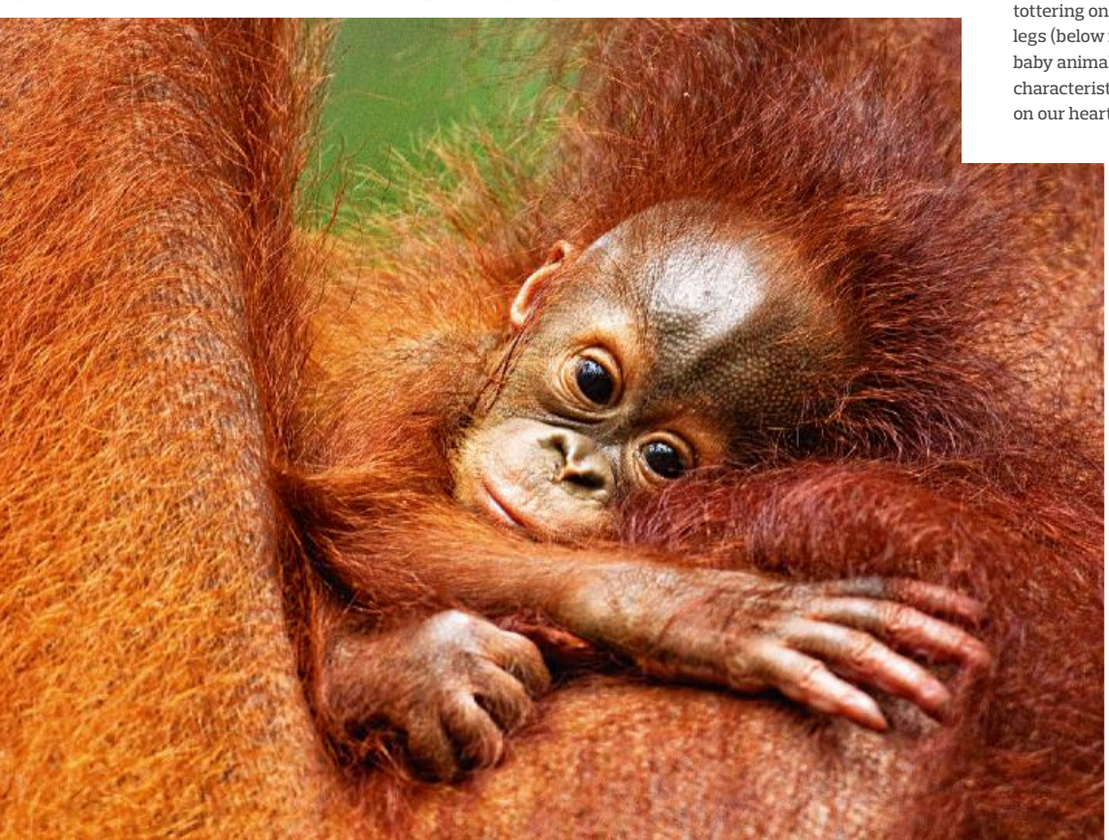
Research published in 2009 by German and American scientists found that both women and men seem to have an internal trigger that not only zooms in on cuteness but also prompts us to want to look after the creature in question – which suggests this is an evolutionary adaptation. 'Any predisposition to be especially benevolent toward critters that meet the "baby schema" is likely to be strongly favoured by natural selection,' confirms Barash.

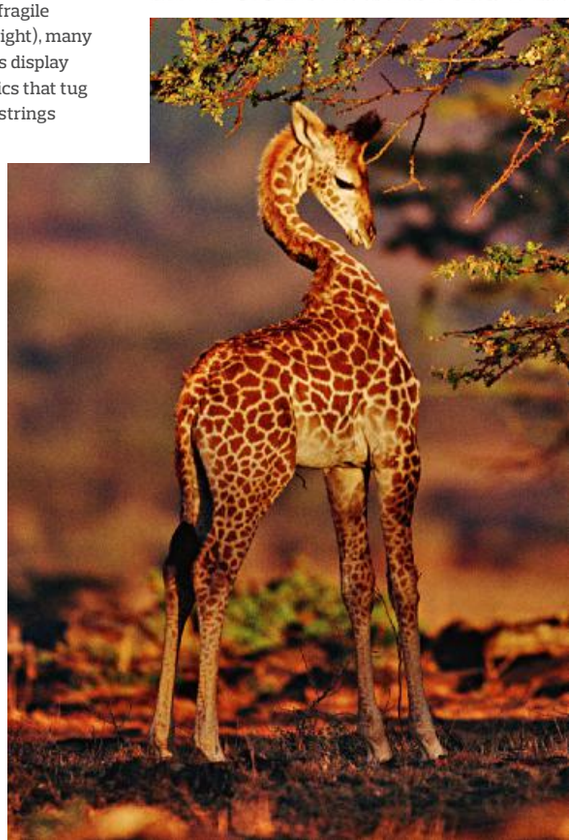
Eloise Stark works in the psychiatry department at the University of Oxford, studying parent-child interactions, and she believes the mere sight of something cute leaves a big impression on our minds. 'We know that [when we see a young animal or

A baby chimp shows how facial expression and body language play a large part in our affection for the young of all species. **Previous spread:** human-like behaviours, such as holding 'hands', also play a role

Scientists believe our nurturing instinct for children spills over into an affection for anything that resembles them

From playful lion cubs (above) to fluffy baby orangutans (below left) to young giraffes tottering on fragile legs (below right), many baby animals display characteristics that tug on our heartstrings





child] there is a really fast burst of activity in the orbitofrontal cortex, an area of the brain involved in reward,' she says. 'We think this early activity biases the brain towards processing the cute stimulus – for example, by making sure we give it our full attention. The effect of this may be to approach the infant or cute animal, wanting to pick it up or look after it.'

Young cheetahs have the small features and super-soft fur of the domestic cat, so it makes sense that they should provoke the same kind of response in us humans as the average tabby

Our nature to nurture

It's hard to judge whether other species experience the same pangs of love for cute creatures that we do, but this caretaking instinct may be particularly strong in humans because our offspring rely on us for far longer than those of every other mammal. Horses and cows can walk within hours of being born, for example, and cats and dogs reach maturity inside the space of months. Human babies, meanwhile, come into the world utterly helpless and remain dependent on their parents for many years. By plucking on our heartstrings, human babies are cleverly – if unknowingly – ensuring that they stay alive.

Does this mean babies' features have evolved to appeal to us, or that humans have evolved to find their features cute? 'I would think that the two have co-evolved,' suggests Stark. 'It would make sense to think that over time, the cuter the baby, the better care it received, boosting its chances of survival.' Research Stark has co-authored found that babies reach out to all our senses – with their newborn

The caretaking instinct is strong in humans as our offspring rely on us for longer than those of other mammals

HERE'S LOOKING AT YOU, KID

Human babies' hair or eye colour can change dramatically over time, but one species of primate, the silvered leaf monkey (pictured right), is born clothed in its very own amber warning.

In contrast to the grey of their parents and the rest of the clan, newborn leaf monkeys are orange. This high-vis evolutionary trick is believed to have developed to stop babies from being separated from their mothers, as well as to protect them from predators (which see orange as a sign of toxicity) and even to remind the rest of the troop that they should volunteer for babysitting duties. After about three months, the babies start to develop silvery-tinged fur from the top down. (There is a point when their heads are grey and their bodies are still bright orange.)

These animals, native to Borneo, Malaysia and Sumatra, are keen explorers, so their bright hue allows mum to keep watch as they swing through the trees.

Physical traits that we associate with abnormality, such as the spotted coat and asymmetrical body shape of the hyena (above) and the scaly skin and patchy hair of the warthog (below) make it harder for us to find them 'cute'. **Below left:** a young leopard

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smells and giggly laughs, for example – to help secure a caregiving response.

This multisensory assault seems to draw in not just parents, but all potential carers, including siblings, grandparents and strangers. 'From the research we have so far, it looks like the cuteness response is inclusive of everyone, regardless of whether you are a parent or not,' says Stark. 'This is why people are able to capitalise on cuteness in marketing, selling "cute" toys like Hello Kitty. The cuteness activates the same brain mechanisms, regardless of whether the object is a baby, a puppy or an object.'

The pet factor

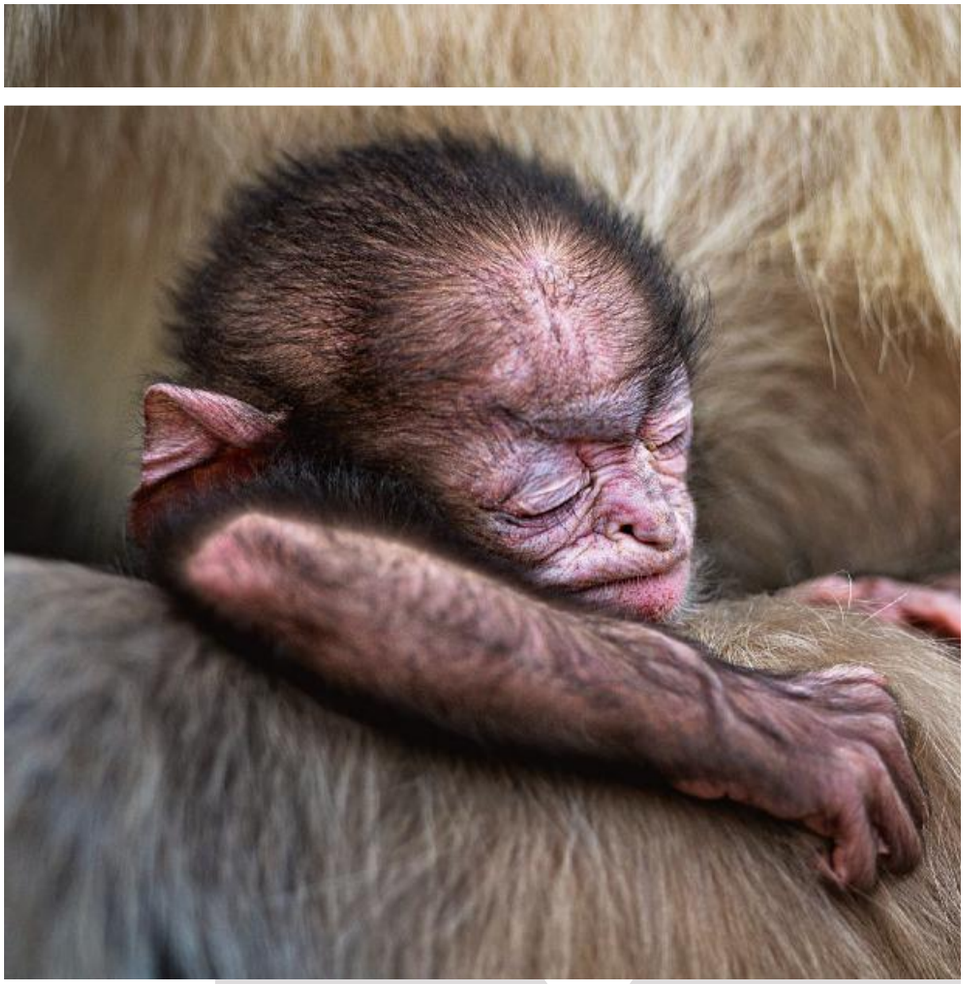
According to geneticist Adam Wilkins at Humboldt University in Berlin, the power of this mechanism is particularly clear when we look at our pets. Many generations of domestication have left household pets with very different features from their wild ancestors. They tend to be smaller, with shorter faces, smaller teeth and floppier ears. They have been bred to cater to our baby-loving demands, even if these infantile characteristics have had the unfortunate side effect of making the animals physically weaker.

Another dark side to cuteness is where it leaves subjectively less attractive animals in the race for our affection. An Australian study published last year found that 'ugly' animals, including certain species of rodent and bat native to the country, are at risk of extinction because they don't attract as much research and conservation funding.

The tongue-in-cheek Ugly Animal Preservation Society has dedicated itself to celebrating the creatures that don't meet our high aesthetic standards. Top of the list comes the blobfish, which looks as though it has a permanent frown on its unappealingly slimy face. As the society's tagline reminds us, 'We can't all be pandas.' And let's not forget either, that as we get older, we all become less cute.

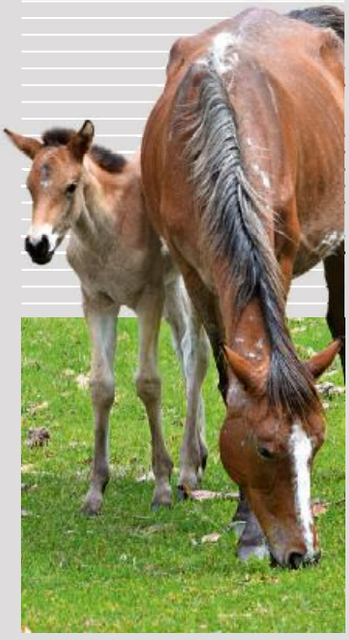
Additional words: Matilda Battersby. Photographs: Anup Shah and Fiona Rogers

When we look at babies, a 'love hormone' called oxytocin is released that compels us to want to care for them, and a similar mechanism is at work when we view baby animals such as this grey langur monkey (above right) and serval (right)



POSITIONS, PLEASE

Human and great ape mums have long been known to have a 'left bias' when cradling their babies. Holding infants to our left side, we have left-eye to left-eye contact, enabling our brains to process the baby's needs in the right half of our brain associated with reading faces and problem solving. New research shows that 'follower type' species such as wild horses (right), orcas, walruses and kangaroos use a similar positional bias. Normally, the young of these animals will stick to mum's right side, watching her with their left eye. Researchers observed animal mothers moving to the right of their young at times of stress, however, to monitor them with their left eye and be ready to lead them away from the threat. This is counter to the expectation that the mother would put herself between her young and danger.



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Hit refresh

Longing to escape the daily grind? You don't have to go trekking for six months to get off-grid. A night under the stars – or even a stroll without your phone – could be all you need to revive body and mind, says adventurer Alastair Humphreys

We all love the idea of adventure. Stories of great journeys to the ends of the earth are always popular. But most of us don't have the time, money or even the motivation to cycle around the world, row across an ocean, or trek through a desert. However, if the idea of adventure is to challenge ourselves, to see new places, and to get a fresh perspective on the world and ourselves, then we don't need to do anything so extreme. The concept of microadventures is based on the idea that it's better to do something than do nothing at all. So a simple weekend in the woods, or a midweek out-of-office escape, could be all you need to squeeze a dose of the natural world into your busy working life.

There's a microadventure to suit anyone who feels the urge to escape the city. We're often too busy and too stressed in our daily lives, feeling the irresistible pull of screens, smartphones and emails, but by connecting with the natural world for even just a few hours, we can return home refreshed and inspired. Perhaps you like the idea of camping out with your friends, chatting round a campfire together. Or you might want to do something physical but rewarding, such as spending a day planting trees in urban areas with Trees for Cities. Or you could take a working holiday volunteering for the National Trust nature reserve at Stackpole on the beautiful Pembrokeshire coast, or the John Muir Trust in Scotland that's dedicated to protecting and enhancing wild places.

The idea of microadventures acknowledges that most of us would love to live more adventurously but lack the time. And it challenges us not to accept this as an excuse to do nothing. It doesn't matter how small you start as long as you start. Check out the box opposite for more ideas.

Photographs: Alastair Humphreys, iStock

MORE MICROINSPIRATION

The nine-to-five routine often gets in the way of our dreams of adventure. But what about the five-to-nine? You have 16 hours away from your desk – the perfect opportunity for a microadventure. Head for the countryside one evening, spend a night under the stars, wake with the sunrise and bird song, and be back at your desk in time for work the next morning. Wild camping is legal in Scotland, but not in the rest of the UK. However, as long as you leave no trace and sleep out of sight, you are unlikely to have a problem. But do ask for permission if you want to sleep on private land.

The spring equinox – when day and night are equal length – falls on 20 March. Last year I spent a night in the same woods on both equinoxes and both solstices (the longest and shortest days). It was a lovely way to take notice of the changing seasons, and to reflect on the season just passed and the months and opportunities ahead.

Learn to look at the familiar in unfamiliar ways; there is beauty and wildness everywhere, if only we choose to see it. Try going on a familiar walk by the light of a full moon – you become more alert and more aware of your tiny place in the universe, and it helps puts life into perspective. Keep the torch in your pocket for maximum effect.

The hardest part of most adventures is getting motivated to begin. Having a purpose helps. The Citizen Science projects on the iNaturalist app (recording what animal, plant and bird life you see, for example) are an effective way to make a Sunday stroll more meaningful.

One of the undeniable rules of the universe is that no one ever regrets going for a wild swim once they've done it! Jump into a river or the sea and you'll be grinning and buzzing all day.

Alastair Humphreys is an adventurer and author. His book,* Microadventures, *is out now. For more adventures, visit alastairhumphreys.com

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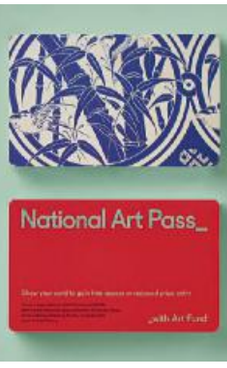

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More than four decades have passed since we last stepped on the moon but the desire to go back is growing. This time though, the competitive spirit is not about politics, it's about business

Half a century ago, men were walking on the moon. It's one of the greatest things that has happened in modern mankind. Today, it's lost in history, for the most part.' Words from one of the final interviews ever given by Gene Cernan, the last person to walk on the moon, who passed away this January.

There are now only six of the original 12 moonwalkers left alive, all of whom are now in their eighties. We are close to losing the people who made the Apollo missions – landing humans on the moon and returning them safely – possible. Not just astronauts, but scientists and engineers who, against the backdrop of the Cold War, drove forward the most significant achievement in exploration of the 20th century.

During the Apollo era, a world enthralled by the space race envisioned that we would be living on the moon by now, perhaps even Mars. But, in the more than four decades since the final Apollo mission, humans have still not returned to the moon. Although we have achieved much in space – from the Hubble Space Telescope, to the International Space Station and exploring all of the classical planets in our solar system with spacecraft – it is a sad thought that we could very soon live in a world where there are no moonwalkers left alive. Cernan, however, was confident we would return. 'We will go back to the moon, it is our destiny,' he said. 'Curiosity is the essence of human existence.'

This year could be when we rekindle our relationship with Earth's only permanent natural satellite. Today a new race for the moon is emerging and quietly growing in momentum. But while the first space race was political, a battle between the Soviet Union (USSR) and the US for supremacy in

After the first moon landing in 1969, a further 10 astronauts travelled to the surface in another six missions, until the programme ended in 1972

The new space race

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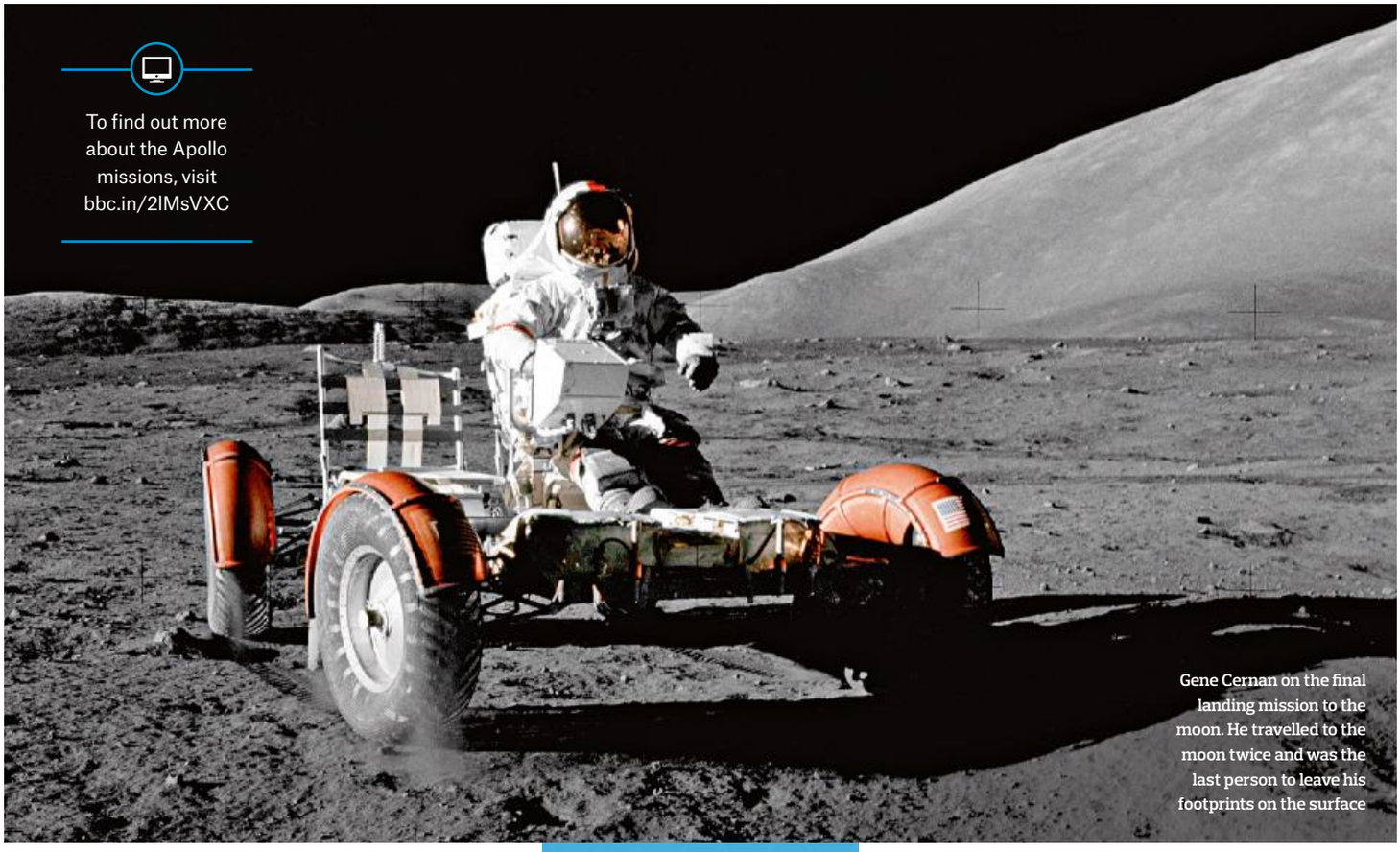


Gene Cernan on the final landing mission to the moon. He travelled to the moon twice and was the last person to leave his footprints on the surface

spaceflight, this new space race is grounded in business rivalry.

'The programmes that led to Apollo were unsustainable economically and doomed to operate for a very finite period of time,' explains Chad Anderson, CEO of Space Angels Network, which invests in commercial space companies. 'Today, public-private partnerships are giving new ventures the commitment they need to take the risk of developing a new company, and giving NASA a much more cost-effective solution. These new models are what have enabled the "entrepreneurial space age" that we are experiencing today.'

Also helping to fuel this new interest is the Google Lunar XPRIZE. The competition will award $30million (£24million) to the first private team to land a rover on the surface of the moon, drive 500m and send back HD video from the lunar surface. 'The goal is to push forward the new space economy and act as a catalyst for inspiration,' explains Chanda Gonzales-Mowrer, senior director at the Google Lunar XPRIZE. 'For the Apollo generation, this is the new "Apollo moment" and for the younger generation, this is something to make them think, "Wow".'

Among the private companies hustling for position in the new space race is Astrobotic, which aims to develop a DHL-type delivery service to the moon, capable of taking cargo and passengers to the lunar surface on behalf of paying nations. 'Our long-term goal is to make regular deliveries to the surface of the moon. We want lunar deliveries to become routine,' says Astrobotic's CEO John Thornton. He anticipates that Astrobotic will be one of the first commercial companies to travel to the moon. 'We expect to land on the surface in 2019,' he says.

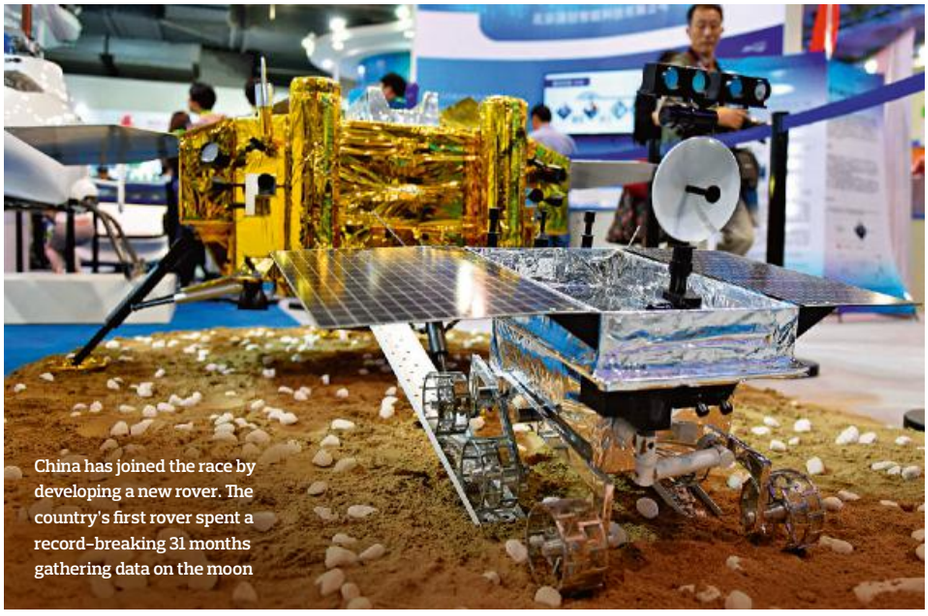
While the commercial race will certainly draw attention back to the moon, nothing compares with the inspiration of humans once again walking on its surface. In China, a country that lived under the Mao regime during the Apollo era, and where many citizens would have been unaware of the historical landings because of news blackouts, there are rumours of ambitions for a crewed landing in the 2030s. This follows on from the success of China's *Yutu* (Jade Rabbit) rover and the nation's plans to send a craft to the surface of the far side of the moon in 2018.

In Europe, the goal is for international collaboration on a Moon Village, a permanent lunar outpost for both robots and humans. 'We want to make the moon the eighth continent,' says Bernard Foing, executive director of the European Space Agency's (ESA) International Lunar Exploration Working Group. 'Since Apollo, there have been a number of new discoveries

Giant leaps in technology

The moon landings not only inspired a generation and led to scientific discoveries in space, but the technology developed has helped to shape modern life back here on Earth. The computer microchip is a descendant of the integrated circuits used in the Apollo Guidance Computer, and the cordless drill uses technology developed to extract moon rock samples. Also, the fire-resistant textiles worn by firefighters were first used for spacesuits, and even the computer joystick was first used by astronauts, who employed it to drive the lunar rover on the moon. If plans for us to return to the moon come to fruition, a whole host of new derived technologies could benefit future generations on Earth.

A permanent moon base is a natural next step and gives us the potential to further explore our solar system



China has joined the race by developing a new rover. The country's first rover spent a record-breaking 31 months gathering data on the moon

about the moon in terms of history, evolution, water and resources,' Foing adds. 'And remember the moon is just a few days away.'

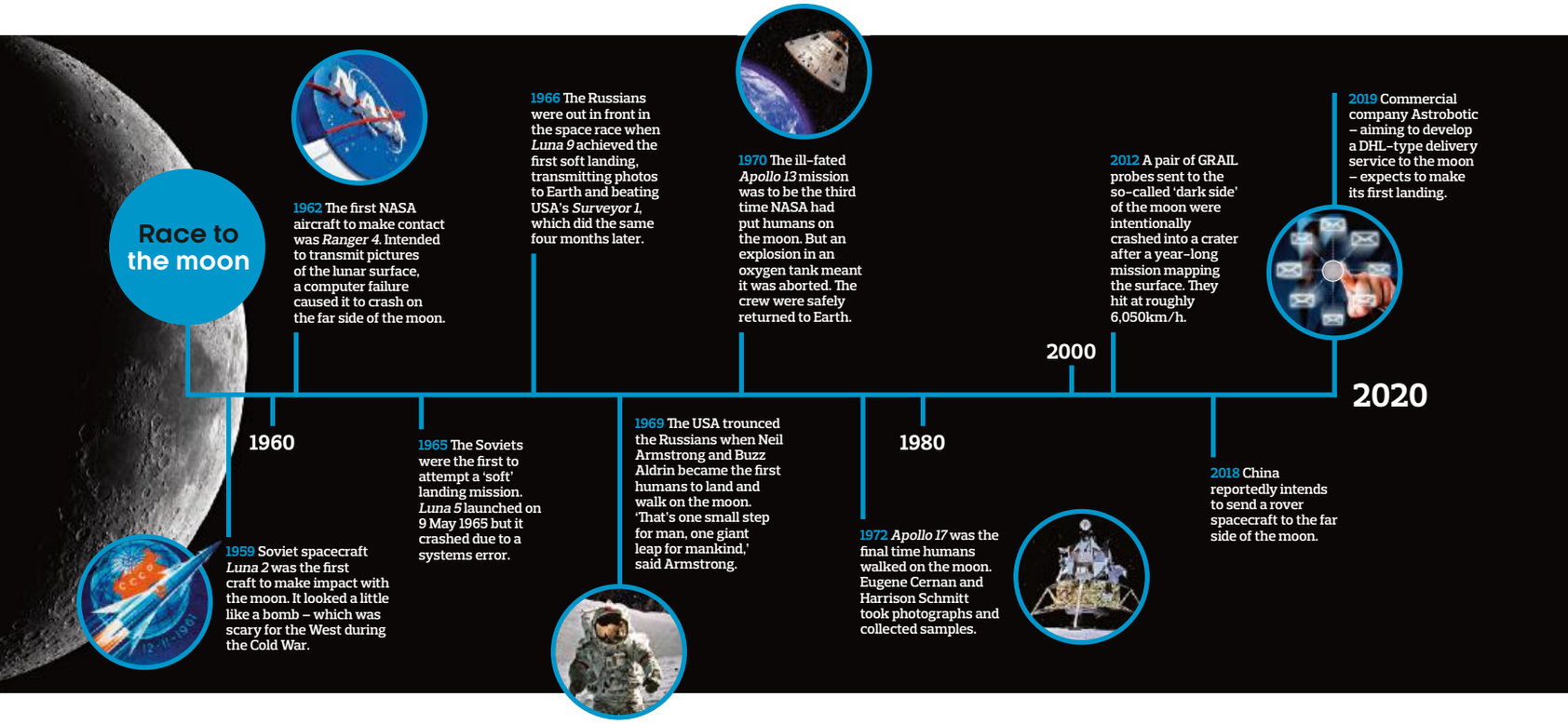
Foing believes that, within the next 10 or 15 years, we will be able to settle on the moon and solve a lot of challenges. 'We can learn to use resources, generate economic benefits to fund further explorations and benefit from the resources and data we find there,' he says. The timing for the Moon Village could be right, with the International Space Station scheduled to come out of service in the next decade or so. For ESA, a moon base is a natural next step. 'A permanent base gives us the potential to further explore our solar system,' explains Foing.

Of course, the next goal in human exploration of space is Mars. Among the strongest advocates for going to the red planet is *Apollo 11* moonwalker Buzz Aldrin, who has publicly stated that had we continued space exploration with the same momentum as at the time of the Apollo missions, we would have been on Mars by 'the 1980s or 1990s at the latest'. However, returning to the moon could be the most practical way of getting humans to Mars. 'Those that want to return to the moon think it a much more near-term reality, and one that could be used as a stepping stone on the way to Mars,' adds Space Angels Network's Anderson.

For moonwalker Cernan, what mattered most was continuing the work of Apollo. Speaking in the biopic of his life, *Last Man on the Moon*, he described his final moments on the surface. 'I looked down at my footprints and I knew I wasn't coming this way again. Why were we here? I looked over my shoulder and there's the Earth. There's reality. I wanted to reach out, put it in my spacesuit and bring it home and show it to everybody.'

One day, most likely in the next few decades, humans will walk on the moon again. The ramifications will not only help to pave the way for us to become a space-faring species, but will transform life on Earth, through science, technology and inspiration. When we do return, future space explorers will forever be standing on the shoulders of Cernan and the other pioneers who made our first reaches for the moon possible.

Words: Sarah Cruddas. Photographs: iStock, Alamy, Getty



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Don't miss your chance to win an overnight stay at Chewton Glen Hotel and Spa, in the New Forest

Ever dreamed of sleeping high up in the treetops? Well, we're giving readers the chance to win an indulgent one-night stay for two in a secluded Treehouse Suite in the grounds of Chewton Glen Hotel and Spa in Hampshire.

While the treehouses are 10m above the ground, we should make it clear the lucky winners' stay will be far from the *Swiss Family Robinson*. For a start, this is a luxury version of a treehouse, with a marble bathroom, freestanding bath, a wood burner and underfloor heating. While you can take in the sights and sounds of the forest, just like the Robinson family, you'll be sitting on a cosy sofa by the woodburner, lying in your king-size bed or relaxing in the hot tub out on your spacious private deck.

If you're looking to explore, Chewton Glen is on the edge of the New Forest National Park and a 10-minute walk from the coast. But with use of the award-winning hotel spa, a spa treatment, a three-course meal and a breakfast hamper all included in the prize package, you needn't venture far.

Find out more about Chewton Glen Treehouses by visiting hostunusual.co.uk

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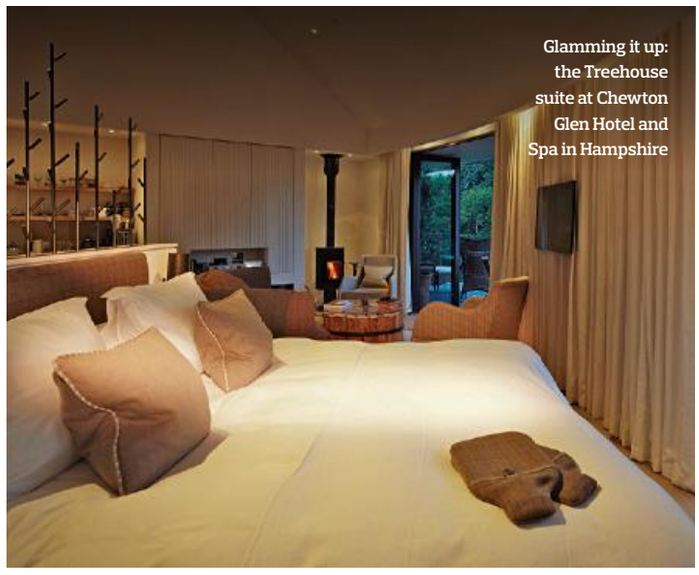

Glamming it up: the Treehouse suite at Chewton Glen Hotel and Spa in Hampshire

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THYLACINE (TASMANIAN TIGER)

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CONSERVATION STATUS EXTINCT

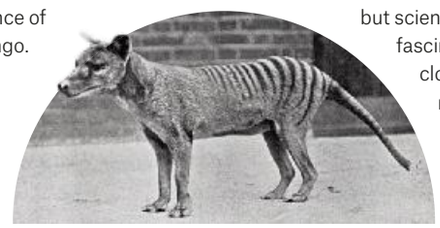
In our latest feature on intriguing specimens in Chicago's Field Museum of Natural History, we profile the Tasmanian tiger – a victim of targeted destruction, which many people believe may not be extinct at all

With the body of a dog, stripes like a tiger and a jaw that could open up to 120 degrees (only snakes have as much jaw power), the thylacine, or Tasmanian tiger, has a cult-like status down under – despite having been extinct since 1936.

It may be due to its enticing name, or perhaps because of its sad end, but people on Tasmania and the Australian mainland continue to be fascinated by the Tasmanian tiger, and thousands of sightings have been reported in the 80 years since it was declared extinct, though all are unsubstantiated.

The thylacine was the largest carnivorous marsupial to ever exist, weighing up to 30kg in adulthood. Bones of the animal dating back 2,000 years have been found on mainland Australia, but it appears to have declined as a consequence of competition with the dingo. By the time European colonisers arrived in Australia, the thylacine could only be found on the island of Tasmania. There, the canine-like animals began attacking settlers' sheep, until a bounty scheme was put in place, eradicating them in their thousands. By the 1920s, wild thylacine were extremely rare. The last known remaining thylacine died in Hobart zoo in 1936 – locked out of its sleeping quarters, it died of exposure.

The animal continues to be the subject of great debate, after the Australian Museum in Sydney launched the Thylacine Cloning Project in 1999. In a process known as de-extinction, the plan was to extract DNA from a museum specimen to alter the genome of a related living species and use a surrogate mother to give birth to a clone – a genetically identical copy of the specimen. The project was abandoned in 2005 because of the poor quality of the DNA samples, but scientists continue to be fascinated with the idea of cloning the extinct marsupial, and claim to be about 20 years away from resurrecting the species.



Words: Lauren Heinz. Photographs: Marc Schlossman, Alamy

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The tiny Booted Racket-tail Hummingbird is found on the edges of cloud forest in the Andes, at elevations of between 1600-2200 metres. The male is 12cm long, including tail.

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Photo: Murray Cooper

** Ban Ki-moon, 2015. International Day of Forests - Secretary-General's Message for 2015. United Nations*

Inside the April issue

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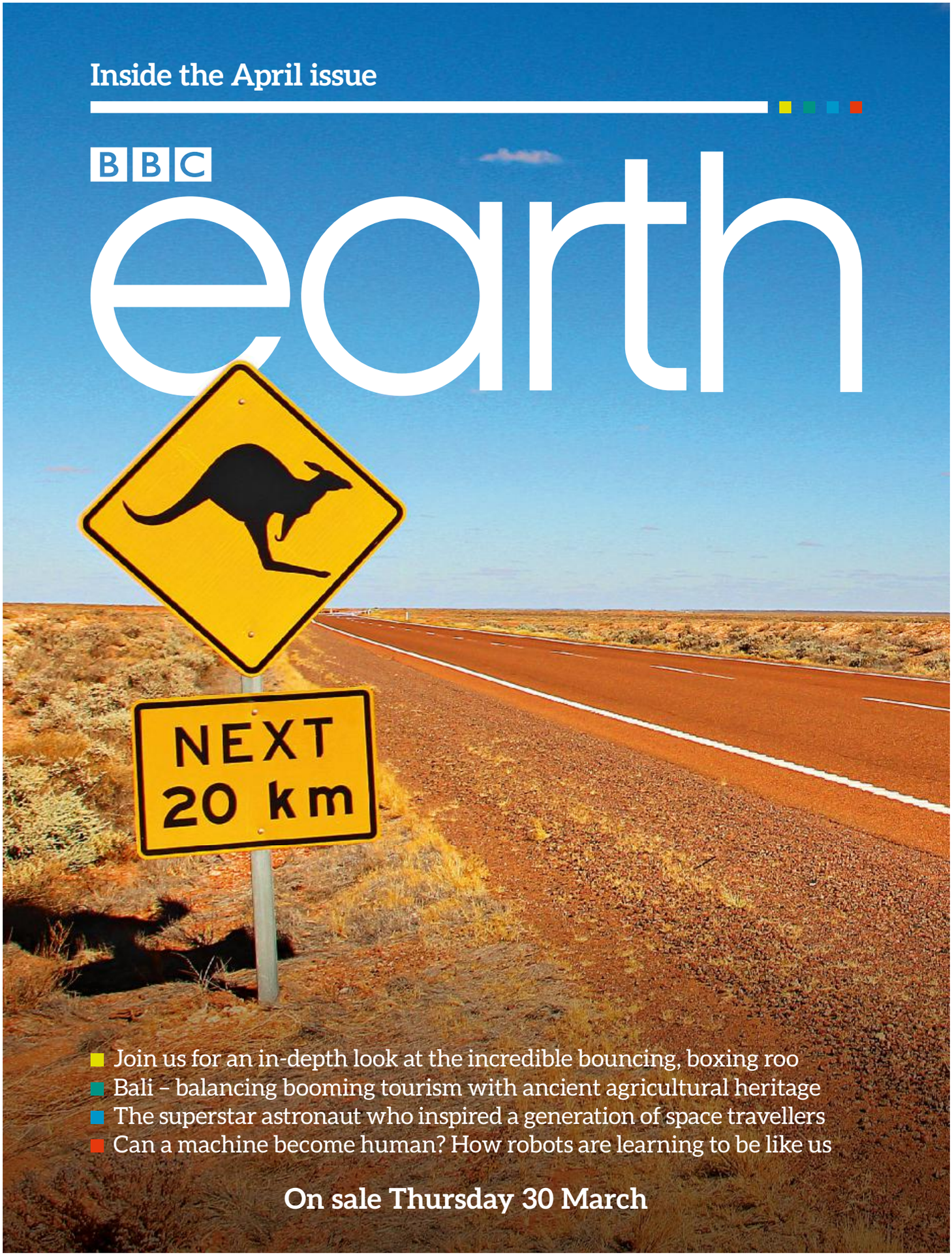

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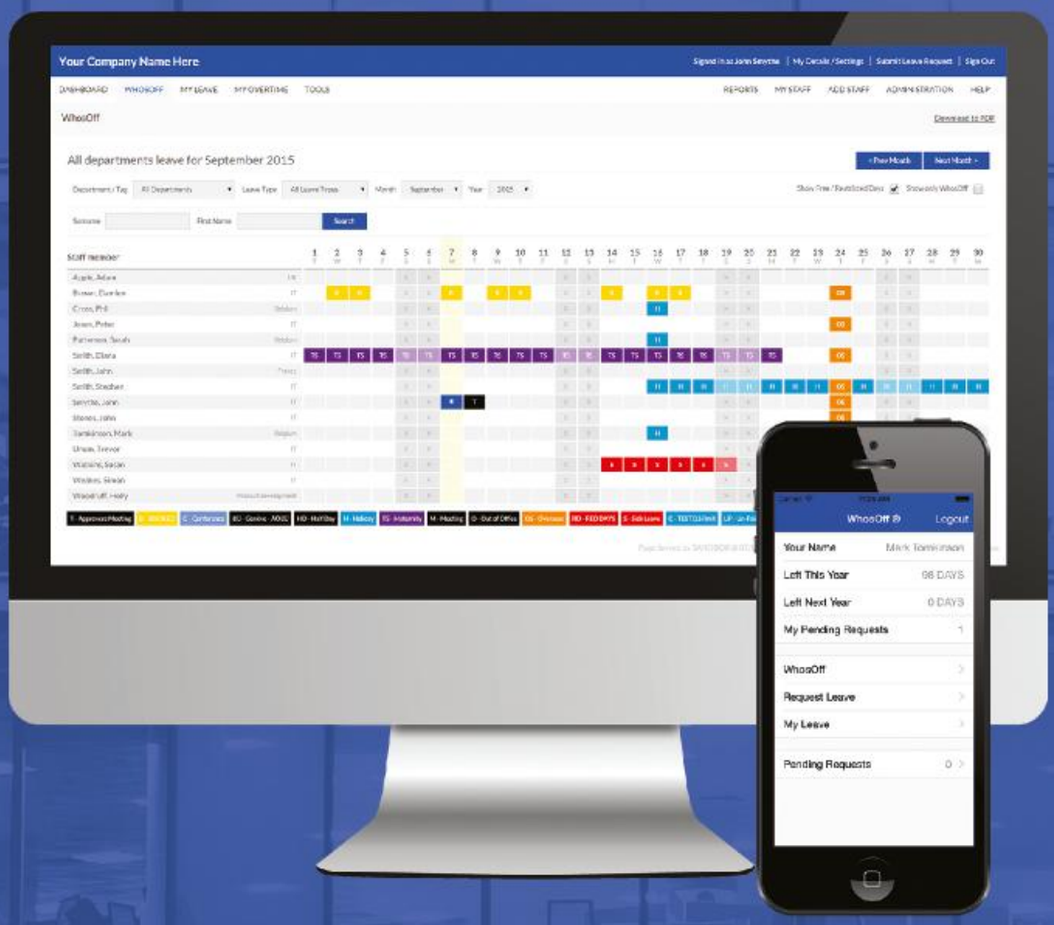

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Curious world

Why do ostriches bury their heads in the sand?

It may come as a surprise, but they actually don't. In fact, they lie low on the ground to hide from predators, with their necks blending in with the ground. As the world's largest and heaviest bird (which also cannot fly), you'd imagine that it would struggle to survive in a sandy environment. However, it turns out that they are quite adept at surviving in deserts.

Ostriches have long legs for running away from predators, with just two toes to stop them from sinking in the sand. Their long camel-like eyelashes protect their eyes from sand grains – in fact, their Latin name is *Struthio camelus*! They eat pretty much anything, from seeds and leaves to the occasional insect and lizard, and can go long periods without water, getting moisture from the plants they eat. To help them digest their food, ostriches, like many birds, swallow sand and pebbles to grind food in their gizzard (a specialised muscular pre-stomach).

How do gold and silver beetles get their colour?

The gold and silver beetles of Costa Rica look like jewels fit for royalty. But despite their blingy appearance, Chrysina beetles are actually made from the same stuff as dowdy cockroaches and spiders – chitin. The difference is that the elytra, or hard forewings, are made up of layers that bend light waves to give the illusion of a metallic sheen. Some 70 layers of chitin are stacked in decreasing thicknesses, refracting light at each interface. The wings of the golden beetle reflect light in wavelengths larger than 515 nanometres – similar to the reflection spectra for actual metals – while the silver beetle's wings reflect wavelengths in the entire visible range. It's thought their dewy appearance helps to camouflage them among the wet leaves of the Costa Rican rainforests.

How do you help a paw-ly cat?

Cats have an uncanny feline ability to walk away from potentially fatal injury. But what happens when they seem to have used up their nine lives? Well, all is not lost. Cats who lose their legs in an accident now have renewed hope, after two cats in Bulgaria recently each received a pair of bionic back paws, enabling them to walk normally.

The first bionic cat in the UK, called Oscar (left), received two Guinness World Records in 2010. One for being the first animal with two bionic limbs and the second for being the first animal to have implants inserted into its joints. Inspired by the way deer antlers grow through skin, artificial pegs are drilled into the ankle bones and coated in hydroxyapatite to encourage bone cells to grow onto the metal. Skin then grows over an 'umbrella' at the end to prevent infection, and the rest of the peg protrudes from the bone and skin, allowing artificial paws to be attached.

The treatment is now being tried around the world, offering injured cats a new lease of life.

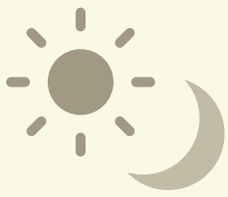
Words: Yashi Banymadhub. Photographs: iStock; Alamy

Curious world

Why does the moon sometimes come out during the day?

The sight of a pale moon in a clear blue daytime sky is quite a common occurrence. But how does the moon appear during the day? In fact, when the moon is above the horizon, which it is for roughly 12 hours every day, it will be visible in the sky – provided it is a cloudless day.

This is because the moon's visibility depends on the brightness of the reflected light from the sun bouncing off it. Apart from full moon (when the moon rises as the sun sets, and sets as the sun rises), and new moon (when the moon is too close to the sun to be visible), the moon is visible in daylight nearly every day.



Do fish have feelings?

Whether animals are sentient beings is a question that scientists have been puzzling over for centuries. Some cognitive experts would argue that there are varying levels of consciousness for different living things, or that some animals may have an emotional capacity while others may not. Dog owners will certainly argue that their pets have emotions but it is less certain if plants, insects and fish have feelings too, as we cannot see them express any. As fish have a simpler brain structure than mammals, they lack a cerebral cortex, which could mean that they lack the ability to feel suffering and pain. However, a 2015 study published by The Royal Society showed for the first time that zebrafish experienced something called 'emotional fever' (stress-induced hyperthermia, which was believed to happen to mammals, birds and reptiles only). Zebrafish subjected to a short period of confinement experienced a rise in body temperature of 2-4°C, showing the capacity to respond to stressors. There's a lot of scientific interest in this area so studies and debate over whether fish experience emotion continue.

Inbox

Get in touch to tell us your views on nature, science, space and everything else about *BBC Earth* magazine

In our December issue, we met the first great ape to mimic human speech

Photograph: iStock

APEING HUMAN SPEECH

I liked your feature on Rocky the 'talking' orangutan (December 2016). The orangutan has to be my favourite animal. They spend most of their lives in the tree canopy, where they eat, sleep and give birth. The mother teaches her young what foods are safe to eat, and how to build a nest or make an umbrella from branches. They're so intelligent, or perhaps it's the ginger hair that does it for me!

Isabella Hollifield

GREEN ISSUE

I notice that your magazine is not printed on recycled paper and, as you are an environmental magazine, I think it should be.

Paul Phillips

Thanks for your email. BBC Earth *is printed on PEFC-certified paper from sustainably managed forests. Glossy magazine material is important to the paper recycling process, as fibres degrade after several uses and some fresh material is needed to keep the cycle going. So please do always recycle your magazine.*

SPECIAL DELIVERY

Congratulations on the magazine – fantastic focus, images and text. Can you tell me how I can subscribe from the United States?

George Erickson

To subscribe from the US, and elsewhere, go to bbcearthmagazinesubs.imbmsubscriptions.com and select 'Rest of world' from the country dropdown menu. You can also call the subscriptions helpline on +44 1293 312135.

Correction

In the February 2017 issue, we incorrectly stated that Luke Massey had won the Urban category at 2016's Wildlife Photographer of the Year awards. He has asked us to make clear that he was a finalist and the winner was Nayan Khanolkar.

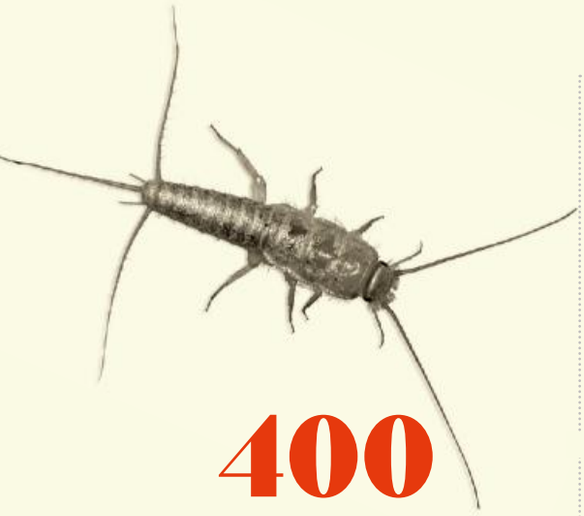
Email us at bbcearthmagazine@therivergroup.co.uk

TALKING POINTS ON SOCIAL MEDIA

Our water heater broke last week, and I had to endure three days of cold showers before we could get it fixed. That was bad enough... I can't even begin to imagine swimming with ice. **Debs Tarrents Scott**

It was the International Ice Swimming Association's British Championships in Loch Lomond on Saturday 11 February. Ice swimming is so much more than a cool thing to do. Much cooler than just cool. **Matty Dee**

Snow leopards aren't blood-thirsty killers. Compensating the herders is as much for the snow leopards' benefit as the herders. Revenge killings by herders have done severe damage to snow leopard populations. **James Smith**



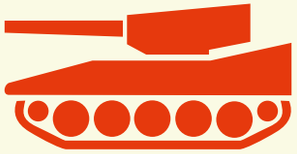
400 million

Number of years over which the firebrat (a primitive silverfish-like insect) has barely changed.

3.4 million

People who watched episode one (23 January) of this year's *Winterwatch* – the highest audience ever for the programme.

1 **Number of tanks on the show.** The RSPB used it to clear an area of heathland of spiny gorses so that other plants can grow.

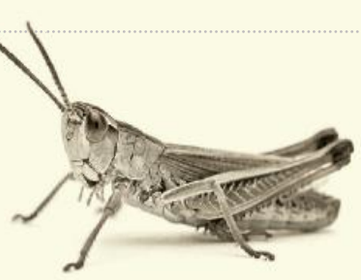


22 Species of dragonfly recorded at Arne.

Keeping watch on Winterwatch

The Winterwatch presenters wrapped up warm and headed for RSPB Arne at Poole in Dorset at the start of the year, for the hit live wildlife show. Here's what they discovered...

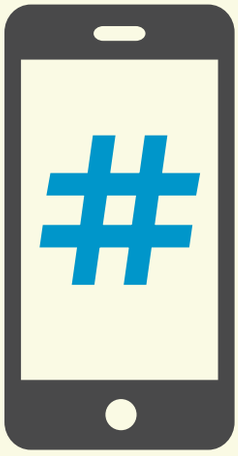
18



Species of grasshopper recorded at Arne, including the striking large marsh grasshopper, the female of which comes in green, brown and pink.

500g

The weight (equivalent to a grapefruit) that a hedgehog has to fatten up to before it can safely hibernate.

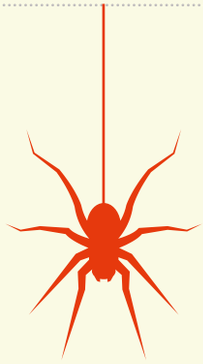


7.8k

Number of #Winterwatch tweets on the final night of the series (26 January).

237

Number of spider species found at Arne, including the raft spider, which lives on water.



23,000

Number of waders and wildfowl resident at Arne during the *Winterwatch* broadcasts.

6

Number of native reptile species found at Arne: common lizard, sand lizard, slow worm, adder, grass snake and smooth snake. They love the well-drained soils that keep them dry as they bask in the sun.

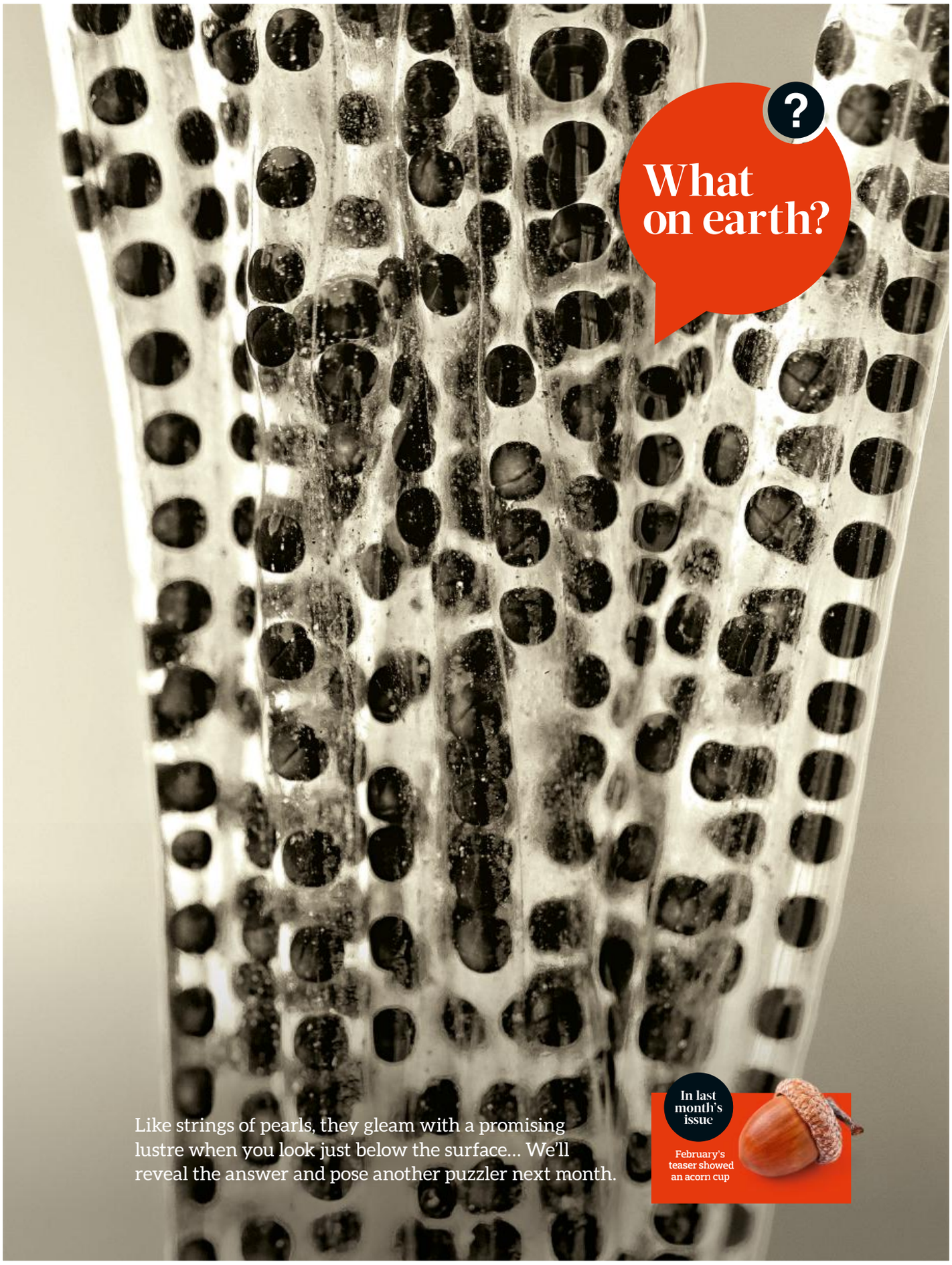
Weight of the tag fitted to a rare Montagu's harrier, to track its migration to Africa.

20,000

Number of vibrations a minute from an electric toothbrush that presenter Michaela Strachan used to 'charm' a spider out of hiding. It replicated the vibrations of a fly landing on the spider's web.

80%

The decline of richly biodiverse heathland similar to Arne in England since 1800.



What on earth?

Like strings of pearls, they gleam with a promising lustre when you look just below the surface... We'll reveal the answer and pose another puzzler next month.

In last month's issue

February's teaser showed an acorn cup

Photographs: Shutterstock, iStock

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