# CURIOUS

WILL WE EVER GET A JURASSIC PARK?

HOW DO YOU BECOME A PROFESSIONAL EXPLORER?

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SHOULD WE ALL BE

# MEDITATING?

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16



WHERE ON EARTH

**THE ALIEN TERRAIN OF THE DANAKIL DEPRESSION**

Searing hot water, sulfurous springs, pools of caustic acid, and plumes of scorching steam. Not your average tourist hotspot and yet this alien-like world needs to be seen.

10

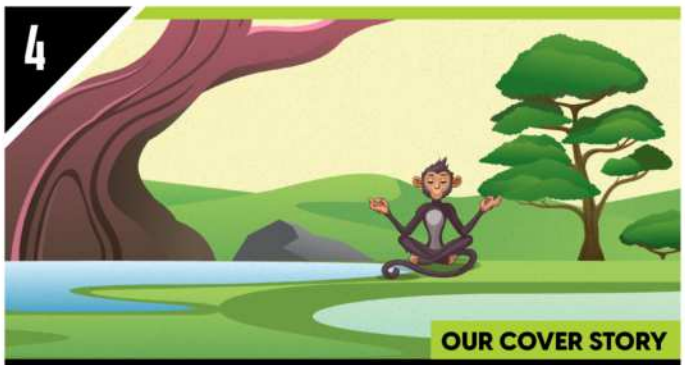


DEEP DIVE

**WILL WE EVER GET A JURASSIC PARK?**

On the 30th anniversary of the iconic movie, Rachael Funnell investigates if we're any closer to cloning real life dinosaurs.

4



OUR COVER STORY

**SHOULD WE ALL BE MEDITATING?**

Are there real-world benefits? Ben Taub investigates.

**June 2023**

# CONTENTS

**News Bites | page 2**
What's new, what's weird, what's happening?

**What On Earth | page 7**
The mad hatterpillar

**We Have Questions | page 8**
How do you become a professional explorer?

**Book Bites | page 14**
Crashing the Internet

**Meet The Author | page 15**
Scott Shapiro on *Fancy Bear Goes Phishing*

**Science In Media | page 18**
What to watch, read, and listen to this month

**Dates To Remember | page 19**
What to look out for this month

**Dark Vs. Light | page 20**
How will you end the issue?

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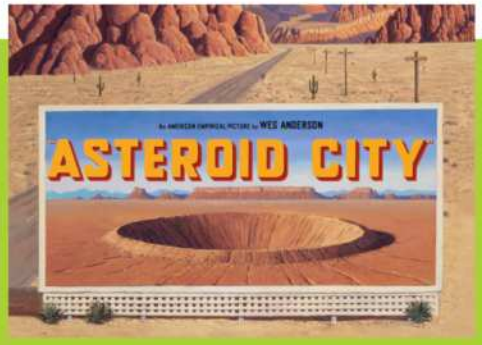
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# NEWS BITES




## Jurassic Park Turns 30

For 30 years, humanity has collectively been terrified of rampaging *T. rexes*, clever velociraptors, plastic cups of water, and spoonfuls of green jello, while simultaneously quoting "Life, uh, finds a way," at every opportune moment. Beloved by the public and experts alike (despite its "mad" science and questionable-looking creatures), *Jurassic Park* made dinosaurs more real than we had ever seen them and inspired generations of palaeontologists, palaeobotanists, and filmmakers. So, how does it hold up 30 years later? Well, scientists are quite united in the fact we will never clone a dinosaur, but at least the most recent offering in the movie franchise gave us the long-awaited **feathered dinosaurs**. These terrible lizards have been ruling the screen for 30 years and there's no reason they won't continue to for another 65 million years.




## Asteroid City

Style over substance or visionary auteur, Wes Anderson can be divisive. However, his first foray into science fiction seems to have most people optimistic that we may get a stylish space-age alien movie from the quirky director. Set in 1955, young astronomers and Space Cadets head to a fictional American desert town for the annual Junior Stargazer convention and witness an incredible outer space encounter that will change the world. Opening in US cinemas on June 16, followed by a global release on June 23, it's unlikely to be a coincidence it comes out just before Asteroid Day on June 30.



## Asteroid Day

**Asteroid Day** is held every year on June 30 to raise public awareness of asteroid impact hazards. It's observed on the anniversary of the 1908 Tunguska event, which saw an air burst over Siberia level 80 million trees and smash windows in towns 60 kilometers (37 miles) away. The roughly 12-megaton explosion was a mystery for a long time, as no impact crater was found. In the end, scientists determined it was an asteroid roughly the size of a 25-story building that exploded 5-10 km (3-6 miles) above Earth's surface. Now, thanks to missions like **NASA's DART**, most people are aware of the global networks tracking "Near-Earth Objects", but it's good to remember to give them a healthy dose of respect – we all saw *Don't Look Up*.



## Celebrating Sally Ride

June 18 marks the 40th anniversary of Sally Ride becoming the first US woman in space, making history, breaking NASA's gender barrier, and inspiring countless generations of women and girls around the world. In 1983, Ride and her female astronaut colleagues had to deal with a lot of sexism and gender bias within the space program. For example, the NASA engineers in charge of putting together the first women astronauts' flight kit assumed they would all want to wear makeup in space. "A makeup kit brought to you by NASA engineers," Ride laughed in a **2002 interview**. She's also acknowledged as the first known LGBTQ astronaut. Ride died in 2012, but her legacy lives on.



*Image Credit Top Left:* Chinch, Shamim9595/Shutterstock, edited by IFLScience, *Right:* Universal Studios, *Bottom Left:* ZargonDesign/iStock *Right:* NASA




### The Big Questions Is Back

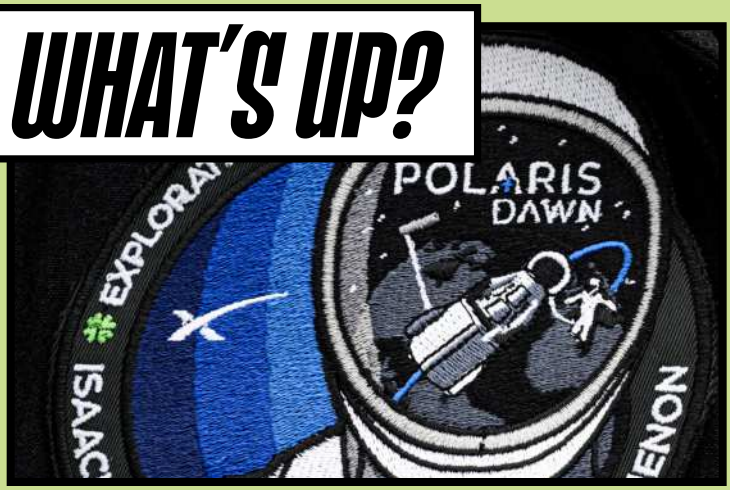
IFLScience's podcast *The Big Questions* is back this month, kicking off season 3 with a deep dive into whether *Jurassic Park* could really happen as the iconic movie turns 30. The rest of the season continues exploring some of the biggest questions and mysteries in science and technology, taking in climate change, space environmentalism, quantum computers, dinosaur sex, and lab-grown meat. Top experts drop by to tackle all these topics and more. If you have a Big Question, tune in, it may just get answered! *The Big Questions* is available on **Apple Podcast**, **Spotify**, **Google Podcast**, **Podbean**, **Amazon Music**, and more.




### Tales Of The Space Age

Long has LEGO® been elevated from children's toy to discerning adults' pastime – and its brand new LEGO IDEAS series **Tales of the Space Age**, while not too brain-taxing, is extremely aesthetically pleasing. LEGO's IDEAS series invites fans to submit ideas under a theme. Designed by Jan Woźnica, whose idea won the "Out of this World" contest, the new four-piece set features a rover and lander under two moons, a meteor shower falling over satellite dishes, a rocket launch, and a black hole, all inspired by classic sci-fi posters and book covers from the 1980s.

## WHAT'S UP?




# Polaris Dawn

## The World's First Civilian Spacewalk

**Name:** Polaris Dawn
**Appearance:** Futuristic
**Location:** If successful, somewhere in the Van Allen radiation belts

**What is the Polaris Program?**
SpaceX's series of private missions that will start using the Crew Dragon and culminate with the first crewed **Starship** flight.

**What is Polaris Dawn?**
The first of three missions in the Polaris Program, a private crewed space mission to reach the highest Earth orbit humans have ever flown at around 1,400 kilometers (870 miles). The previous record was set by Gemini 11 in 1966 at 1,368 kilometers (850 miles).

**Who is Polaris Dawn?**
The crew is made up of four private civilians: Jared Isaacman, who led the crew of **Inspiration 4**, the world's first all-civilian space mission to orbit, plus pilot Scott "Kidd" Poteet and engineers Sarah Gillis and Anna Menon.

**What's so exciting about another billionaire-sponsored space mission?**
The crew of Polaris Dawn is set to make history with the (off)world's first all-civilian spacewalk. This will be the first test of SpaceX's extravehicular activity (EVA) suits that could one day be used on missions to Mars. As the flight plan takes the mission through portions of the Van Allen belts, the crew will carry out scientific research on the effects of spaceflight and space radiation on human health. It will also be the first test of in-space communications using SpaceX's Starlink satellite constellation.

**How long will they be in space?**
The team is set for a five-day orbit of Earth.

**When will it launch?**
Currently, the launch is scheduled for "no earlier than summer 2023", so it could be as soon as June that humanity reaches dizzy new heights and finally breaks a 57-year record.



*Image Credit Left:* IFLScience, *Bottom Left:* LEGO, *Right:* Polaris Program/John Kraus



# SHOULD WE ALL BE MEDITATING?

**Can we really benefit from taking time out to meditate, and is it worth it?**

By Ben Taub

***Image Credit**: James Rodrigues, Modified from Envato Market, sergio34/iStock, Taisiia Iaremchuk/iStock, Jenny On The Moon/iStock*

In the Buddhist tradition, meditation is seen as a path to enlightenment and a tool to realize the Fourth Noble Truth: that there is a way to end our worldly suffering. While modern science tends not to deal in such mystical notions, there is some evidence to suggest that the practice enhances mental health, soothes the body, and might even alter the structure of the brain.

Likewise, while the first three Noble Truths outline the ubiquitousness of suffering in the world, it is now widely accepted that everyday stress and anxiety can be pathological experiences that can seriously harm our physical and psychological well-being. Depending on how you look at it, then, meditating could either bring you closer to Nirvana or help you stay physically and mentally healthy.

But how much can we really benefit from taking time out to meditate, and is it worth it?

## What do we even mean by "meditation"?

When most people hear the word "meditation", they probably imagine the ultra-flexible, robed stereotype sitting in the lotus position and "ohm"-ing themselves into some sort of spiritual trance. However, in reality the term doesn't refer to any particular practice, but denotes a wide variety of techniques that are designed to integrate the mind and body while simultaneously calming both. Some of these methods involve sitting in complete silence and simply observing one's thoughts and feelings; others include the repetition of mantras, and many require focusing attention on the breath.

In recent years, the term "mindfulness" has come to denote the non-distracted, non-judgmental state of mind associated with meditation. Stripping away the religious and mystical aspects, clinical psychologists offer mindfulness meditation as a practical mental health exercise for patients experiencing certain forms of emotional distress.

"Mindfulness is awareness of the present moment," Dr Neda Gould, director of the Mindfulness Program at Johns Hopkins Medicine, told IFLScience. "In mindfulness meditation, we are setting time aside to focus on a specific 'anchor' of the present moment. This is often the breath. A common thread across meditations is the focus on an anchor to the present moment. The anchor can be different but the process is similar."

Dr Gould's anchor analogy builds upon the traditional Buddhist depiction of the mind as a "monkey" that refuses to sit still, disobediently swinging from branch to branch with zero chill. The point of meditation, therefore, is to calm the monkey mind and settle one's thoughts

If that all sounds a bit metaphorical, bear in mind that focusing on the rise and fall of the breath helps to **regulate the release of noradrenaline**, a "fight-or-flight" neurotransmitter that plays a role in attention and stress. Accordingly, meditation techniques that involve observing the breath have been linked to heightened awareness, sharper focus, and a general relaxation of the nervous system.

Searching for a mechanism underlying these positive effects, one study concluded that "cultivating all aspects of attention through mindfulness meditation leads to greater psychological well-being through **decreased ruminative processes**." In other words, anchoring that monkey may help to keep the mind from straying into dark territories, allowing meditators to stay present and think positively.

## What happens when you catch the monkey?

"At an individual level, the benefits of meditation can vary but often individuals report positive emotional and physical shifts following regular meditation practice," said Gould. "The research shows significant improvements emotionally (e.g., decreased depression and anxiety) and physically (e.g., improvements in pain)."

While it's true that many studies have highlighted the mental and bodily benefits of meditating, there is a lot of conflicting data, and much of the research on this topic is of a low quality. Very few studies on meditation have followed up with participants for more than a few months, and even those that meet higher scientific standards have struggled to reach a consensus on the effects of meditation.

In 2014, Gould and her colleagues conducted a **systematic review** of 47 studies which revealed "moderate evidence of improved anxiety, depression and pain and low evidence of improved stress/distress and mental health-related quality of life" among participants in mindfulness meditation programs. Other studies, meanwhile, have produced more **sensational results**, including a review from 2018 which found mindfulness meditation to be as effective as cognitive behavioral therapy and antidepressant medications for patients with certain mental health disorders.

Navigating the various claims made about meditation can be tricky, and it seems fair to say that scientists still aren't entirely certain how beneficial it is. Part of the problem is that participants in these studies vary quite drastically in their baseline mental health and commitment to meditation. Experienced meditators, for instance, are likely to have certain traits that novices lack, which means clinical outcomes tend to differ radically between cohorts.

One interesting study, involving **complete beginners**, found that meditating for just 13 minutes a day for eight weeks "decreased negative mood state and enhanced attention, working memory, and recognition memory as well as decreased state anxiety scores." According to the researchers, this finding "suggests that even relatively short daily meditation practice can have similar behavioral

effects as longer duration and higher-intensity mediation practices."

Encouraging as this conclusion may be, however, these findings need to be replicated in multiple cohorts before they can be taken seriously. And when it comes to studies on meditation, replication seems to be particularly challenging.

**AS OUR SCIENTIFIC UNDERSTANDING OF THE MIND-BODY CONNECTION DEEPENS, REASONS TO SUSPECT A PHYSICAL ADVANTAGE ARE BEGINNING TO APPEAR.**

## The mind-body connection

If the psychological benefits of meditation are hard to quantify, the physical gains are even more challenging to pin down. Despite claims about reductions in chronic pain and improvements in blood pressure, high-quality studies supporting these assertions are extremely few and far-between.

However, as our scientific understanding of the mind-body connection deepens, reasons to suspect a physical advantage are beginning to appear. For example, one large review found a link between meditation and the **expression of genes** that regulate the production of pro-inflammatory compounds called cytokines. Released in response to stress, cytokines have been linked to cellular aging and cancer, so it's possible that meditation may help to buffer the molecular consequences of stress.

Another fascinating study involving 37 Tibetan Buddhist monks found that the devotees had higher concentrations of **beneficial gut bacteria** than non-meditators from the same region. Though full of limitations, this research adds weight to the notion of a gut-brain axis and suggests that mental health and the microbiome may be interlinked.

## Can you re-wire your brain?

"There is fascinating research on the changes that happen in the brain following regular meditation practice, including decreased activity in the areas of the brain involved in the stress response, and increased activity in the prefrontal cortex, which is involved in executive functioning tasks," said Gould.

Indeed, one study found that different types of meditation can **alter the structure of the brain** in different ways, with mindfulness meditation linked to increased thickness within regions associated with attention and cognition, while compassion-based meditation techniques led to increases in a region associated with emotional regulation. Further research has highlighted a connection between meditation and changes within the **right precuneus**, a brain region that is linked to happiness.

As wonderful as all this sounds, though, it will probably come as no surprise to learn that these findings are yet to be confirmed in large-scale clinical trials. Notably, one much-hyped study found **increased functional connectivity** within key brain networks after just eight weeks of meditation, yet researchers were **unable to replicate these findings** in a larger cohort of participants.

To borrow one final Buddhist analogy, then, meditation is sometimes likened to sitting beside a muddy stream, patiently waiting for the debris to settle and the water to become clear. From a scientific perspective, the effects of meditation seem as clear as mud, so perhaps the best thing to do is to just sit patiently, observe the breath, and try and catch that monkey.

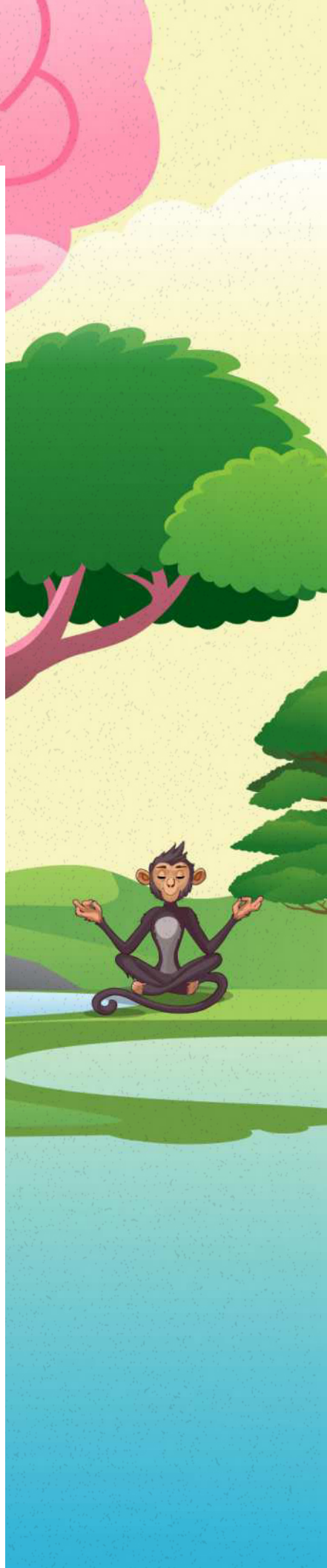


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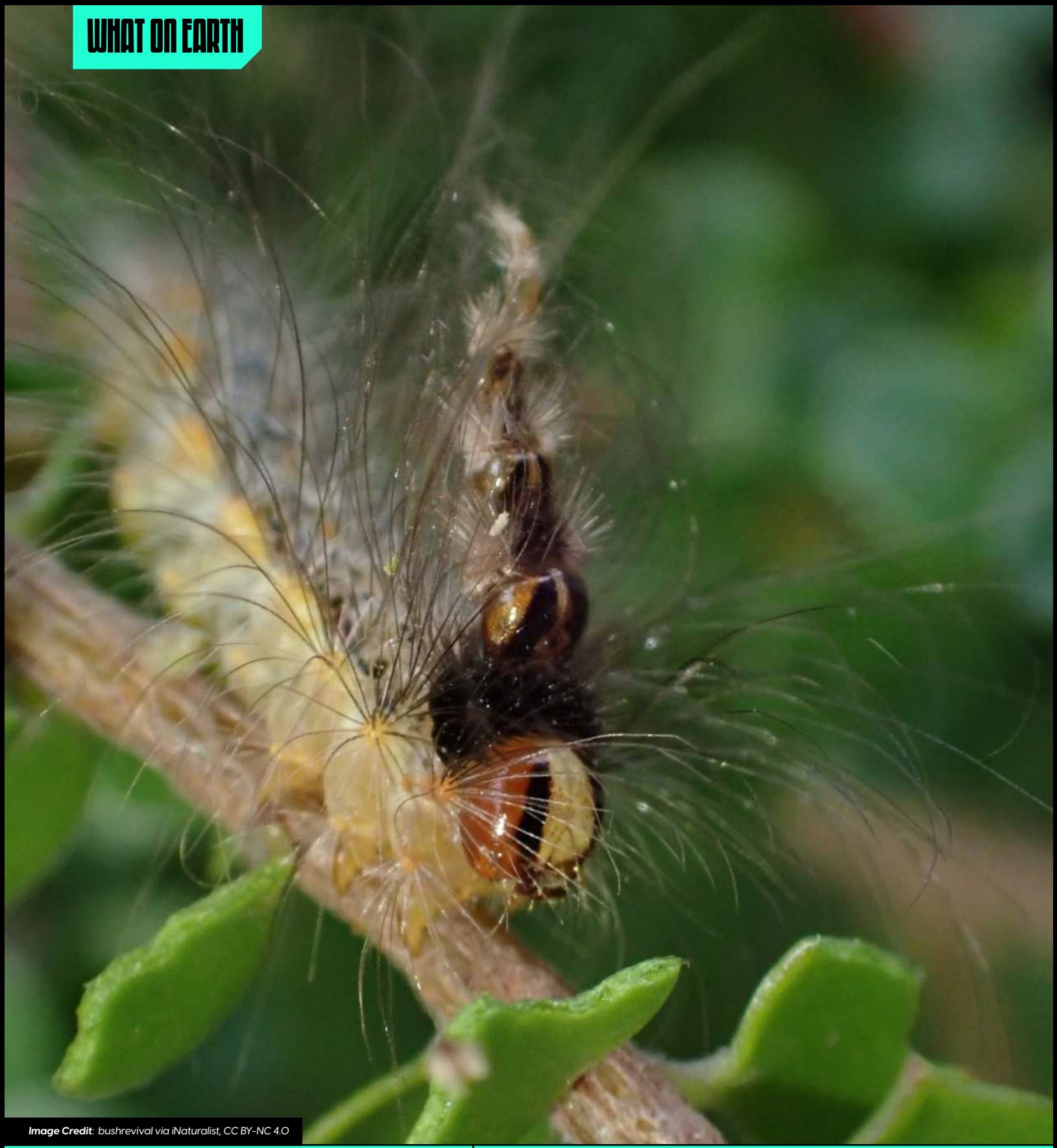


**Image Credit**: *bushrevival via iNaturalist, CC BY-NC 4.0*

# THE MAD HATTERPILLAR

A hauntingly fabulous hat sits atop the mad hatterpillar, an Australian caterpillar that wriggles through life wearing the heads of its old shed exoskeletons. *Uraba lugens*, also known as the gum leaf skeletonizer for the way it destroys eucalyptus, does this as a peculiar defense mechanism. The towering fascinator makes it harder for predators to launch a fatal attack, keeping them at bay one old, shed head at a time.



**Image Credit**: *BBC Studios/Ferne Corrigan*

# HOW DO YOU BECOME A PROFESSIONAL EXPLORER?

## THERE'S EXPLORING, AND THEN THERE'S EXPLORING.

Q&A

By Rachael Funnell

Jetting off to remote locations, getting up close and personal with rare and endangered wildlife, and motorbiking a few Siamese crocodiles in baskets: it's all a day in the life for National Geographic Explorer, presenter, stand-up comedian, and palaeoanthropologist Ella Al-Shamahi. Exploring is something that anyone can do almost anywhere, but the prospect of doing it for a living seems like a childhood dream. So, it got us thinking, how do you become a professional explorer?

Al-Shamahi recently returned to our screens for series two of *Our Changing Planet*, a BBC documentary that aims to track the rewards of efforts made by scientists and local conservationists fighting to protect the planet and the species living on it at a critical time in Earth's history. Series one saw Al-Shamahi trek into Cambodia's Cardamom Forest, and for series two she ventured to the Mekong and rode across rough terrain to relocate endangered reptiles with hopes of establishing a new and thriving wild population.

We caught up with Al-Shamahi to find out what exploring is really like when the cameras are switched off, and how one goes about becoming a professional explorer. Spoiler alert: it takes more than a good Indiana Jones hat.

## What's it like being an explorer?

**EA:** The thing with exploration is it takes many different forms. I was just with a friend over the weekend who works out in the Cook Islands, and she lives there, that's how she does it. Whereas I live in London and then I do expeditions, whether they're kind of TV adventures or more hardcore stuff.

Whatever form it takes, it means you get a front-row seat to some exceptional, extraordinary places, people, stories, information, and science. It really is a privilege to be able to see that. I'm very, very lucky that I often get to see "off the beaten track" stuff. You also get to see parts of the world that have been really affected by conflict. It's incredible to see people trying to protect biodiversity and do science, meanwhile, they've got this trauma of decades of war.

## Any downsides?

**EA:** It is really, really incredible, but I can get tired from the travel sometimes, just the practical components. Sometimes I'm like, "I need more vitamins," but I think that happens to everybody. We're all just tired.

## How did you get into it?

**EA:** I was interested in evolution because I came from a creationist background, so I actually started off not really believing in evolution. And as I started getting deeper into it, I was quite interested in Yemen, which is where my family comes from, because I knew some really interesting scientific questions could be had with regard to human evolution and Yemen specifically.

I was also doing stand-up comedy and had actually gone off to film school to learn how to make ethnographic and documentary films, because I really wanted to be behind the camera. I had no interest in being on camera, but I wasn't very good behind camera. I was good at being a producer but I was bad at being the director.

Then people started saying to me, "stop messing around, you do science, you do comedy, why don't you be a TV presenter?" At the same time, the National Geographic Society sent me a letter asking me to be one of their explorers, which was really cool. Around a year or two later I got my first show, which was one I had been pitching.

## So, it was quite a varied journey?

**EA:** Yeah, I think it's a good example of why you should try and experiment with lots of things. When I first started out, I definitely had a lot of people saying "why are you doing stand-up?" or "why are you doing film? Just focus on science, don't be silly."

I was passionate about comedy, I thought it was really good for my mental health and I just found it really enjoyable. I also found filmmaking really interesting, so I did it. I think if you're interested in something, even if it doesn't make sense in the natural mix of what you're doing, just go for it. Don't let people tell you what works as a career.

## Has being an explorer made you a better storyteller?

**EA:** I think it's definitely made me more fun in the pub. We always have these jokes amongst us, and not just explorers, to be fair, like war journalists as well, that we've all got our war stories. And when we say that we mean like, *crazy* stories. And we get a kick out of knowing how to tell those stories, they're just so bonkers.

But I think at the same time, it's a real responsibility as well. What's the point in me going to incredible places if I'm not doing something productive with it, because that's just a holiday, right?

There has to be a purpose to it. There has to be something that you're trying to do to help or to communicate. So, I'd say it's definitely given me the stories that make me an interesting storyteller at times. But it's also a responsibility.

***If you'd like to see Al-Shamahi doing what explorers do best, series two of Our Changing Planet is available on BBC iPlayer now.***



*Image Credit: BBC Studios*

SCIENCE FACT OR FICTION:

# WILL WE EVER GET A JURASSIC PARK?

How far can cloning go, and what would we do with a bunch of dinosaurs anyway? On the 30th anniversary of the iconic movie's release, Rachael Funnell investigates if we could – and whether we should – create a real-life Jurassic Park.



**Image Credit**: AnnaMaria, DC_Studio/Envato




They say be careful what you wish for, but hot damn, don't we all want to go to Jurassic Park? Before all of the chaos and carnage and people getting eaten on the toilet, John Hammond's dream of a dinosaur island looked like a great day out. If we ignore the very real risk of death, what is the likelihood of humans one day cloning dinosaurs? Will we ever get a Jurassic Park?



In the 30 years that have passed since the movie based on Michael Crichton's novel first hit the silver screen, cloning has come on a long way. JP fans must have thought it an exciting day when Dolly the sheep, the first mammal successfully cloned from an adult cell, was born on July 5, 1996. Of course, there are no living adult dinosaurs from which to casually nab a cell, but what was it *Jurassic Park*'s Mr DNA said?

"A DNA strand, like me, is the blueprint for building a living thing. And sometimes, animals that went extinct millions of years ago, like dinosaurs, left their blueprints for us to find. We just had to know where to look!"

Unfortunately for any wealthy philanthropists who are reading this with an aim to founding a dinosaur island of their own, the science of *Jurassic Park* falters even at this early stage – and there are plenty more roadblocks the further you keep going. But just how close to, uh, finding a way has cloning technology made it?

## Bingo! Dino DNA!

Mr DNA's dinosaur genome extraction technique leans on the bloodsucking lifestyle of mosquitos that did exist millions of years ago – and we've even found blood-engorged specimens. One such example was retrieved in north-western Montana, though it was preserved in rock rather than amber. The rare specimen contained heme, the oxygen-carrying group of hemoglobin in a mosquito's host's blood. So bingo, right? Except that "Large and fragile molecules such as DNA cannot survive fossilization," explained the authors of the **2013 paper**, and the specimen fell short of the time of the dinosaurs by around 20 million years anyway.

To quote John Hammond in Crichton's original book: Oh balls.

Amber fossils are, however, different from rock ones, capable of freezing organisms in time and preserving remarkable and delicate detail, such as the **genitals of a 50-million-year-old assassin bug**. With such fragile junk in the trunk, could an amber fossil have dino DNA to boot?

"When we look at insects in amber, what we tend to find is the outside of the insect, that kind of chitinous husk or the crunchy bit, if you like, of the insect [is preserved], but the inside stuff isn't. So, there isn't any blood found within those," Dr Susie Maidment, dinosaur researcher at London's Natural History Museum (NHM), told IFLScience.

While Maidment doesn't rule out the possibility of finding preserved constituents of blood in a Mesozoic-era mosquito fossil one day, it may be that biting insects aren't our only shot. In 2015, she was part of a team that discovered **red blood cells inside a Cretaceous dinosaur fossil bone**. The presence of nuclei in the blood cells, and their similarities to that of birds, mean it's unlikely to have been a modern



*Image Credit Top:* macashop/iStock, *Bottom:* funstarts33/Shutterstock

contamination. However, a closer look yielded bad news for anyone wanting to ride an Ankylosaur.

"We sectioned the cells using a focused ion beam, which is like a really high-powered, ultra-small knife and we stained the nuclei to see if there was any DNA – but we didn't find anything," said Maidment in an **NHM article**. "Even if you find blood or soft tissue, you don't necessarily find DNA."

## Filling in the gaps

It seems no specimens to date have contained sufficient genetic material for a discussion about cloning just yet, but what if one day that changed? On a warming planet you can't be sure what's about to pop out of the permafrost, so what if we found a partial dinosaur genome? Could that be enough if we stuffed the gaps with, say, frog DNA?

"There are some fairly major flaws with this whole concept," explained Maidment. "Firstly, to know where the gaps in the DNA are, you need to have the whole genome to start with otherwise you don't know which bits are missing."

"The second problem is that frogs are probably the least likely organism you'd choose[...] the organism that you would choose would be birds, because birds are the direct descendants of dinosaurs. When *Jurassic Park* came out, I don't think that was 100 percent accepted. Humans are more closely related to dinosaurs than frogs are. So, it was totally a bizarre choice, but it was needed for the narrative of the film."

The sex-switching capabilities of some amphibians did indeed make for a thrilling plot twist, but it seems that, in reality, this would be a pitfall for any startup trying to cook up some dinosaurs in a lab. It pays to remember that *Jurassic Park* was intended as a work of fiction, not an instruction manual, so that it isn't the blueprint for a real-world theme park isn't surprising, or an indictment of the body of work.

With that in mind: books aside, where do we stand on bringing extinct animals back to life?

## Doing the dodo

As Dolly showed the world, creating a clone of an extant animal is within our grasp, but when dealing with species that are no longer living and breathing you've got to get a little more resourceful. In recent years, stories about bringing back the dodo and the "de-extinction" of the woolly mammoth seem to be in the news all the time. Is there any substance behind the hype?

In February of this year, a start-up received **$150 million in funding** for their project to bring back *Raphus cucullatus*,



the dodo. Earth's lost, bottom-heavy bird shuffled off this mortal coil some 350 years ago, and yet scientists have still been able to **map its full genome**.

The roadmap to a living dodo, for scientists at Colossal Laboratories & Biosciences, begins with its closest living relative: the Nicobar pigeon. By making primordial germ cells of extinct and endangered species, they hope to be able to transfer these to a surrogate chicken host so that they can be incubated and hatch as nature intended.

This strategy might seem like a glimmer of hope for the future of a real Jurassic Park. We're within the realm of birds, after all, the **living descendants of dinosaurs**. However, these animals also represent a uniquely difficult task for cloning.

## The marble run of avian reproduction

Before we go trying to get a chicken to lay a velociraptor, we should recap on the complex nature of avian reproduction. This veritable marble run of ovulation means that once the yolk leaves the ovary, it's constantly on the move. It travels from there to the oviduct, then into a construction line that layers the albumin (egg white) and shell membrane.

Creating a mammalian clone is a comparatively simple task of making an embryo and sticking it inside a surrogate uterus. Unfortunately, one cannot simply make a dinosaur egg and put it inside a chicken.

## What if we did it anyway?

Were we to suspend disbelief – a willingness that underpins all good sci-fi – and accept that dinosaur cloning could happen, are we even set up to house dinosaurs in the modern era? After all, the entire *Jurassic* franchise hinges on the pitfalls of inappropriate security around bloodthirsty animals (why didn't a park supposedly cloning dinosaurs have the **budget for a remote-controlled gate**, anyway?).

It's no secret that for all the good work some zoos do, there are plenty of others keeping captive animals in poorly maintained and inappropriately sized enclosures. If we can't keep bears happy, what hope do we have of enriching a captive **therizinosaur**? Somehow, we can't see people wanting to hold ol' salad scoops' freaky talons like the adorable paws of an otter.

Indeed, animal rights is a tricky subject when it comes to creating corporate assets with brains and feelings. As is *checks notes* grass...?

"What about the things that they eat?" posited Maidment, sensibly. "Grass hadn't evolved when the dinosaurs were around. So, the herbivores weren't eating grass, which is quite difficult to eat. It has lots of bits of almost glass-like material in it, which causes your teeth to wear down really fast."

"Things like horses have evolved these very high-crowned teeth, which wear down over time," she explains. "Dinosaurs didn't have that, they replaced their teeth continuously throughout their lives, but if they were eating grass, could they have digested it? Could their teeth replacement rate keep up with being worn away? And would plants today be poisonous for these dinosaurs that lived in a world where flowering plants hadn't even evolved yet?"

With existing cloning technologies, animal rights policies, and the marble run of avian reproduction being what they are, it seems like a day out at Jurassic Park is probably consigned to fiction. That said, with nobody but prospective dinosaur dentists set to profit from the return of a potentially human-eating extinct animal group, perhaps now is the time for questioning if we should, rather than if we could.

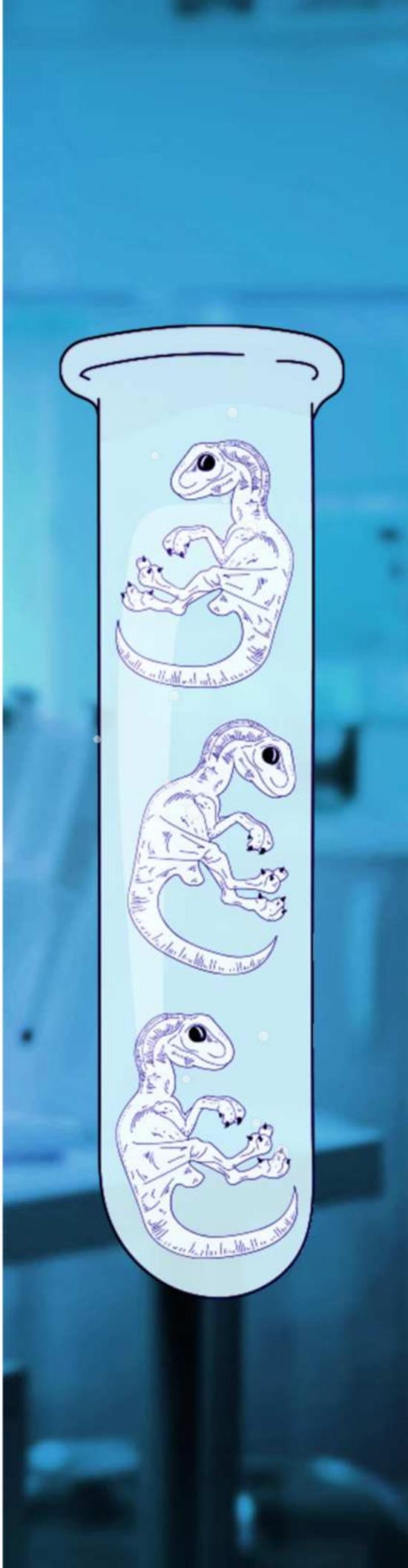
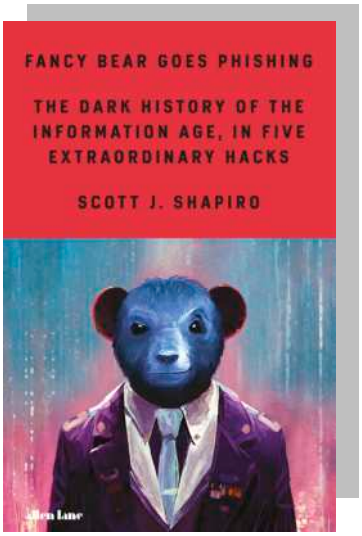




Image Credit: AnnaMaria, DC_Studio/Envato

# CRASHING THE INTERNET




In this tense excerpt from *Fancy Bear Goes Phishing*, Professor of Law and Philosophy, Scott J Shapiro, takes us through the day a grad student crashed the Internet.

"I think I really fucked up." Paul knew that Robert was in serious trouble. The quiet, bespectacled 22-year-old graduate student never swore. Paul later testified at Robert's trial that his friend was "usually sort of puritanical in his speech. That is why I thought something really major must be wrong."

Something really major was wrong. Paul's friend had just crashed the Internet. The call came at 11 pm, November 2, 1988. Robert Morris Jr., a PhD student in computer science at Cornell, described the unfolding disaster to Paul Graham, a graduate student at Harvard.

Earlier that night, around 8 pm, Robert sat at a terminal in Room 416O of Upson Hall, then home to Cornell's Computer Science Department, in Ithaca, New York, and remotely logged in to prep.ai.mit.edu, a VAX 11/75O computer at MIT's Artificial Intelligence Lab in Cambridge, Massachusetts. He transferred and executed three files, thereby releasing what he and Paul had called "the brilliant project": a self-replicating program . . . a computer "worm."

The worm was programmed to infect computers on the then-nascent Internet. After it infiltrated one computer, that computer would serve as a base from which to infect others. With each new target, the worm would copy itself and dispatch its clone to a new home. Working in tandem, the worm and its clones would continue multiplying until they had completed their mission and infected the entire Internet.

But Robert's own mission was purely scientific; he wanted to build a program that could explore the Internet. He was trying to infect as many computers as he could simply to see how many he could infect, not to wreak havoc by crashing them. But when Robert returned from dinner to check the progress of his experiment, he noticed that the network was sluggish.

There was a conspicuous lag between typing and characters appearing on the screen, and between command and execution. The worm was spreading too quickly and consuming too many resources. It had boomeranged from Cambridge back to Ithaca in under three hours and was taking over his department's network. And this was just the beginning.

Robert's worm didn't just cripple the Cornell network; it was barreling through the Internet, trouncing everything in its path. Just a few minutes after its release at MIT, the worm's first known infection occurred at the University of Pittsburgh. From Pittsburgh, the worm zoomed cross-country and hit rand.org, the network for the RAND Corporation in Santa Monica, California, at 8:24 pm. Within the hour, computer managers at RAND noticed their network slowing; several nodes were at a standstill.

At 9 pm, the worm was spotted creeping around the Stanford Research Institute. By 9:3O pm, it was at the University of Minnesota. At 10:O4 pm, it infiltrated Berkeley's gateway machine, the computer that served as the university's portal to the Internet. Almost immediately, computer administrators noticed an unusually large load on the machine and a backlog in their system. At midnight, administrators at MIT, where Morris had first released the worm, returned from an ice cream break to discover their network was failing, too.

At 1:O5 am, the worm penetrated Lawrence Livermore National Laboratory, a site responsible for securing the country's nuclear arsenal. Soon the worm had burrowed into the Los Alamos National Laboratory in New Mexico, the home of the Manhattan Project and the world's first atomic bombs. Robert's brilliant project no longer seemed so brilliant.



Image Credit: Allen Lane

# AUTHOR Q&A



## WITH SCOTT J SHAPIRO

### AUTHOR OF *FANCY BEAR GOES PHISHING*

Named for one of the world's most famous elite cyber espionage groups that favors phishing messages and spoof websites, Scott Shapiro's new book *Fancy Bear Goes Phishing* delves into five great hacks – the who, what, why, and dramatic fallouts in this smart tale of technology, and, ultimately, humans.

### Why did you choose these hacks?

I knew that one had to be the first internet hack, the Great Worm, which crashed the internet in 1988. Aside from being the earliest hack of its kind, the case raises several interesting technical and legal questions. I also wanted to include recent hacks with some level of mystery or intrigue: the 2016 Mirai botnet attack and the Russian hack of the Democratic National Committee (DNC) during the Clinton-Trump presidential election. I especially liked that each story raised diverse technical and legal questions.

I also wanted to pick stories that had not yet been fully told. That's how I settled on the Bulgarian virus factory in the 1990s and the hack of Paris Hilton's cell phone in 2005.

I approached all five like detective stories, trying to uncover who did it, how they did it, and why they did it. I hope this approach makes the stories engaging and helps readers understand the motivations behind these hacking incidents.

### What can we learn from them?

Popular media usually portrays hackers as twisted young geniuses who live in their parents' basements, wear hoodies, and subsist entirely on energy drinks. This is a caricature. Hacking is not a dark art, and hackers are not 400-pound [180-kilogram] wizards or idiot savants. They are regular people who have names, faces, and relationships.

Cybercrime is a business, and criminals are businesspeople looking to make a profit. They don't want to read your emails or spy on you through your webcam. They aren't interested in *you*, per se. Protecting ourselves means making ourselves unappealing targets. We don't need to be bulletproof; we need to raise the cost of attacking us so that other targets become more attractive. It's like outrunning a bear – you don't actually have to outrun the bear, just the other guy.

### Why do these attacks happen?

Although the history of hacking seems like a technical story, it is actually a human story. This may sound counterintuitive, but to truly understand the root causes of hacking, we need to consider the interplay between what I refer to as "upcode" and "downcode."

Downcode is the technical computer code that hackers use to gain access to systems and data. It's the code literally below your fingertips. Upcode, on the other hand, refers to the social, political, and institutional forces that shape the world around us, including personal beliefs, social norms, legal rules, corporate policies, professional ethics, and website terms of service. While computers run on downcode, humans run on upcode. And upcode shapes downcode.

Ultimately, hackers exploit human vulnerabilities. That's why it's a mistake to think of cybersecurity as just an engineering problem. It is more useful to think of hacking as a human problem. By examining the interplay between upcode and downcode, we can gain a deeper understanding of how hackers operate, why they do what they do, and what steps we can take to prevent future attacks. •

***Fancy Bear Goes Phishing* is published by Allen Lane and is *available now*.**



*Image credit:* Scott Shapiro, © Guy Jordan



Searing hot water. Sulfurous springs. Pools of caustic acid and plumes of scorching steam. Sounds hectic, right? Nonetheless, the Danakil Depression in northern Ethiopia is a geological hit with curious sightseers. Its blue-burning lava and bright yellow springs might be a psychedelic assault on the eyes, but they're the spectacular manifestation of continental rifting.

**Image credit:** *guenterguni/iStock*

# THE ALIEN TERRAIN OF THE DANAKIL DEPRESSION

The Earth's crust is not a uniform thickness across the planet, and in places like the Danakil Depression, the effects of continental rifting can be seen in vivid technicolor. Here, tectonic plates are pulling apart, separating formations like the Danakil Alps and Ethiopian Plateau that were once neighbors.

The hot, colorful, and treacherous terrain has earned the region the nickname "Gateway To Hell," but it's been utilized by humans mining for salt by hand for centuries, and has since become a popular tourist destination.

According to **NASA's Earth Observatory**, the ever-sinking landscape at the Danakil Depression means it will one day fill with water to form a great lake or possibly even a new ocean – but for now, more formidable things bubble on its surface. The Danakil Depression is home to Gada Ale, a volcano that sits at around 287 meters (942 feet) and joins the Erta Ale chain of volcanoes. It's a stratovolcano, made up of layers of lava and ash inside which a vast crater lake of scalding liquids and gases simmers.

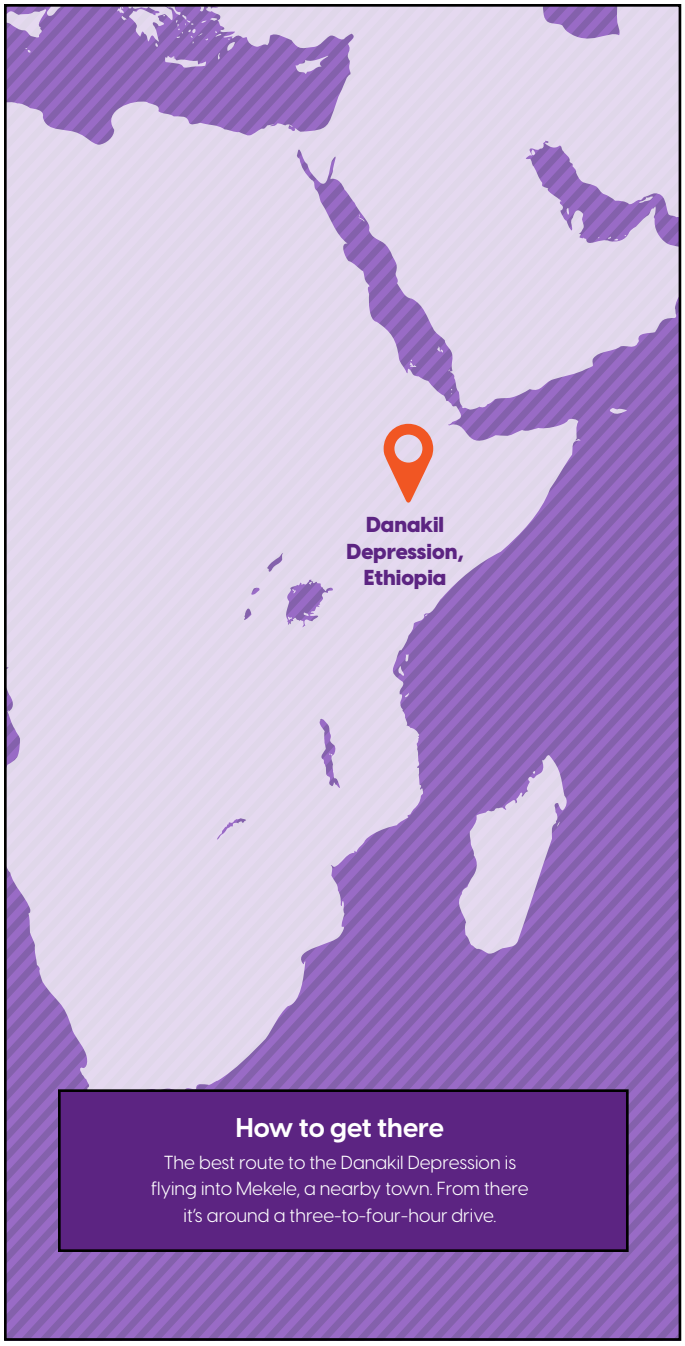
The hot and inhospitable environment is a cacophony of sights and smells, the most alluring of which seem to be found at the Dallol sulfur springs. Sitting at the base of the Dallol Volcano, the crusty salt flat is pockmarked with springs and craters in near-neon hues of green, orange, and yellow.

The region's wild coloration comes from the unique terrain that brings together seawater and volcanic minerals including sulfur, iron, and copper. Despite belching out combinations of chlorine and sulfur gas, scientists discovered back in 2017 that life can thrive in Dallol's waters, though it is very small.

They found evidence of bacteria living in the waters that are classed as "polyextremophiles" for being able to tolerate the extremes of heat, salinity, and acidity all at once. But before you head out to get a look at their alien-like habitat, it's worth considering this first-person account.

"The environment is very extreme," Barbara Cavalazzi from the University of Bologna in Italy, who has been conducting expeditions in Danakil since 2013, told the **BBC**. "On average, the temperature over there around lunchtime can reach 48°C (118°F). One time we measured 55°C (131°F)."

Steamy.



## PLAY




### Highwater

**Game from Demagog Studio**

It's the end of the world and, predictably, the ultra-rich are about to get the heck out of dodge on an evacuation mission to Mars. You and a band of ragtag friends from a high-rise hit by the floods are refusing to get left behind without a fight. Will you make your way onto the Mars-bound "Hope Mission" rocket?

***Available now.***

## WATCH




### The Days

**Series from Netflix**

On March 11, 2011, a 9.0 magnitude earthquake struck the east coast of Japan, creating a 15-meter (50-foot) tsunami that killed over 18,000 people along Japan's northeast coast and triggered what's believed to be the worst nuclear disaster since Chornobyl at the Fukushima Daiichi power plant. *The Days* explores what happened next.

***Available June 1.***

## ADVENTURE



### Indiana Jones And The Dial Of Destiny

**Movie from Disney and Lucasfilm**

Harrison Ford and his big hat are back for this fifth installment in the iconic *Indiana Jones* franchise. Alongside *Fleabag*'s Phoebe Waller-Bridge, he goes in search of an instrument that could change the course of history. What follows is a suitably treacherous adventure movie featuring an urbanized take on the *Raiders Of The Lost Ark* boulder scene.

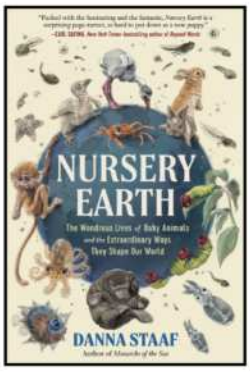
***In cinemas from June 30.***

## READ

### Nursery Earth

**Book by Danna Staaf**

In *Nursery Earth: The Wondrous Lives of Baby Animals and the Extraordinary Ways They Shape Our World*, researcher and author Danna Staaf shines a light on the miniature versions of wild animals. From a salamander embryo that breathes with the help of algae inside its cells to the spotted beak of a parasitic baby bird that tricks adults of other species into feeding it, it proves that age is just a number when it comes to adapting novel ways to stay alive.




*Available from* ***June 6.***

# SCIENCE IN MEDIA

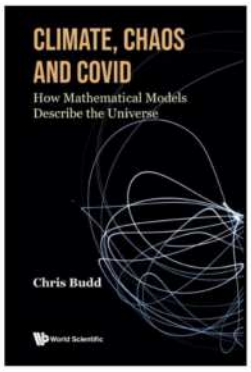



## UNCOVER

### Climate, Chaos And COVID

**Book by Chris Budd**

In the news, we often hear how models can tell us in which direction a pandemic is about to move or what our outlook is when it comes to global temperatures – but for the average person who's perhaps not naturally numerically minded, it means little. In this book, Professor of Applied Mathematics Chris Budd shows why models work, how good they can be, their advantages and disadvantages, and how they make the modern world possible.




*Available* ***now.***

 *Image Credit Top Row Right:* Disney and Lucasfilm, **Bottom Row Left:** The Experiment Publishing, **Right:** World Scientific Publishing

# DATES TO REMEMBER

This month will see the longest day of the year in the Northern Hemisphere, courtesy of the summer solstice. Be sure to make the most of it, and the rest of June, which offers up a whole host of other treats, including a less-delicious-than-it-sounds "Strawberry Moon", World Ocean Day, and much more.

## JUNE 1

### Dinosaur Day

Dinosaur Day is an opportunity to celebrate dinosaurs (duh), palaeontology, and our world's ancient natural history. If you're based in the UK, or happen to find yourself in London this June 1, why not mark the occasion with a trip to the Natural History Museum to see *Patagotitan mayorum*, one of the largest dinosaurs ever to walk the Earth, in all its gigantic glory? For more information and a sneak peek of the exhibition, check out our exclusive interview **here**.





### 4 Strawberry Moon

June's full Moon, the last before the summer solstice, is known as a Strawberry Moon, so named for the berries that ripen in North America this time of year. Unfortunately, the Moon won't be turning a delicious shade of strawberry red – it will stay looking decidedly Moon-like – but you should still be able to catch a breath-taking glimpse of it at its fullest if you cast your eyes up at the sky around 3:42 am UTC.




### 8 World Ocean Day

Our oceans are under threat: climate change continues to **heat them** into a salty, tidal soup, which is becoming more acidic and less oxygenated, while the long-suffering creatures that call them home face **pollution**, habitat destruction, and overfishing. World Ocean Day seeks to rectify this, championing marine conservation and climate action to protect and restore our blue planet.

### 21 Summer Solstice

For those in the Northern Hemisphere, June 21 will be the summer solstice, or midsummer. At exactly, 2:58 pm UTC, the North Pole will be at its maximum tilt toward the Sun, which itself will travel the longest path through the sky, giving the longest day and shortest night. Meanwhile, for Southern Hemisphere inhabitants the opposite is true – get ready for the shortest day and longest night thanks to the winter solstice.



### 23 International Women in Engineering Day

This year marks the 10th annual celebration of **International Women in Engineering Day** (INWED), brought to you by the Women's Engineering Society. While encouraging more women and girls to pursue careers in engineering, INWED profiles female engineers across the globe and salutes their incredible achievements in a field in which they're still massively underrepresented.






*Image Credit Top Left:* IFLScience, ***Top Right:*** CochiseVista/iStock, ***Middle Right:*** Betka82/iStock, ***Middle Left:*** Mattia Al Azizzy/Shutterstock, ***Bottom Right:*** nicolamargaret/iStock





# ARE YOU DRAWN TO THE DARKER OR LIGHTER SIDE OF SCIENCE?

Choose how you end each issue. For those who prefer the darker side, Maddy Chapman shows how to crack a criminal (or beat a detective, depending on how you look at it). If you like your science lighter, you may soon be able to stop and smell the roses – in VR.

# UNDER INVESTIGATION

We've all seen the TV shows: a no-nonsense detective interrogates tight-lipped members of a crime syndicate, to no avail at first – but THEN, eventually, even the toughest nuts crack, spilling their secrets to the now rather smug-looking detective, who has saved the day yet again. But how do they do it (you know, aside from the fact it's written in the script)?

A **new study** might have some answers, and not just for us average Joes keen to learn more about investigative interviewing, but also tips to help established detectives hone their skills.

Researchers created 22 faux criminal networks, recruiting groups of up to six people who all previously knew each other and asking them to imagine themselves as members of a gang that laundered money via a chain of fake tanning salons.

The groups then had to discuss and come up with a strategy they hoped would hold up under interrogation before being individually interviewed by an actor portraying a detective.

The researchers found that members of the hypothetical crime syndicates were more likely to disclose information if they thought it would make them appear cooperative and could benefit their network – something for detectives to bear in mind when interviewing. Furthermore, the extent to which they were willing to disclose this information varied depending on the network they were in.

In real life, this may mean that knowing the group an interviewee belongs to, and knowing how other members of it reacted to questioning, could predict their likelihood of disclosing information.

"Suppose Doe [a theoretical detective] discovers that a particular interviewing approach tends to elicit high-stakes information from one network member," the study authors write. "That knowledge could be used to plan an interview with another [member]: Doe can now better predict how best to elicit high-stakes information from members of [the network]."

Next stop, a prime-time spot on the telly.

# SMELL THE (VIRTUAL) ROSES

Wake up and smell the metaverse. Virtual reality (VR) just got a whole lot more exciting, as researchers have finally figured out a viable way to incorporate odors. Their small, wireless interfaces mean that one day, you could find yourself smelling in VR, something that has stumped scientists for years.




The senses of sight, sound, and touch have all previously been mastered in VR, but smell has remained a challenge. Current headset designs tend to be bulky and often involve liquids and wires, none of which is conducive to a seamless immersive experience.

But that may be about to change thanks to the latest developments, which are the subject of a recent **paper**.

Pineapple, mint, watermelon, candy, rosemary, mojito, and morning (we're not sure, either) – these are just some of the 30 scents that could soon be available to us in VR.

Researchers have developed two wearable interfaces: one that sits on the skin between the nose and mouth and another that straps under the headset like a face mask. Both use perfumed paraffin wax which, when heated, wafts an array of scents into the user's nostrils in just 1.44 seconds.

Both devices are controlled by a small chip, which communicates with a computer via Bluetooth to coordinate scent release and VR visuals.

With some more tweaking, these small, light, and wireless new designs could transform VR experiences. And not just by improving immersive gaming – they could have clinical applications too. Merging scent and VR could help people with anosmia (loss of smell), or memory issues, and might even help boost mood, lead author Xinge Yu told **MIT Technology Review.**

But why should the benefits be limited to humans? Let **cows** smell virtual grass and **mice** smell virtual cheese, we say. Smell-O-Vision for the masses!

The Darker Side of Science | THE LIGHTER SIDE OF SCIENCE