UNIVERSITY OF CAMBRIDGE

Cambridge Alumni Magazine
Issue 90 — Easter Term 2020

Why the humble battery holds the key to the climate emergency

In plain sight: machine learning needs to go back to basics

Fitzbillies: celebrating 100 years of bunmongering

CAM

Cambridge Alumni Magazine
Easter Term 2020
Issue 90

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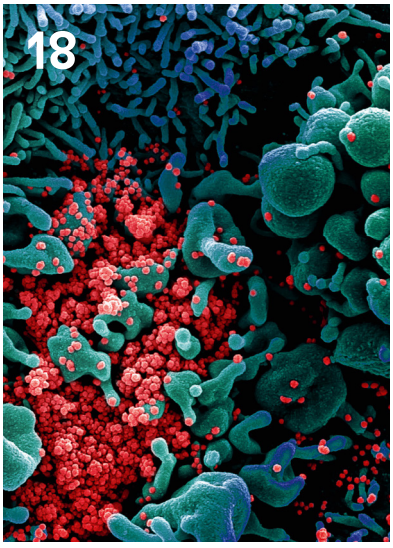

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Editor's Letter

Welcome to the Easter Term edition of CAM – and to a magazine made in lockdown. But while the CAM team wrestled with socially distanced photography, researchers and experts from across the University were working to support the local, national and international fight against Covid-19. We report on their work on page 18.

What have you been doing in lockdown? In 17th-century Paris, the rich and fashionable kept themselves occupied by taking drugs – including ones that may seem rather familiar. Dr Emma Spary traces the lines of empire and the thrill of the new on page 24.

Elsewhere, on page 36, Professor Neil Lawrence explains why the next phase of artificial intelligence should involve going back to basics. And on page 12 we celebrate Fitzbillies – a uniquely Cambridge institution which this year marks its 100th anniversary. If ever there was an excuse for a Chelsea bun, this surely must be it.

As we emerge – to some extent – blinking into the light, there is change afoot. In CAM 88 we reported on how staff and students are working to decolonise the curriculum. In response to the Black Lives Matter campaign, many of you have asked about the University's approach to antiracism. You can read the alumni briefing in Download on page 42.

On these topics – along with all other things Cambridge related – we look forward to your contribution to the debate, online at the new website, magazine.alumni.cam.ac.uk, by post, email or on social media.

Mira Katbamna
(Caius 1995)

CAM online

Check out our new digital home:
magazine.alumni.cam.ac.uk

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PHOTOGRAPHY: CAMILLA GREENWELL

Inbox

Reasons to feel hopeful

Pedantic nitpicking, I know (but what else is a Cambridge education for?): your contributor may be right that Malcolm X said Plymouth Rock landed on him, but Cole Porter had the idea first, in *Anything Goes*.

(There's always something in CAM to start a conversation!)

Patrick Wallace
(King's 1967)

In my spare time I help to run the Christian Campaign for Nuclear Disarmament. We believe that it is a lack of hope that leads to people settling for the uneasy status quo of 'nuclear deterrence'. Christians, and other people of hope, should demand better: a world where there is a clear and urgent path to the total abolition of such abominations.

Martin Tiller
(Sidney Sussex 1986)

I studied the graphs. The vertical scales aren't shown, and the zeros are clearly some way above the bottom of the coloured areas. But in dark times I still live in hope – that one day statistics will be properly presented.

John Hartley
(Corpus 1975)

I agree with you on the importance of hope in this uncertain time of climate emergency. In the UK, we already have the technology to become carbon neutral within 10 years. What is missing is the political willpower to implement it.

The British government has shown how rapidly it can respond to the Covid-19 emergency, so why [not the] climate emergency? Could it be because supplementing big fossil fuel companies, cutting down ancient woodland for HS2 and allowing developers to build houses way below the carbon-emission standard is in the interests of capitalism and the elite?

My hope is that the government will wake up to the fact that we are all in this together and realise that they need to act now.

Elaine Carter
(Newnham 1972)

A timely reminder to be hopeful in CAM 89 – complete with some fantastic Gapminder graphics!

Kate Stockings
(Homerton 2014)

Great quote in CAM: "So what if things get worse? Do I then give in to despair? No, because even if things get worse, they can't close down the possibility of change."

Krista Carson
(Homerton 2013)

Those of us who think about long-term change do see reason to hope for reset in so many areas: "Hope is the thing with feathers".

Rachael Unsworth
(Selwyn 1977)

All the lonely people

When we set up the Campaign to End Loneliness a decade ago, we wanted to call attention to the profound blight on life so many of us experience.

It's a terrible, tragic irony that the murder of one of the University's most celebrated alumnae, Jo Cox [Pembroke 1992], who felt acutely lonely as an undergraduate, prompted so much awareness and action to find ways we can overcome those feelings.

It's so good to see CAM, and Cambridge, getting to grips with understanding this 'lonely city' that we all inhabit at some point, whatever our age.

Paul Cann
(King's 1972)

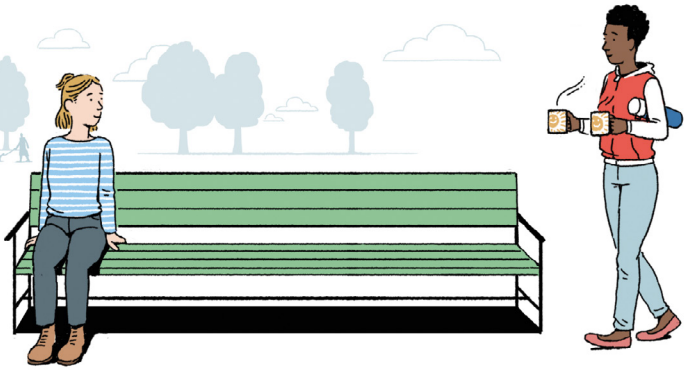


ILLUSTRATION: MICHAEL KIRKHAM

How to be modern

I'm afraid I have bad news for David Orton, who writes that "if Cambridge [won't provide] an education in... western civilisation, I shall be suggesting to my grandchildren that they apply elsewhere – perhaps Durham?"

He may be interested to know that at Durham we are revising our curricula to make sure that they are not wholly British-/European-/western-centric, and that the important and fascinating cultures, pasts and presents of places across the world are represented and explored.

Hopefully this is precisely the kind of thing that his grandchildren would enjoy studying, whether at Durham or Cambridge or elsewhere.

Helen Foxhall Forbes
Associate Professor of Early Medieval History, Durham University
(Trinity 2001)

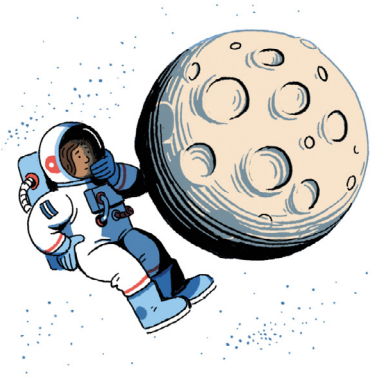
Superpower

An excellent article (*inter pares*) in CAM 89, but it repeats the mantra "storing hydrogen is expensive and complex". Until the 1960s, most homes and many industries were powered by 'town gas' – 50 per cent hydrogen. Storage, distribution and metering were never considered problematic, and most of the system was reused as natural fossil gas (mostly methane) replaced it. The delightful cartoons depicted transport, but two-thirds of UK energy consumption is static, and, while planes, cars and trucks might present a problem, ships and trains could in the long term run on liquid hydrogen.

Alan Calverd
(Peterhouse 1963)

Whilst it may be sensible to utilise surplus (renewable) electricity to split water to make hydrogen for use in fuel cells on Earth, on the moon this becomes much more problematic.

Although there is ample sunlight even on the far side of the moon, the engineering problems should not be overlooked. The variation in temperature between the illuminated hemisphere of the moon and that in shadow is around 350°C, making metal fragile and joints hard to seal.



Maintaining temperatures below the critical temperature of hydrogen is problematic. Of course, everything can be built in controlled lunar environments, but this is no easy task either. So while one day we may well go to the moon and build a hydrogen economy, I would suggest this is many decades away. A hydrogen economy here on Earth is going to be difficult enough to achieve.

Peter Baker
(Magdalene 1964)

Praise

Congratulations on the fantastic new digital edition of CAM! It was great to get a sneak peek at the latest issue a few days ahead of the print copy landing on my doormat. Each issue seems to contain just the right combination of articles that make me think "Oh, that's interesting!" and ones that make me think "I don't even know if that's a real word!"

But that's the beauty of CAM – I come away from each issue knowing a little more about the world.

Craig Nunn
(Homerton 2007)

Just wanted to say that I thought the latest issue was great. Especially liked the hopefulness article, but also gender, loneliness, certainty and Egypt – all brilliant.

Michael Mann
(Christ's 2001)

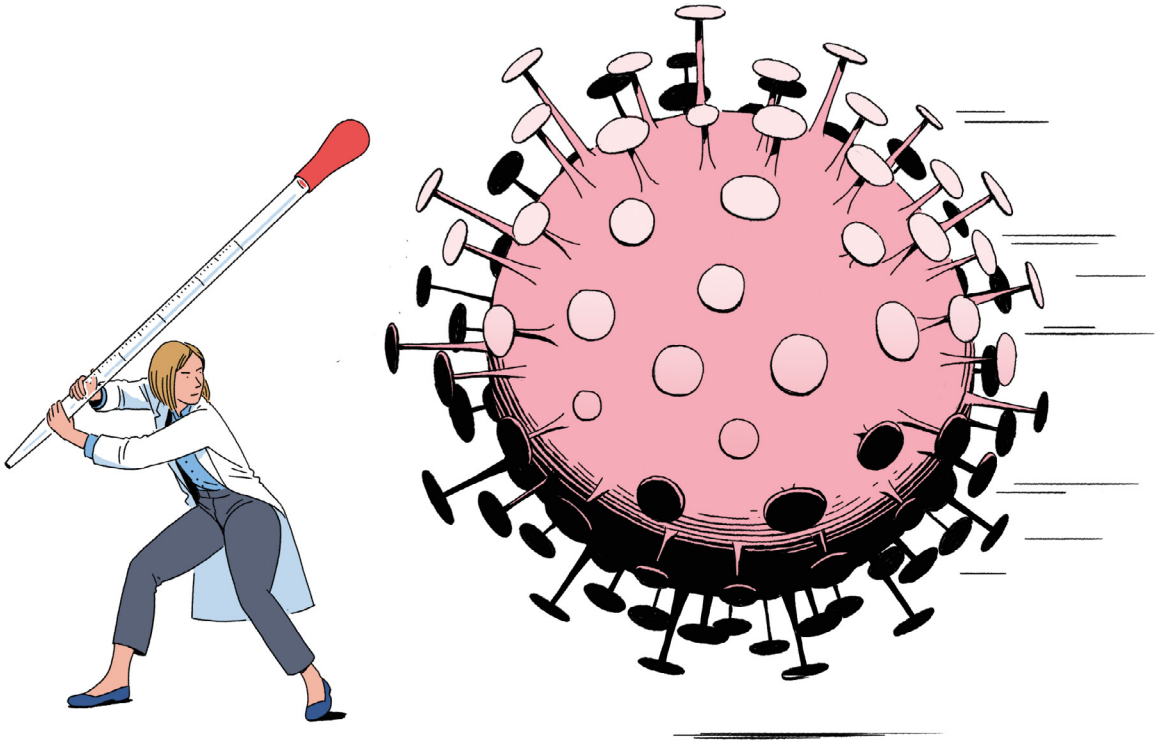
Just now I was sitting on my patio in the evening sun, reading CAM, sipping a G&T and listening to the ewes and lambs in the adjacent field blaaring away while they sorted out their lives. When I decided it was time to go in to cook my supper, I smacked my hand on the table and said out loud: "That was a bloody good read!"

And it really was – I read every article from beginning to end, and I particularly enjoyed the graphics.

Julian Gray
(Clare 1960)

In Numbers

265 medics graduated early this year as part of the national effort to provide additional medical staff to the NHS.



Research

New Cambridge institute pivots all resources to focus on Covid-19

The Cambridge Institute of Therapeutic Immunology and Infectious Disease (CITIID), which only opened last October, has redirected more than 150 researchers and all of its effort towards tackling Covid-19.

Based on the Biomedical Campus, CITIID is integrated with the NHS, locally, through Cambridge University Hospitals (CUH) NHS Foundation Trust and the Royal Papworth Hospital NHS Foundation Trust, and, nationally, through the National Institute for Health Research (NIHR).

In early April, the Institute opened what is believed to be the largest Containment Level 3 facility at any UK academic institution, vital for work on dangerous pathogens such as Covid-19.

"The state-of-the-art facilities and equipment at CITIID will allow us to do essential work on Covid-19 in a safe environment," says Professor Gordon Dougan. "Our Institute, on the Biomedical Campus, is perfectly suited to lead Cambridge's response."

The Institute has also been instrumental in helping to set up and evaluate point-of-care, rapid diagnostic testing for patients at Addenbrooke's, as well as developing tests for frontline healthcare workers.

"Organising the logistics for testing has been a huge challenge," says Professor Paul Lehner, who specialises in immunobiology. "But thanks to a tremendous collaborative effort between CUH and the University, we are now testing frontline healthcare workers as well as people who are off work and in isolation."

Covid-19 patients at Addenbrooke's have been recruited for a study that forms part of the Covid-19 BioResource, a collaboration with the NIHR. State-of-the-art analysis of blood and other samples will help the team understand how coronavirus infects humans and causes disease, and how the immune system fights back.

CITIID is taking a leading role in the £20m Covid-19 Genomics UK Consortium, a major national effort to help understand and control the infection. Its researchers are also leading the evaluation of a new rapid diagnostic test for Covid-19, developed by a University spinout company, which is capable of diagnosing the infection in under 90 minutes.

Professor Ken Smith, Director of CITIID said: "Together with our partners in the NHS and NIHR, we aim to identify those patients at greatest risk and understand why the coronavirus makes some people so sick while leaving others with only mild symptoms. Ultimately, we hope this will lead to the development of new treatments against this dreadful disease."

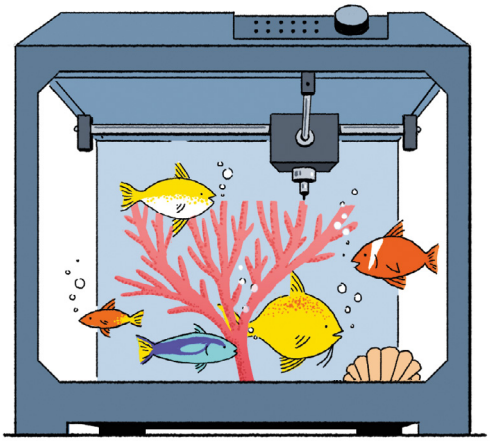
You can read more about the University's response on page 18 and at cam.ac.uk/topics/covid-19.

ILLUSTRATION: MICHAEL KIRKHAM

£20m alliance maps spread of Covid-19

The University of Cambridge is leading a major national effort to help understand and control Covid-19. The Covid-19 Genomics UK Consortium will deliver large-scale, rapid sequencing of the cause of the disease and share intelligence with hospitals, regional NHS centres and the government.

cam.ac.uk/20millionalliance



Deconstructed

Three into one as University's Boat Clubs join forces with one group for all

The University's boat clubs have voted overwhelmingly to form a single, high-performance rowing club for women, men and lightweight athletes to compete in the Boat Race against Oxford.

The Cambridge University Boat Club (CUBC) is a decisive step in the unification of the three original rowing clubs: CUBC, CUWBC and CULRC. They will also have a new digital home: cubc.org.uk.

The process began with a meeting convened by the Vice-Chancellor, Professor Stephen J Toope, together with senior representatives of the three boat clubs.

"Bringing our talented student athletes, staff and alumni together into a single organisation is a once in a generation opportunity," says new CUBC Chair elect Annamarie Phelps.

PHOTOGRAPHY: JAMES LEE

Three-minute Tripos

3D-PRINTED REEFS WILL SAVE THE PLANET. DISCUSS.

Isn't everything awful?
Quite a lot of things, yes. But nature is still nice, no?
Oh yes, nature. I must admit, I've been noticing how nice things like trees and grass and flowers are.
And white-sand beaches and coral reefs. Pictures of them on my computer screen, anyway.
But aren't coral reefs filed away in the Folder of the Doomed?
Not so! Researchers from Cambridge and California San Diego have created 3D-printed coral-inspired structures that can grow dense populations of microscopic algae.
Wow. So we 3D-print an entire reef? And stick it in the ocean?
Not quite. The structures won't replace coral. But they do have lots of applications. The team, led by Dr Daniel Wangpraseurt, a Marie Curie Fellow in the Department of Chemistry, has created Mantaz, a company that uses coral-inspired light-harvesting approaches to cultivate algae for bioproducts in developing countries.
How will that help?
Algae is great at offsetting CO_2 emissions, so anything that makes its production more efficient is A Good Thing. Those emissions are ultimately responsible for the coral reefs dying off in the first place.
That's like a symbiosis thing.
Exactly! Isn't it apt? In the ocean, corals and algae have an intricate symbiotic relationship. The coral is a host for the algae, while the algae provide sugars to the coral through photosynthesis. This relationship is responsible for one of the most diverse and productive ecosystems on Earth.
I'm off to go and look at coral. Pictures of it, anyway.

cam.ac.uk/3dprintedreefs

Mark IV radio echo set

At the Scott Polar Research Institute, today's cutting-edge equipment is tomorrow's exhibit – so long as it doesn't get lost in a cupboard for 60 years.

INTERVIEW **LUCY JOLIN** PHOTOGRAPHY **SCOTT POLAR RESEARCH INSTITUTE**

Antarctica, 1969. A group of men are strapping a blocky, metal contraption to the underside of a tiny plane. Back inside the plane, they connect the machine to an oscilloscope. Next, they set up a film camera. The whole scene has a makeshift feel to it, but make no mistake: this is the dawn of a new age of Antarctic exploration, the first time scientists will soar over the world's most inhospitable continent in an attempt to find out what is under its vast ice sheet. And that box – a Mark IV radio echo set – is what will enable them to do it.

As the plane flies over the frozen continent, the radio set transmits electromagnetic waves that pass through ice but bounce off solid rock. Using this technique (known as radio-echo sounding), they discover mountain ranges, valleys and lakes hidden under the ice – including the largest, Lake Vostok, at 250km long. But as technology advances, the Mark IV is unpacked back at the Scott Polar Research Institute (SPRI) and never packed up again.

"When Scott and Shackleton explored Antarctica, all they could do was walk across its surface. There was no sense of what lay underneath their feet," says SPRI curator, Charlotte Connelly.

In 1961, the Antarctic Treaty came into force. Twelve nations with an interest in the continent agreed to keep it for peaceful purposes, making possible collaborative science projects. That's when scientists from the SPRI created the radio-echo set and started flying over Antarctica and Greenland with it, working with colleagues from Denmark and the US military.

Between the project's end and the Mark IV's eventual resurfacing, nobody is quite sure what happened to the device: it was probably left in a cupboard.

"We're quite unusual in that we are an active research institute and we've got a museum, an archive, a picture library and a research library all in one building," says Connelly. "So you might put your everyday work kit in a drawer – and someone might find it in 20 or 30 years, and look at it with new eyes."

The Mark IV and the measurements it took are still vital to helping us understand how the continent is changing, she says. "And that's incredibly important to our climate-change modelling, and all those ongoing discussions. It's not the kind of science that you publish and forget about. It's a fundamental part of our record of what's happening in Antarctica."

To find out more, please visit: spri.cam.ac.uk.

100 years at the Scott Polar Research Institute

1920
The SPRI is founded in Cambridge as a memorial to Captain Robert Falcon Scott, RN, and his four companions.

1934
The Institute moves from rooms above the Sedgwick Museum to a new home, designed by Sir Herbert Baker, on Lensfield Road.

1960
The Ford Foundation enables the Institute to expand with new offices, laboratories, cold rooms and a lecture theatre.

1998
The Shackleton Memorial Library, named for Sir Ernest Shackleton and his son Sir Edward Shackleton, is opened.

2010
To commemorate the centenary of the Terra Nova expedition, the Institute's Polar Museum is refurbished and reopened.

2020
The SPRI celebrates its centenary looking forward to the future as a world leader in polar research, education and heritage.

Alumni Festival 2020

ILLUSTRATION **MICHAEL KIRKHAM**

The 30th Alumni Festival will be unlike any of the 29 Festivals that have preceded it. For the first time ever, the Festival will be completely digital, enabling you to join us, no matter where in the world you are located.

This September, let Cambridge's finest thinkers and researchers blow your mind at the University's first ever truly global Alumni Festival. Reimagined for the new normal, for the first time ever all events will take place online – enabling you to take part no matter where in the world you are located.

This will be the University's 30th Festival. In the three decades since the first festival, the world has changed beyond all recognition: the Cold War has ended, internet communication has changed our lives permanently, and society has become more connected and yet more fractured than ever before. And in the past three months, Covid-19 has radically altered everything we considered to be normal.

In this context, Cambridge thinking could not be more relevant. Festival speakers will address the biggest global issues, explaining how Cambridge research and thinking are helping to find solutions to global challenges.

Highlights include deep-dive exposure to the latest research from departments as diverse as the Cambridge Judge Business School and the Institute for Manufacturing. Participants will be able to find out how the Cambridge Zero team are harnessing the University's research and policy expertise to create a zero-carbon future and take part in a truly digital, truly global alternative to the ever-popular Come and Sing scratch choir.

This year's programme will be hosted entirely online and will take place 17-26 September. Booking opens on 13 August. Places for some events will be limited, so keep a lookout for updates on the website – and sign up for regular festival bulletin email updates at alumni.cam.ac.uk/festival.

The Alumni Festival will take place 17-26 September 2020.
alumni.cam.ac.uk/festival

Democracy is back. And thank goodness – because in challenging times we need more, not less, of it

David Runciman is Professor of Politics.

ILLUSTRATION **KATE COPELAND**

Remember democracy? Just six months ago the UK was full of it. We had a hotly contested general election along with furious argument – inside and outside parliament – about Brexit. Extinction Rebellion brought the politics of civil disobedience to the streets. There was an atmosphere of conflict and dissent. Disagreement was everywhere.

Today that seems like another age. Party divisions are stifled, experts are heeded and the atmosphere is one of baffled deference to authority. Parliament is a shadow of its former self. A fractured political society has been brought together by the experience of a common threat.

But I would argue that we should beware those who predict a permanent change. Contentious democracy will soon be back. Why? Because nothing about the political response to the pandemic has altered the forces that were driving growing democratic dissent. People were increasingly frustrated with representative institutions that many felt no longer spoke for them. This in turn reflected a growing sense that parts of the economy were being left behind and parts of society were being ignored.

Over the next few years, governments everywhere will have to make tough choices about who continues to get economic help and who is left to fend for themselves. There will be winners and losers. For now, with many of us still confined to our homes, we have all been getting the same message from the government. Soon we will start answering back. Under conditions of economic hardship, these arguments are likely to be even more ferocious.

At the same time, new technology is continuing to amplify our disagreements. The same platforms that give governments the ability to track our movements also give citizens the ability to voice their fury. The digital revolution has always pulled politics in both directions at once: towards more control and towards more contestation. The pandemic doesn't change that.

The social divides that have recently opened up in democratic politics are likely to widen over the coming years. The Brexit referendum revealed a nation deeply split by age and education. It was old vs young, graduates vs non-graduates. The economic fallout of the lockdown will do nothing to diminish these divisions. Educational and generational inequalities are being exacerbated. For now, many young people are happy to make sacrifices for the sake of older people. But, over time, they will want something in return. If they don't get it, anger will grow.

My feeling is that the Brexit years were just a warm-up for the political fights coming, which will be starker, because the stakes will be higher. In some ways, this should not worry us. It means that fears of a slide into authoritarianism are probably overblown. First, because authoritarian regimes are going to be facing the same pressures. And, second, because democratic publics are going to resist being pushed around. We won't find it hard to recognise we still live in a democracy.

The danger is that we try to deal with these challenges without reforming the institutions that have left so many people feeling ignored. What the past few years have shown is how hard it is to manage contentious democracy through traditional forms of democratic politics. Representative democracy was under strain because more and more voters wanted a direct say in the decisions that affected their lives. New forms of technology made that seem possible. Old systems of democracy made it seem futile.

The present crisis is an opportunity to try something new in our politics. We should not be afraid of deep democratic disagreement. But we should be wary of trying to manage that disagreement while stifling greater opportunities for political participation. More direct democracy, more local democracy, more workplace democracy, more deliberative democracy would all offer something different.

Democracy will only be the loser from this crisis if we think it can somehow stay the same when the world has changed.

David Runciman is Professor of Politics and the host of the Talking Politics podcast, which you can find at talkingpoliticspodcast.com.

Putting cake (and buns) on the table

Fitzbillies – the legendary Trumpington Street café – has been keeping Cambridge sweet for 100 years.

WORDS **HELENA POZNIAK** PHOTOGRAPHY **SAM A HARRIS**

Was it the Bakewell that clinched it? Fitzbillies was up for sale – and the tart was the finishing touch to the bid of a couple desperate to buy the beloved Cambridge purveyor of buns and nostalgia. The previous owners had gone bankrupt and marketing executive Alison Wright couldn't bear to give up on a place that had supplied the best cakes of her childhood.

But first she had to convince the landlords – Pembroke – that she could be a worthy custodian of a landmark that has weathered war, rationing, fire and hardship. And so, in her final pitch, she baked the Bursar a monumental tart to accompany her meticulous business plan.

"I guess it was a metaphor," she says. "Bakewell is a tart that can easily be rendered cloying and horrible. But recreate it with short, buttery pastry, moist frangipane and fresh raspberries and you have something exquisite – the best of the traditional and the new."

It worked. Pembroke's team was won over by Wright's passion for baking and her husband, Tim Hayward's, conviction they could take the cake shop into the 21st century without trampling on tradition.

Nine years later, Fitzbillies is celebrating its centenary, and, while the humble cake shop has come a long way, it has retained the distinctive shop front and Trumpington Street location, a favourite stopping-off point for students en route to lectures. More scandalously, courgette muffins and brownies now sit alongside the scones and Chelsea buns, and of course it serves coffee of a quality that no 20th-century, postwar-austerity student would recognise.

Fitzbillies opened its doors on 4 October 1920. It was founded by brothers Ernest and Arthur Mason (their names are still visible on the ›


52 Fitzbillies. 52
52A
NEW!
Fitzbillies
BRE
CAKES
FRESH
BAKERY
.MASON.
.MASON

shop front) who wanted to put their demob money to good use. A huge brick oven and bakery took up most of the backyard, and the family lived above the business. (Today these serve as lodgings for students, who are some of the café's best customers.)

It is thought that the brothers intended to call their shop Fitzwilliam's, after the museum, which is just across the road. No one knows why they didn't. One theory posits that the Fitzwilliam refused permission, and another that there was already a Fitzwilliam bakery in Ireland. It is certainly true that the motto of Fitzwilliam College's rowing crew was, and remains, 'For Fitzbilly pride'. But the most amusing explanation – supplied by the Fitzwilliam Museum's historian – is that it's named after the two illegitimate sons, Fitz and Billie, of the Museum's benefactor, Viscount Fitzwilliam of Merrion. What we do know is that the café flourished, with the brothers Mason serving up a range of no-nonsense cakes and savouries, and providing a rich seam of undergraduate memories.

Dr John C Taylor (Corpus 1956), now 83, remembers how Fitzbillies gave a helping hand to dating and romance. In 1950s Cambridge, a combination of rationing, compulsory meals in College, and a lack of affordable cafés and restaurants, made their cakes an even more desirable treat. "Like all undergraduates, I ate three square meals in College. Tinned sardines were often on the menu. My women friends – who were vastly outnumbered by us men – were partial to a fondant fancy, so a trip to Fitzbillies was certainly the way to impress," he says.

Chelsea buns were already part of Fitzbillies' mystique. Writing in *The Observer Guide to British Cookery* in 1984, food writer Jane Grigson (Newnham 1946) vividly recalled the anticipation involved. "The most anxious queues I ever joined were outside Fitzbillies," she wrote. "No undergraduate tea party was complete without their Chelsea buns, syrupy, well-spiced, licentious and exceptional during the years of ersatz cakes and shortages."

In 1958, the Masons sold Fitzbillies to Garth Day, the son of a local baker; in 1980, the Days sold to Clive and Julia Pledger, who expanded with an in-store shop at the now-defunct Eaden Lilley department store, and a mail-order chocolate business. In 1991 Penny Thompson, a customer of 20 years, took over, opening a tea room on the first floor.

And so it went on – the buns, the fondant fancies, the sausage rolls, until a fateful morning in December 1998, as long-time Fitzbillies baker Gill Abbs recalls. "That morning I tried to walk to work but every street was closed. I knew something was wrong," she says. When she arrived, she saw a blaze ripping through the building. "It was just before Christmas. It left everything completely black and destroyed."

Bunmongers

Left: Gill Abbs, head baker (cakes), joined Fitzbillies in 1971 and is the keeper of the Chelsea bun recipe. **Above left:** Paul White, head baker (bread), has reintroduced bread to the Fitzbillies menu. **Above right:** the boss, Alison Wright.

I ate three square meals in College. Tinned sardines were often on the menu. My women friends were partial to a fondant fancy, so a trip to Fitzbillies was the way to impress

The fire was reported in the national press and lamented by alumni around the world. Arson was suspected and the shop took nearly two years to rebuild.

Happily, Fitzbillies survived, ensuring Chelsea buns continue to count as a basic food group for many undergraduates. However, when Wright took ownership, she realised that something vital was missing – the recipe for those buns that had lured students and dons in their droves.

Wright's own father, James Wright (St John's 1961), recalls students waiting like gannets for the off-cuts of Chelsea buns. "We'd queue around the shop counters – there was no café then – and outside in the street in an orderly fashion. Then the door at the back would open, and down the steps would walk a baker carrying a tray of bun bits. It was a tense moment. These were particularly gooey and syrupy – it was a great prize if you could be there at the right time."

But there was no written recipe for the buns. Rather, Gill Abbs, who has presided over their production for 49 years, had it in her head. Luckily, she was happy to share with the new owners, who hired her pretty much on the spot. "It's a recipe that doesn't really belong to me, it belongs to Fitzbillies," says Abbs.

So how exactly does she do it? Despite having made more than five million buns in her working life, Abbs's day still starts at 4am, when she comes in to oversee trays of enriched bun dough as they are flattened, spread with butter and fruit, and rolled up tight. Once cooked, a "spectacular" amount of syrup is ladled over – and buns are then placed face down in more syrup, ready to serve. This isn't any old syrup, says Abbs – it's made by a small-scale UK producer Ragus ('sugar' backwards) almost exclusively for Fitzbillies. "It's somewhere ›

Fitzbillies: The Book

Fitzbillies: Stories and Recipes from a 100-year-old Cambridge Bakery by Alison Wright and Tim Hayward, featuring photographs by Sam A Harris, is published by Quadrille.
To win a copy, enter CAM's prize crossword on page 47.

The door at the back would open, and down the steps would walk a baker carrying a tray of bun bits. It was a tense moment. The bits were particularly gooey and syrupy and were a great prize – if you could be there at the right time

between golden syrup and treacle, just the right thickness," says Wright. In an average year, they'll make some 160,000 Chelsea buns; Abbs bakes or supervises most of them, judging by eye how to cut them.

University towns run on cake, says Wright's husband, food writer Tim Hayward. "Before the food renaissance hit the city, anyone wanting to eat something that wasn't brought to a 100ft-long oak table had to go to a pub for a pie or sandwich or to a bakery for a bun."

Cake shops and cafés have their own daily and annual rhythm, observes Wright. There's the pre-lecture rush, the mid-morning break for academics and tradespeople, and 'scone o'clock', when cream teas are in high demand.

Front-of-house veteran Kirsty Chapman says she can sniff the air and predict if it's going to be busy indoors or whether sun-seeking customers will want a takeaway. Fitzbillies has its own unique calendar: the flurry of freshers' week, the mince-pie marathon that is Christmas (King's choristers are amply supplied), vegan demand during January segueing into treats for Valentine's and Mother's Day. Easter leads into the exam-driven hunger of cramming students, then to May Week when fondant fancies are in demand at garden parties – and after that, of course, says Wright, it's wedding cake season.

But by far her favourite time – and this makes her a little tearful – is the alumni weekend at the end of September. "It's so lovely to meet people returning and telling us about their fond memories – whether they left in the 1950s or last year."

New visitors appreciate vegan and gluten-free choices, which might have the original owners turning in their graves. But if there's one thing Abbs and the current owners aren't quite in harmony over, it's lardy cake – older customers are still shocked by its absence from the menu. "We used to make it from the bun dough – add more dried fruit and fold in lard and brown sugar, roll it in thick syrup, tip it over and caramelise it," says Abbs. "It was a lovely thing to eat, but the public don't want it. You do have to move with the times."

Share your Fitzbillies memories: cameditor@alumni.cam.ac.uk.

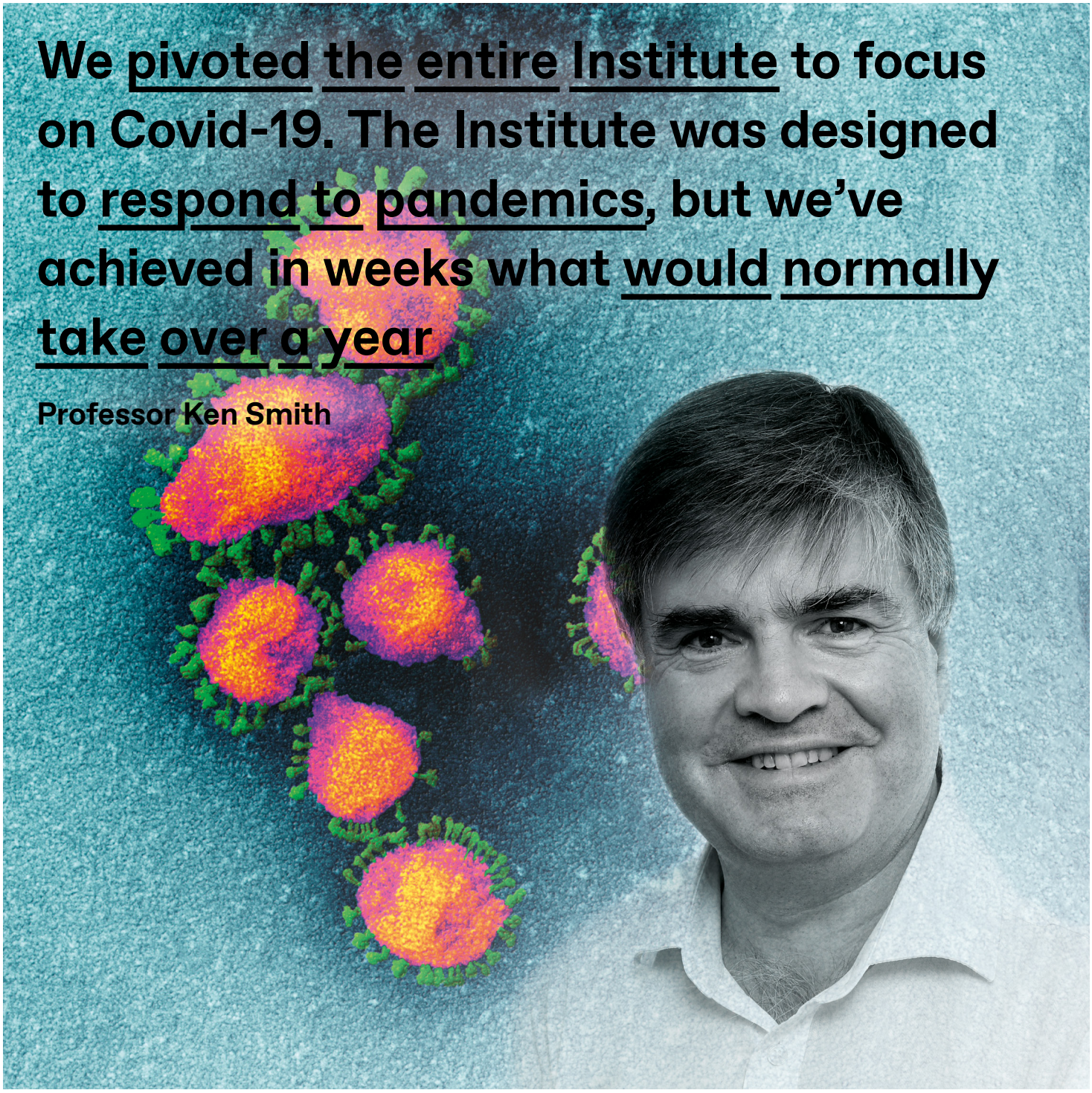
On 18 March, the Vice-Chancellor, Professor Stephen J Toope, announced that the University was moving into the red phase response to the Covid-19 pandemic. "We will need all the fortitude, resilience and generosity of our community to get us through," he said. "I am confident that this crisis will bring out the best in all of us." Across the University, world-leading experts from immunology to engineering have proved him right, as they focus their energies and talents on tackling the Covid-19 pandemic.

WORDS **PAMELA EVANS**

The response was led by the Cambridge Institute of Therapeutic Immunology and Infectious Disease (CITIID), one of the University's newest institutes – it opened at the end of last year.

"When it was clear that there was going to be a lockdown, we decided to pivot the entire Institute to focus on Covid-19 research," says CITIID's Director, Professor Ken Smith. "All the groups in CITIID work at the interface between pathogens and the immune system, and indeed the Institute was designed to respond to pandemics. But what we've achieved within weeks would have taken over a year in a normal situation. And that's down to incredible collaboration with Addenbrooke's [part of the Cambridge University Hospitals NHS Foundation Trust] plus the Cambridge Biomedical Research Centre. And we have been humbled by unflagging support throughout the pandemic from volunteers, from across the University, whether scientists helping with laboratory research or couriering blood samples or senior technicians volunteering as cleaners."

CITIID is home to the UK's largest academic microbiological Containment Level 3 facility and 150 scientists and clinicians. It works with a range of collaborators from across the UK and beyond. It is integrated with the NHS both locally, through



We pivoted the entire Institute to focus on Covid-19. The Institute was designed to respond to pandemics, but we've achieved in weeks what would normally take over a year

Professor Ken Smith

Professor Ken Smith

As Director of the Cambridge Institute of Therapeutic Immunology and Infectious Disease, Professor Smith has had an intense few months – but the team's work is already having an impact on the national and international response to Covid-19.

Eye of Science/Science Photo Library

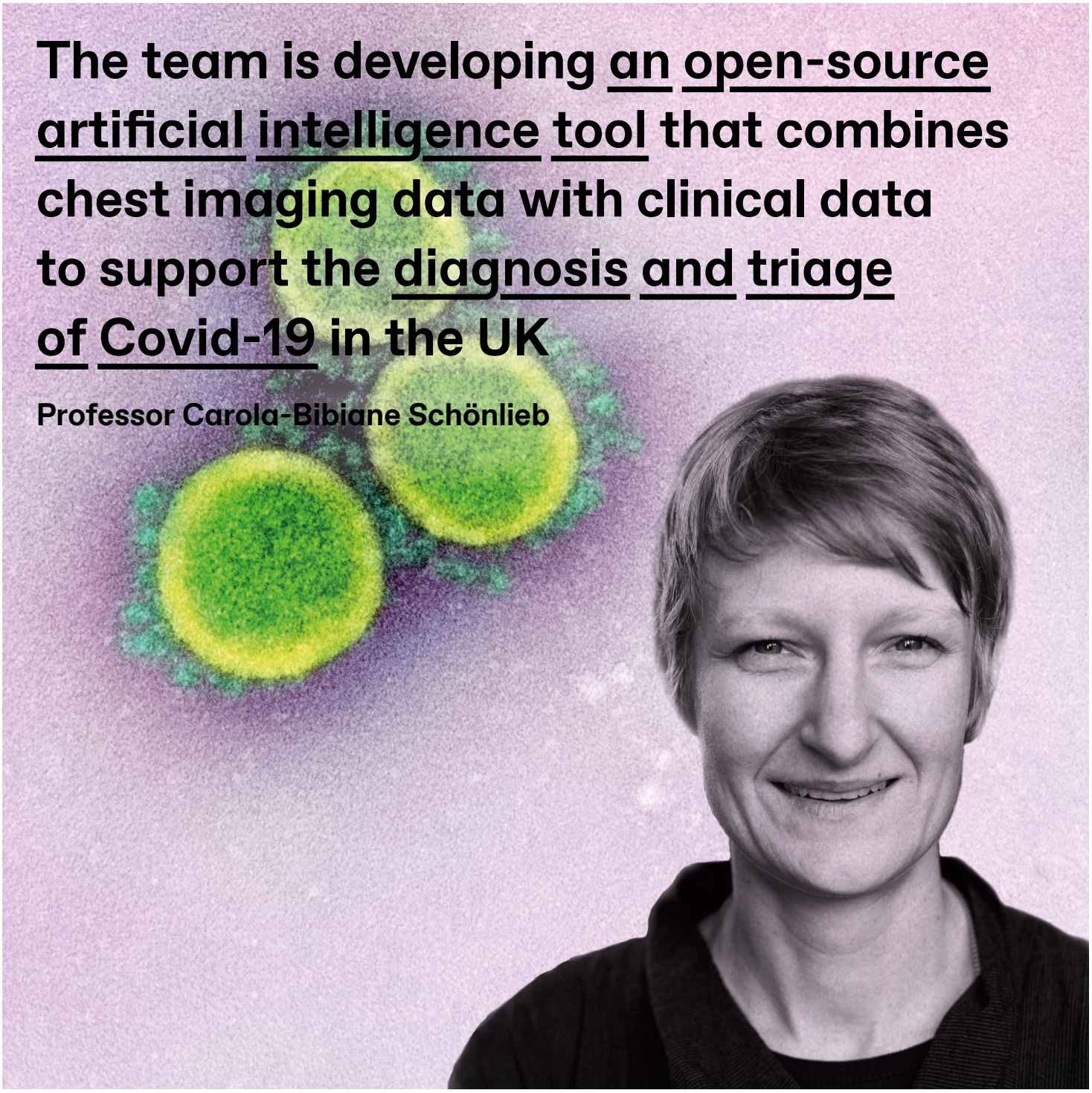
Addenbrooke's and the Royal Papworth Hospital, and, nationally, in particular through the National Institute for Health Research (NIHR).

The team knew the initial response had to focus on staff on the frontline, and that testing both patients and healthcare workers would be key. Medical researcher Dr Helen Lee developed the technology behind the SAMBA II machine while working at the haematology department in Cambridge. Originally intended for HIV testing in Africa, her spinout company, Diagnostics for the Real World, rapidly adapted it for Covid-19. Meanwhile, Professor Ravi Gupta of CITIID led the first validation study. The machine is now being used extensively at Addenbrooke's, and more widely in the NHS. "It gives a result in minutes to an hour, which means you can make rapid decisions," says Smith. "This allows patients to be sent quickly to the appropriate wards, speeding up medical care and reducing the chance of virus transmission. That has been a game-changer."

Another approach is a polymerase chain reaction (PCR) test, modified by Dr Martin Curran. This test allows scientists to extract a minuscule amount of RNA from the virus and copy it millions of times, creating an amount large enough to confirm presence of the virus. However, because the virus itself is infectious, ›

The team is developing an open-source artificial intelligence tool that combines chest imaging data with clinical data to support the diagnosis and triage of Covid-19 in the UK

Professor Carola-Bibiane Schönlieb



Professor Carola-Bibiane Schönlieb

Applied mathematician Professor Schönlieb's project will process and analyse complex, multi-stream patient data such as imaging, clinical information and laboratory results. The team has already begun receiving large imaging and clinical datasets from Austria, China, Italy and the UK.

NIAD/National Institutes of Health/Science Photo Library

samples have to be carefully processed. Understandably, the safety requirements slow down the testing process. In response, Professor Stephen Baker has been working on augmenting both capacity and speed of testing. His team at CITIID have used a method of inactivating the virus at the point of sampling. This means that tests can now be processed in Containment Level 2 facilities, which are more widely available and have fewer restrictions on their use. Their method is based on previous work led by Professor Ian Goodfellow and colleagues in the Department of Pathology. From initial nasal swab to result, the entire process takes just four hours. This enabled the team, working with academic infectious diseases physician Dr Michael Weekes, to begin screening healthcare workers at Addenbrooke's Hospital for Sars-CoV-2. Initially three per cent of working hospital staff tested positive, but after six weeks of screening this has been reduced to fewer than one in 1,000.

The University, in partnership with AstraZeneca and GSK, has also risen to the UK government's challenge to provide sustainable testing capacity for Covid-19. A new state-of-the-art laboratory has been set up in a matter of weeks at the University's Anne McLaren Building, which uses advanced automation to deliver tests at rapid scale and pace. It was an enormous undertaking that involved

everything from recruiting and training staff to bringing in equipment and setting up scientific protocols. At maximum capacity, the lab can run tens of thousands of tests a day to contribute to the national effort to tackle Covid-19.

Testing for antibodies, to see if people have had the virus, will also be crucial to future efforts to control the disease. At CITIID, teams are assessing commercially available serology tests alongside ones produced by the Institute and its collaborators. These will be moving in-clinic "very soon", says Smith. "These tests are important in that they tell us who has been exposed, and potentially whether you have protective immunity or not. We know we can measure antibodies in the blood. What we don't know yet is whether or not they kill the virus and provide immunity, or how long this protection will last. All the serum that we and others are collecting around the country is being used to try to answer those questions."

Patient trials enabling researchers to learn more about the disease and possible therapies are now up and running. While most people recover from Covid-19, a proportion experience an unusually aggressive inflammatory response. This drives damage to the lungs and other organs, which can be fatal. If we understand more about why some have this response and some don't, we could use targeted therapies to reduce inflammation more effectively, says Smith. "So we have started recruiting patients with different degrees of severity of Covid-19, from asymptomatic patients all the way through to patients in intensive care and on ventilators. We have recruited 250 patients and are now doing immune analyses to compare the stages of disease." The Institute's Professor David Jayne has also set up a national trial currently under way to compare the effects of two drugs, Ravulizumab and Baricitinib.

This is a cross- and multi-disciplinary response. Carola-Bibiane Schönlieb, Professor of Applied Mathematics and Head of the Cambridge Image Analysis (CIA) group, and Evis Sala, Professor of Oncological Imaging, are leading a team developing an open-source artificial intelligence tool that combines chest imaging data and clinical data to support diagnosis and triage of Covid-19 in the UK. The project will process and analyse complex, multi-stream patient data such as imaging, clinical information and laboratory results. The team has already begun receiving large imaging and clinical datasets from Austria, China, Italy and the UK.

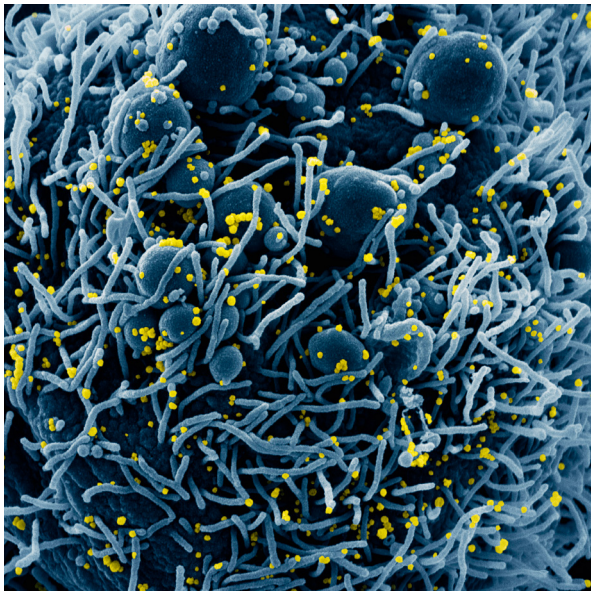
AI is also being used to help decision-making at a hospital-wide level. Using anonymised data from Public Health England, Mihaela van der Schaar, the John Humphrey Plummer Professor of Machine Learning, Artificial Intelligence and Medicine, has built a working proof of concept that demonstrates the potential use of machine learning in helping to manage scarce resources like ICU beds and ventilators – although, she emphasises, the decisions will still be made by healthcare professionals on the basis of their organisation's priorities and policies.

"Among other things, we wanted to demonstrate that machine learning techniques can accurately predict how Covid-19 will impact resource needs – such as ventilators and ICU beds – at a patient and a hospital level, thereby giving a reliable picture of future resource usage and enabling healthcare professionals to make well-informed decisions about how these scarce resources can be used to achieve the maximum benefit," she says. "Based on the data we received from Public Health England, we now have a proof-of-concept demonstrator showing that this can be done, in the form of a new system we call Adjutorium. Once trained with patient data, Adjutorium was able to make highly accurate predictions about the patients whose data we used for verification."

Of course, Covid-19 is just the latest in a string of pandemics: A(H1N1) influenza being the most recent prior to the current one. Repurposing knowledge from past pandemics has been crucial to understanding how the novel coronavirus behaves. In 2018 Julia Gog, Professor of Mathematical Biology (DAMTP), and her team were behind the UK's largest citizen science experiment in collaboration with the BBC, using location data from mobile phones to map how pandemic influenza might spread across the UK. Now, she and other members of her research group have been modelling and mapping the spread of Covid-19, using knowledge gleaned from the BBC project to work out how to reduce the number of people an infected person infects – the reproductive ratio, or R.

"Public health experts have been saying for decades that when it comes to pandemic flu, it wasn't a matter of 'if', it was a matter of 'when'," says Gog. "And now that this coronavirus pandemic is here and things are changing every day, we've got to get information out there quickly, but make sure that it's useful information that can help inform good policy."

Understanding the mechanics of the virus will be crucial to finding effective treatments. Like other dangerous viruses such as Zika, Ebola and influenza, ›



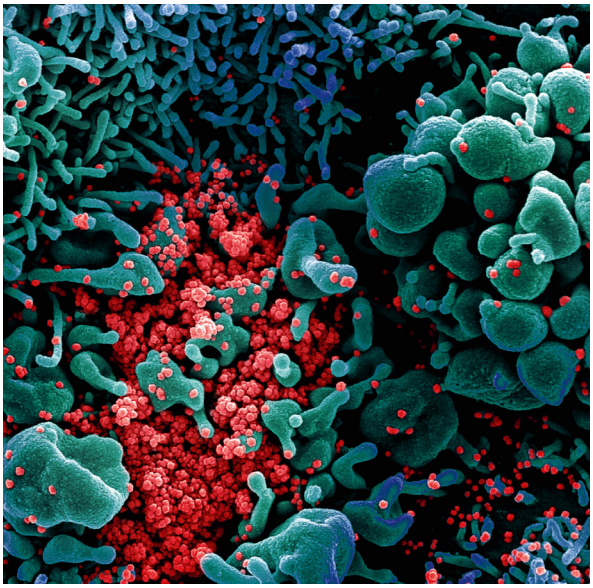
Under the microscope

Coloured scanning electron micrograph of Sars-CoV-2 coronavirus particles (yellow) on an apoptotic cell (blue) from a US patient sample. Sars-CoV-2 is an enveloped RNA (ribonucleic acid) virus that causes respiratory infection that can lead to fatal pneumonia.

NIAD/National Institutes of Health/Science Photo Library

You look at the diversity in the genome and try to wind the clock back: what are the mutations, when did they occur? Where did this strain emerge and how does it fit into the UK pattern?

Dr Charlotte Houldcroft



Under attack

This coloured scanning electron micrograph shows Sars-CoV-2 coronavirus particles (red) emerging from a heavily infected apoptotic cell (blue) from a US patient sample.

NIAD/National Institutes of Health/Science Photo Library

the Covid-19 virus's genome is made of RNA (rather than DNA), which means it has a higher rate of mutation. However, counterintuitively, this could work against the success of the virus, rather than for it.

"Dependencies that arise from unusual biology may serve as chinks in the virus's armour," says Professor Gerard Evan, Head of the Department of Biochemistry. Several teams in the Department of Biochemistry are studying exactly what those chinks might be: Professor Ben Luisi's group, for example, is targeting a specific structured RNA element in the Covid-19 genome that is also found in Sars, Mers and other coronaviruses. It's not known how this element affects the virus lifecycle – but the fact that it's present in all these viruses suggests it plays a fundamental role.

The University is also taking a leading role in the Covid-19 Genomics UK (COG-UK) Consortium, led by Sharon Peacock, who is Professor of Public Health and Microbiology at the University and Director of the National Infection Service for Public Health England. Comprising the NHS, public health agencies, the Wellcome Sanger Institute and numerous academic institutions, the £20m project enables large-scale, rapid sequencing of the disease and the sharing of intelligence with hospitals, regional NHS centres and the government.

Samples from patients with confirmed cases of Covid-19 will be sent to a network of sequencing centres across the UK. The University, together with the Wellcome Sanger Institute, will co-ordinate the collaboration between expert groups to analyse the genetic code of Covid-19 samples circulating in the UK. That will give public health agencies and clinicians a unique tool to combat the virus.

By looking at the whole virus genome in people who have had confirmed Covid-19, scientists can monitor changes in the virus at a national scale to understand how the virus is spreading and whether different strains are emerging. This will help clinical care of patients and save lives. "This virus is one of the biggest threats our nation has faced in recent times and crucial to helping us fight it is understanding how it is spreading," says Peacock. "Harnessing innovative genome technologies will help us tease apart the complex picture of coronavirus spread in the UK, and rapidly evaluate ways to reduce the impact of this disease on our society."

Virus evolution researcher Dr Charlotte Houldcroft is on the frontline of the sequencing effort. She works in a tent inside a lab on the Cambridge Biomedical Campus as part of a team led by Professor Ian Goodfellow. The lab can sequence the genomes of between 24 and 70 virus samples a day.

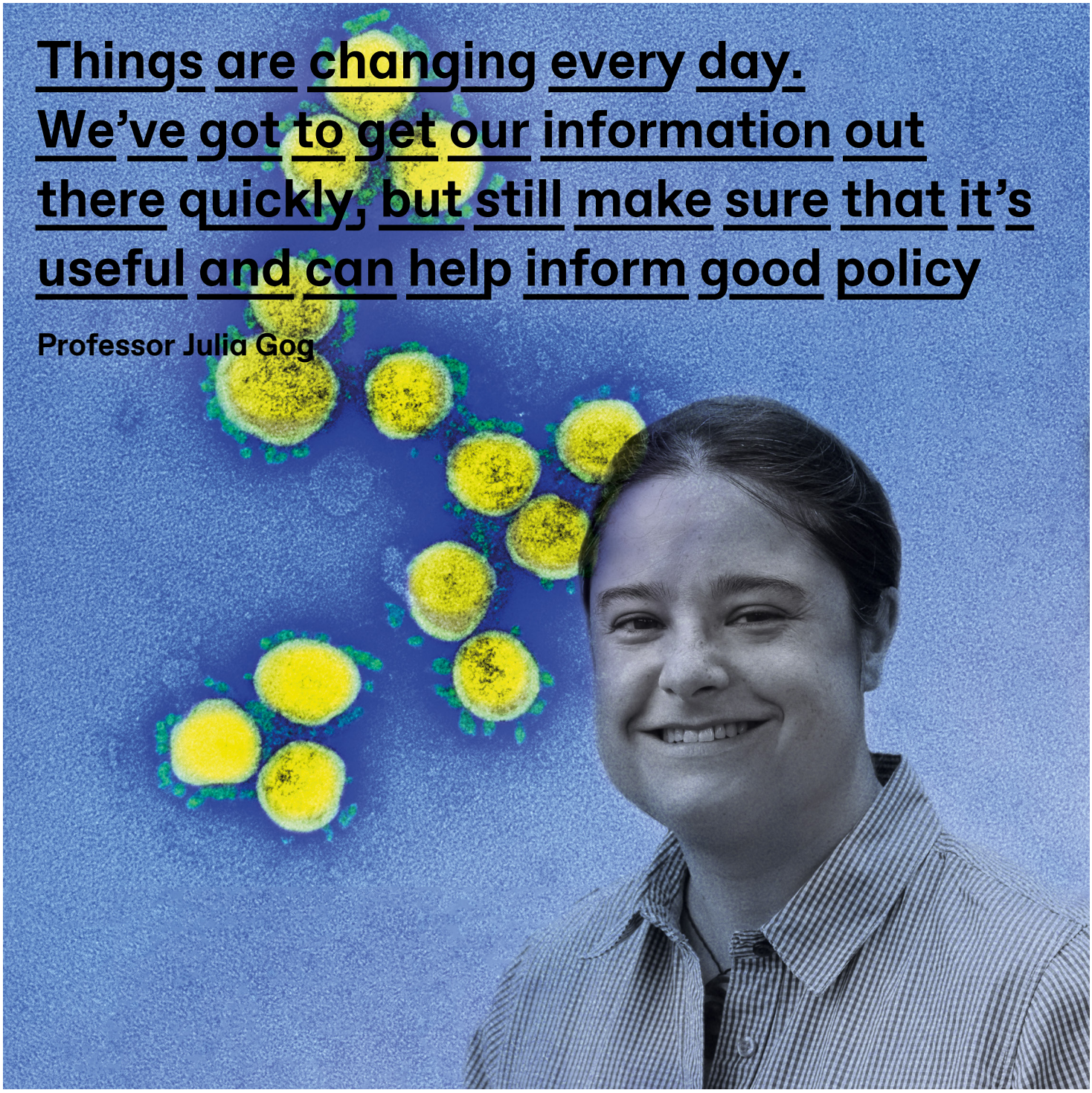
"You look at the diversity in the genome and try to wind the clock back: working out what are mutations, when they occurred, and so where this strain emerged and how it fits into the UK pattern," says Houldcroft. "Some of the first samples of the virus in the UK – the Chinese visitors in York and the cluster in Brighton – are not related that closely to anything we're seeing in the country now. It suggests the tracking and tracing at the beginning worked. It was not until it started to spread across Europe and the US that we get multiple introductions across the UK. Virus clusters in Wales, for example, had contributions from all over the world. There's not a single Welsh strain."

At the Department of Engineering, engineers are using modelling tools originally designed to improve the efficiency of factories to help Addenbrooke's Hospital manage the Covid-19 emergency. "It's looking at the physical flow of patients and projecting admissions rates into the future – identifying where 'bottlenecks' might occur, and where the hospital might need to scale up beds, ventilators, oxygen and staff as part of their Covid-19-orientated activities," says Dr Ajith Parlikad at the Institute for Manufacturing.

Modelling will also help the hospital better understand staffing levels during disruptions such as the Covid-19 outbreak. "With close input from the hospital,

Things are changing every day. We've got to get our information out there quickly, but still make sure that it's useful and can help inform good policy

Professor Julia Gog



Professor Julia Gog

In 2018, Mathematician Professor Julia Gog worked with the BBC to conduct the UK's largest citizen science experiment, using location data from mobile phones to map how pandemic influenza might spread. Now, using that data, she has been mapping the spread of Covid-19 to work out how to reduce the number of people one infected person goes on to infect.

NIAD/National Institutes of Health/Science Photo Library

we've been able to pick from a series of industrial techniques and apply the most useful ones to this new setting," says Duncan McFarlane, Professor of Industrial Information Engineering. "Instead of production lines, we're now looking at hospital wards, and, rather than products or raw materials, we are examining the flow of patients and supplies."

But while understanding Covid-19 and all its ramifications is just beginning, Smith is already looking to the future. "Our long-term strategy cannot be anti-inflammatories for severe disease because you have to stop it getting to that stage. It's either going to be vaccines or anti-viral drugs. We have put a lot of resource into seeking these longer-term solutions.

"There are hundreds of known coronaviruses, and Sars-CoV-2 is the third new one to cross into humans in less than 20 years. So this is not going to stop – these things will keep coming. And we are planning to come out of our work on this pandemic with a much better foundation in place to support a rapid research response to the next one."

To find out more please visit: philanthropy.cam.ac.uk/covid-19-research.

THRILL OF THE NEW: TAKING DRUGS DURING THE REIGN OF LOUIS QUATORZE

WORDS **DR EMMA SPARY**

What is a drug? In 17th-century France – and at the risk of disappointing modern readers – a drug was any material substance that packed a powerful punch in a small volume.

That could be a cutting-edge medicine or narcotic, but it could also be a spice or flavouring. Paints, dyes and varnishes were counted as drugs, as were chemicals in cleaning products, or materials with some innate power, like magnetic iron ore.

All these natural substances were sold in small volumes, at relatively high prices, and were available from specialist shops run by the wealthy grocers or apothecaries who could afford to buy materials that often had to be transported over long distances to city shops in Europe.

And as European cities expanded and prospered, so early modern merchants were increasingly able to invest in expensive foreign drugs. Couple this with the emergence of the first European global empires, in the 16th and 17th centuries, and you get the conditions that drove Europeans to bioprospect in distant parts of the world for new drugs that might be commodified for use back home.

One of the most expensive and mysterious drugs, rhubarb, was transported on camelback over vast distances by merchant networks spanning the globe. The best quality rhubarb was known to come from Bhutan, but one traveller, Tavernier, reported to King Louis XIV that it couldn't be transported to Europe, "because of the monsoons all along the way; humidity is the enemy of Rhubarb ... You can surely imagine the number of rivers that has to be crossed between the Kingdom of Bhutan ... and France".

Rhubarb fetched an exorbitant price because of these transportation difficulties, even while the development of maritime technology in the decades around 1700 ensured that some other distant drugs were coming more within European grasp, particularly those from the Americas. But certain drugs, among them rhubarb and vanilla, would remain a mystery Europe-wide until well into the 18th century, despite much speculation about the plants from which they came. Given this mystery, ›

Opposite

Vanilla plant. Image from *The natural history of Carolina, Florida and the Bahama Islands, Vol. 2*, published in 1734, courtesy of the Biodiversity Heritage Library. Contributed by Smithsonian Libraries.

VIGNETTE: BNF

Louis XIV took a personal interest in the promotion of new drugs and those who could supply them, even venturing to conduct research in his own right. And when a drug became fashionable at court, it prompted a cascade of consumption as courtiers vied with one another to acquire and use it

how did people in the decades around 1700 find out about drugs, and what did they know? How was demand created and how was it satisfied?

Monarchs could be important patrons, boosting the reputation of drugs by using them or by funding – or hiring – drugs entrepreneurs who could provide a supply of them, as well as experimenters who could put them to use. An early example here is Philip II of Spain who, a century earlier, hired Italian, German and Flemish experimenters and gardeners to transform the royal palace and gardens of Aranjuez into a vast site where plant materials could be processed into distilled waters and essential oils, then supplied to druggists' shops around his vast realm, from the Southern Netherlands, Milan, Naples and Sicily, to colonial outposts in Africa, the Americas and the Far East. Like Philip, the French monarch Louis XIV presided over an empire, and took a personal interest in the promotion of new drugs and those who could supply them, even venturing to conduct research in his own right. And when a drug became fashionable at court, it prompted a cascade of consumption as courtiers vied with one another to acquire and use it.

Such projects tended to be attached to the personal interests of one monarch, so there were separate processes at play in creating a single system for researching new drugs, and creating sustained public demand for them. On the sidelines of court life, people like Pierre Pomet, the Paris druggist, were busy keenly observing and collecting drugs, as well as selling them.

Pomet used his knowledge both to increase his ability to detect the useful properties of drugs and to try to find out about the species from which they came. This was especially important since, as botanists were fond of pointing out to their students, two plants might look alike but have completely opposite effects: death or cure. Pomet published his findings in a huge compendium that was intended to serve as a guide for readers wanting to avoid being palmed off with a substitute drug.

But this task was far from easy. In the case of distant exotic drugs such as rhubarb, myriad problems beset the researcher who wanted to identify the link between the plant and the traded good. What Europeans could actually buy in shops was only part of the plant: dried slices of root, crumbling brown leaves or seeds. Correlating these inchoate brown or grey masses with living plants can defy even today's most knowledgeable botanists when studying unlabelled drug collections; in the 17th century, when the living plant was both unavailable and entirely unknown, botanists went ›

Opposite

Ginseng plant. Image from *The natural history of Carolina, Florida and the Bahama Islands, Vol. 2*, published in 1734, courtesy of the Biodiversity Heritage Library. Contributed by Smithsonian Libraries.

Still more burning is the question: what was it like to try an entirely new substance for the first time? What made someone trust that new substance, and what packaging, information, recommendation could encourage that first step?

Opposite

Cacao tree. Image from *The natural history of Carolina, Florida and the Bahama Islands, Vol. 2*, published in 1734, courtesy of the Biodiversity Heritage Library. Contributed by Smithsonian Libraries.

to extraordinary lengths to source plants and then compare them with the shop-bought drug.

Similar difficulties were associated with ginseng, for example. Many forms were in circulation in commerce worldwide, for this drug, favoured at the Chinese court, was also consumed across the Far East, in Japan, Korea, and what is now Thailand. But it was exceptionally rare for Europeans even to own specimens because the Chinese Imperial troops kept close guard over the plant's habitat in Tartary. So those who tried to identify the plant in Europe often ended up describing one or another of the substitute drugs bought and sold outside China.

Plant drugs filtered into European societies through a vast number of different possible routes. Sometimes they were not even brought in *as* drugs, but rather as curiosities: passed around groups of scholars and potentially tested on oneself and one's family or friends, before being put on to a shelf for display. In other cases, they might arrive at court as tributes: diplomatic gifts from foreign rulers or visitors eager to curry favour with the monarch.

And alongside all this more visible and ostentatious activity, there was also the invisible host of exchanges that went on between private individuals, travellers and traders in contact with distant parts of the world. Drugs and drug plants voyaged unrecorded on slave ships, or survived on a plantation somewhere as horticultural curiosities, for decades – all unbeknownst to metropolitan ministers and botanists. Many of these specimens demanded considerable cultivatory skill, and, until greenhouses reached Paris soon after 1700, most tropical plants brought to France perished in the winter cold.

To construct an image of how drugs travelled, where they went and what people learned about them requires an examination of a wide variety of different source materials. Correspondence between private individuals attests to the extent of individual trialling going on. For example, the theologian Nicolas Toinard's first taste of tea came in 1679 when he met the publisher Daniel Elzevir (from the family firm of Elsevier, whose namesake is still in business today). Noting its effects as an appetite enhancer in a letter to the English doctor, John Locke, Toinard added: "I wouldn't have believed it if I hadn't trialled it on myself."

The notion of thinking through the process that made it possible for someone like Toinard to sample an entirely new plant drug originally grown thousands of miles away in China has been a fruitful one for our project. Still more burning is the obvious question, "But what was it *like*?" To contemplate the experience of a person who, for the first time, tries out an entirely new substance is to reflect on an act that we ourselves still undertake. For example, there was a time before most of us had ever tasted açai berries or quinoa, say. But what makes someone trust an entirely new substance, and which formats (of packaging, information, recommendations) 'work' to encourage that first step?

Our society today has a framework for apprehending novelty that is more than two centuries old. But in the 17th century, newspapers and advertising were also new. 'Drugs' had not yet split into foods, medicines and 'chemicals', and there was minimal scientific or medical oversight and testing of these potent substances for safety: no clinical trials, limited botanical expertise, and few regulations surrounding the food supply. To look at the situation in 1700 is to take on board just how far modern consumption of food and medicines has been structured by the need to respond to new plants.

This piece draws on Dr Spary's Leverhulme-funded research project,* Selling the Exotic in Paris and Versailles, 1660-1730, *on which she worked as principal investigator, alongside a team that included two postdoctoral research associates and a PhD student.

Of greatest benefit to humankind

You may be able to buy them for a couple of quid at your local corner shop, but the humble battery could be key to solving the climate emergency.

WORDS **HELENA POZNIAK** PHOTOGRAPHY **SARA LUCAS AGUTOLI**

They're hidden inside our everyday gadgets and cost just a few pounds at the local supermarket. Mostly, we only think about them when they run down or pack up. Yet they keep us connected to each other and the wider world and move us around every day. Last year, they won three key creators a Nobel prize. And, by 2050, they might just save the planet.

Welcome to the awesome power of the humble battery. Indeed, when Stanley Whittingham, John Goodenough and Akira Yoshino were jointly awarded the Nobel prize for Chemistry for their work on lithium-ion batteries, the citation was clear. The three had done nothing less than "created the right conditions for a wireless and fossil fuel-free society, and so brought the greatest benefit to humankind".

But despite their impact, battery technology is based on some fairly well-established principles. "Because the chemistry has been around for more than 200 years, people may think that batteries are not particularly exciting," laughs Professor Clare Grey, who heads the Todd-Hamied Laboratory, dedicated to developing the next generation of batteries and fuel cells.

In fact, while the Nobel-winning trio's lithium-ion battery may have 'created the right conditions' for remarkable change, it will be up to the current crop of researchers – like Grey and her team, and Manish Chhowalla, Goldsmiths' Professor of Materials Science – to deliver on the promise of the battery's potential, exploring innovative battery concepts that have the potential to be as transformative as the original lithium-ion breakthrough. ›

Voltaic pile

The fundamental principle of battery power was demonstrated in 1800 by Alessandro Volta, who proved that the generation of electricity was a *chemical* process. Every schoolchild still gets to experience Volta's insight for themselves when they stick a zinc-plated screw into a potato and wire it up to a copper penny – electrons flow from the positive copper cathode, through the potato, to the negative zinc anode, creating an electrochemical cell with enough energy to illuminate a bulb.

Batteries are a hot area, because they represent a short-term goal to address the CO_2 problem. Can they also be a long-term solution?

Gravity cell

The Daniell cell, invented in 1836 by John Frederic Daniell consists of a copper pot filled with a copper sulphate solution, into which is immersed an unglazed earthenware container filler with sulfuric acid and a zinc electrode. At some point during the 1860s, this design was improved on by a Monsieur Callaud with the creation of the gravity cell (right). Callaud placed a copper electrode at the bottom of a glass jar and then suspended a zinc anode at the top. He then placed copper sulphate around the electrode and filled the device with distilled water – the result was a battery that would continue to be used in telegraph systems in the US and UK until well into the 1950s.

In the Grey Group, researchers from more than 20 countries are tackling everything from improving existing battery models – "we're looking at batteries that roll into the next generation of electric vehicles; we have another set of people who look at materials good for fast charging," says Grey – to reinventing what batteries are and how they work. "We work on some technologies that are current, and some that are far out," she says. "And we also do method and theory. We have to come up with not only the understanding of the fundamental processes, but also the blue-sky stuff that will impact on the [net-zero carbon emissions by] 2050 agenda."

Grey's own pioneering work has been the application of nuclear magnetic resonance spectroscopy to battery research. "This has a similar working principle to the MRI scanners commonly found in hospitals," explains Evan Wenbo Zhao, Grey Group postdoctoral research associate. "In order to improve battery performance, we first need to understand how a battery system functions and fails. The tools we're developing provide this understanding." Grey likens the technique to 'a spy' enabling researchers to see what's going on inside operational batteries.

Some of the Group's work engages directly with that of the pioneering Nobelists. Yoshino made Goodenough's batteries safe by replacing lithium-metal anodes – prone to catching fire – with carbon anodes. However, the resulting battery was less powerful. Now PhD student Anna Gunnarsdóttir is one of a team exploring whether a safe lithium-anode battery might be possible after all: "My work focuses on lithium metal as a potential anode for next-generation 'beyond Li-ion' batteries," she says. "There is now huge interest in lithium metal to make high-energy-density batteries viable."

The challenges are manifold, from the fundamentals of chemical processes – structural changes arising from each charge of a battery, meaning that some degradation is inevitable – to the realities of market economics. The problem, as Grey explains, is that battery power has to compete with gasoline, which is both a fantastically effective energy source and currently priced in a way that doesn't reflect its true environmental cost. "Carbon bonds are a very efficient way of storing energy. [Battery developers] have to give people the same amount of energy as they'd get from petrol, but with the same volume, the same mass, and cheaply."

For Grey, the UK government's goal (also pledged by 76 other countries at last year's global Climate Action Summit) of net-zero carbon emissions by 2050, makes "batteries a hot area, because they represent a short-term goal to address the CO_2 problem. But can they ever be a long-term solution?"

Manish Chhowalla, Goldsmiths' Professor of Materials Science and Core Area Champion of the Henry Royce Institute, says that the achievement of net zero by 2050 "will require new materials to enable the energy transition". He works with materials so new that their existence wasn't even known until 2004 – so-called 2D materials, crystalline structures comprising just a single layer of atoms. The first one found was graphene, a single layer of graphite that is an immensely powerful electrical conductor, supporting current densities a million times greater than copper. Now 2D materials will help create lithium-ion batteries that can charge mobile electronic devices "in seconds and reduce charging times for electronic vehicles to a few minutes, as well as increasing battery lifetimes to five to 10 years without sacrificing performance," Chhowalla says. ›

It would be naive to think that everything we do in the lab today will translate into society in the next five or 10 years. But in 20, or 25? Yes.

The search for new materials with suitable properties, says Grey Group member Dr Supreeth Nagendran, led to another unconventional material, Niobium tungsten oxides, which boast dauntingly complex chemical formulas of $Nb_{16}W_5O_{55}$ and $Nb_{18}W_{16}O_{93}$. These "exhibit minimal, highly reversible structural changes during discharging and charging, hence can be used at high rates without compromising on safety", and now have a patent filed and commercial applications in the pipeline.

But each emergent technology must not only be a match for existing energy solutions in efficiency, safety and cost. It must show potential to exceed them. "To bring these new materials in," explains Chhowalla, "you have to displace the existing technology, which has had investments for 50 years. We can see what the future will look like, based on proof-of-concept devices, but there's effort to determine whether we can make the materials in large quantities, with the same kind of quality and stability. That's why it takes a long time for the translation of these advances into real technology."

And that's also why, although innovative technologies offer potentially huge commercial rewards, the breakthroughs may well come from academic and not corporate laboratories.

"The timescale of industry projects is much shorter," says Grey. "It'd be considered a luxury to do what I do, within industry, yet the techniques we've developed are being used across the world." Chhowalla agrees: "We're not bound by the strings of the market. We're able to take on projects with high rewards and a very low chance of success – but the reasons why they fail will give us insights into how to innovate and improve."

Ultimately, a research environment like Cambridge's enables scientists "to come up with radically different ways of looking at things, that industry wouldn't have the remit to do", says Grey. "We can do it in an unbiased way. We will keep at it for longer."

So don't expect *just* yet to see a Cambridge-created battery replacing the one inside your phone or car, or scaling up to tasks such as storing surplus from the grid or powering an aeroplane. "It would be naive to think that everything we do in the lab today will translate into society in the next five to 10 years," says Chhowalla. "But in 20, or 25? Yes."

"There are technologies that are ready," says Grey. "But the idea of them being mainstream in less than 15 years is very slim. So we have to make sure we're doing the fundamental science, and keep coming up with new ideas. Because, ultimately, it's imperative that we meet the 2050 agenda."

Lead-acid battery

In 1859, Gaston Planté created the first rechargeable lead-acid battery; this was swiftly followed by the Leclanché cell of 1866 – a manganese dioxide battery that was to be the forerunner of double-A and triple-A batteries.

That essential chemistry still powers batteries today. But progress over the past 50 years has been rapid – spurred by the 1973 oil crisis, in which the price of oil quadrupled. Suddenly, developing fossil fuel-free energy became a priority for those economies most affected – including Britain, the US and Japan.

British researcher Stanley Whittingham made the initial breakthrough: an energy-rich material, titanium disulfide, that could house powerful lithium ions in a battery. A few years later, research by American John Goodenough doubled the battery's power.

Finally, the needs of the fast-growing consumer electronics industry then drove Japanese researcher Akira Yoshino to transform lithium-ion battery safety and lifespan – by showing that a simple graphitic carbon could be used as the anode – resulting in the power source we use today.

So while fundamental battery principles remain the same, the materials and methods have evolved, and have led ultimately to a game-changing breakthrough – the Nobel-winning lithium-ion battery.

Hidden in

Machine learning has blurred the line between data and software, unleashing a tsunami of fake news, bots and clickbait. It's just one of the issues that Neil Lawrence, DeepMind Professor of Machine Learning, says it's time to tackle.

WORDS **LUCY JOLIN** PHOTOGRAPHY **THISPERSONDOESNOTEXIST.COM**

Call Professor Neil Lawrence on Zoom and you'll notice, sitting on a shelf behind his desk, an ancient Mac Plus. It was salvaged by Lawrence when he was a PhD student – "the only one of my computer collection I've been allowed to retain," he sighs. "The rest have all gone to the local computer history museum." Next to the Mac Plus is a Lego Mindstorms robot, a shelf full of books about how the mind works and, he gleefully points out, a framed letter from the University. "We will not be able to offer you an undergraduate place at Downing College," it reads.

In September 2019, some 30 years after he received that letter, Lawrence became the University's inaugural DeepMind Professor of Machine Learning and a

plain sight

Professorial Fellow at Queens'. And he's here to completely rethink the way AI is done. "The next wave in machine learning and AI will be a revisiting of what computer science means," he says. "We need to re-examine paradigm-shifting computer science, and how we're doing things, from the ground up."

Back in the early days of the internet, grandiose promises about how it was going to change all our lives caused the dotcom boom – and crash – of 2001. "Not because the promises were wrong, but because it takes time to work out how to do it. I worry about the problems that have been caused by the rush to deploy and build things before we have a good understanding of how to maximise benefit – and minimise harm," he says. "Nobody fully understands how all this works – but it's not sentient. It's just a bunch of interacting software components doing stuff that behaves in a certain way and that can affect society in dramatic ways."

Fake news, bots, search engine optimisation, clickbait: they're all symptoms of the same problem – machine learning blurring the line between software and data. A virus, he explains, works by getting inside the software and persuading it to do something the developer hadn't intended it to do. It's why we spend a lot of time and money trying to stop data being interpreted as software. But in machine learning, the parameters of the model come ›

Does this professor exist?

Incredibly, none of the faces pictured above (bar one) belongs to real people. Like 'deepfakes' (which use deep learning to make images of fake events), they were generated by an AI programme trained on a database of real images. However, one is real: that of Professor Neil Lawrence. Can you spot the real image hidden in plain sight?

It's not a conspiracy – it's simply using real-word data to game a data-driven system

from learning on the data rather than being in the control of the programmer. "That's a high-level breach of this data/software separation," says Lawrence. "It's at the core of many of the challenges we're going to face – and they're going to get worse."

The problem is built into the system, he says. "It's not a conspiracy by Facebook or Twitter. It's simply people using real-world data to game a data-driven system, in an adversarial way – making their information more prominent than the information you really want. It's not new. Remember when Google searches were ranked according to how many links a page had? People simply said: OK, I'll build a link farm that refers people to my site. And if your system is using real-world data, you can't precisely program against that with something like 'If person is good, then trust'. You have to use proxies for 'goodness'. And people will try to game those proxies. You're constantly under attack, but the attacks are harder to identify. To recognise when it's happening, and redeploy, is a huge problem and people are not talking about it enough."

This kind of real-world application fascinates Lawrence, who has done stints in industry as well as academia. After studying mechanical engineering at Southampton, he headed off to the North Sea to work as a field engineer. "I just love making stuff work," he says. "Working on the rigs was interesting, but I wanted more. It was pre-internet, I was reading *New Scientist* and they were talking a lot about neural networks. I bought myself a laptop and started playing around with networks in my downtime."

In 2000, Lawrence came to Cambridge for a PhD on neural networks. It was a wonderful time to be in the field, he says, with cognitive science, signal-processing physics, applied mathematics and statistics coming together to produce a creative diversity of thinking.

The idea of neural networks – models inspired by the workings of the brain – has been around since pioneers such as Bletchley Park alumni Alan Turing (King's 1931) and Tommy Flowers began to build machines and models that could emulate logic. "The typical way we get a machine to do something builds on what's called Von Neumann architecture: we use a programming language to tell the machine what information to put where. A control unit puts stuff in memory, taking it out, doing maths to it – but that's not how the brain works at all," he explains. "Brains learn by having synapses – connections – which determine which neurons fire, and learning in the brain occurs by adjusting how strong these connections are. But that's distributed across our entire bodies. There is no single, centralised intervention point where I can put code in, like there is on a digital machine. So the question is: how do you build these systems that have these distributed characteristics, so different from a classic computer system? In machine learning, the way we're programming machines is that instead of intervening at any individual point, you're teaching by showing an input and what you expect the output to be, and then trying to change the parameters across the system to make this happen. By the end of my PhD, I was trying out all sorts of different methods."

Lawrence was itching to test out his new methods in industry. Unfortunately, industry didn't have the foresight, in the early 2000s, to realise just how important machine learning would become. So after a short stint at Microsoft, he took up a position at the University of Sheffield, followed by a stint at the University of Manchester, before returning to Sheffield as Chair in Neuroscience and Computer Science. But in 2016, he was tempted back into industry, becoming Amazon Cambridge's Head of Machine Learning. He stayed at Amazon for three years until the DeepMind professorship came up. "When I'm in industry, what I really want to see is what happens when the rubber hits the road – when stuff gets deployed, goes wrong, so we get on with the next thing and that works. But when there's a need to step back and reflect on what we should be doing better, that's better done in academia."

Along with big-picture thinking – further aided by a Turing Institute AI fellowship – Lawrence is also keen to continue his work with Data Science Africa, which he helped set up in 2013. It's an initiative supporting the data science community in Africa to deploy machine learning and data science techniques to solve real-world problems, such as monitoring of cassava disease in fields or understanding the distribution of malaria. "This is what I'm talking about: creating effective machine learning systems design. These researchers and scientists in Africa can build the models and devices and do the analysis, but they don't have a sustainable ecosystem to bring it together, one that doesn't require thousands of people to maintain it. That's a really important part of what I will be focusing on."

He's also currently working with the Royal Society's DELVE group, doing what he calls "operational science" around Covid-19. "Having worked at Amazon, trying to answer questions on a weekly basis – that's very different from academic science and it's what you need for the pandemic. I'm helping to take the lessons from operational science at Amazon and using them within the group to help give the best advice we can on the understanding of the virus. We are bringing together a great, diverse group, from economists to virologists – there's a real diversity of expertise."

Machine learning and AI were born in the computer science lab, says Lawrence, and he's eager to take them back in there, pull them apart and invent them anew. "You can't put the genie back in the bottle. So I think the onus is on technical people to talk to society, understand what the problems are, and provide the solutions. And the Cambridge computer lab is absolutely the right place to do it. It might sound overly ambitious. But when I look at the individuals that I'm surrounded by, what they are capable of doing and what they've done in the past, I know we can do it."

To find out more, please visit cst.cam.ac.uk.

DOES THIS PROFESSOR EXIST? PROFESSOR NEIL LAWRENCE IS PICTURED OVERLEAF, MIDDLE ROW, THIRD COLUMN FROM LEFT.

Fom left: Dr Suchitra Sebastian; second-year historian Linda Yu (Lucy Cavendish); third-year English student Shameera Nair Lin (Lucy Cavendish); English graduate student Ananya Mishra (Corpus); third-year English student Hannah Shury-Smith (Homerton); second-year Asian and Middle Eastern Studies student Zara Ramtohul-Akbur (Homerton); third-year English student Nusrath Tapadar (St Catharine's).

Bread is for everyone

The Bread Theatre and Film Company is tearing up student theatre and bringing the world to Cambridge's stages.

WORDS **LUCY JOLIN** ILLUSTRATION **KATE COPELAND**

Bread, says founding committee member and President Shameera Nair Lin, is more than just a theatre company – it's a movement. Founded last year by a group of students from BAME backgrounds, it aims to open up new artistic spaces, voices and narratives within the University – and beyond. "Many of us are from the former colonies, and we grew up with the idea of theatre as Shakespeare, Wilde and Beckett," says third-year Lin who is studying English at Lucy Cavendish. "When we came to Cambridge, we started to realise that the theatre we grew up with wasn't the theatre that spoke to our hearts."

Bread was founded by postgraduate student Ananya Mishra (Corpus) and Cavendish physicist, Dr Suchitra Sebastian. And, although only in its first year, the company has already supported performances of plays seeking to bring different stories to the fore, such as Chong Tze Chien's *Pan Island Expressway* and *God's Property* by Arinze Kene, which is set in the wake of the Brixton riots. It's showcased student writing, too – recent productions include Lin's own play *Corpsing*, and committee member Hannah Shury-Smith's *Chalk*, which deals with the experience of being mixed race. Last summer, the company brought *The Djinns of Eidgah* (by leading Bengali playwright Abhishek Majumdar) to the Edinburgh fringe – to audience acclaim and five-star reviews.

"All our productions are very distinctive, explore new genres, and they're not just about politics," Lin says. "Yes, our narratives are very much geared towards social causes. But there's also love, intimacy of different kinds. It's too easy to say: 'Oh, term only lasts eight weeks, let's just produce another Shakespeare' – our job is to broaden the scope of what's acceptable in the canon."

The society is bringing new voices to the forefront in other ways, too. Bread members are part of the ADC pitching panel, which has a direct hand in programming all the shows that are put on in the main student theatres. Bread also organises students workshops (Bread Labs) with theatre professionals. Looking forward, the committee hope to launch a writing competition for new work and an annual performance showcase and to put on yearly productions beyond Cambridge. "Anyone can get involved – it's not just about people from BAME backgrounds," Lin laughs. "As our logo shows, bread is for everyone."

To find out more about Bread, please visit: breadtheatreandfilm.com

Download

An introduction to what the University is doing to defend equality and foster inclusion

Alumni, students and staff have expressed concerns following recent events in the USA and the inequalities highlighted by the global antiracism movement, Black Lives Matter. Members of our community want to know what the University is doing to address racism at Cambridge. Our work on race equality is ongoing and comprises a range of initiatives to address inequalities and challenge racism at both institutional and individual levels.

Recent events

With the rest of the world, Cambridge has watched recent events unfold in the USA. Two statements published in early June, from the Vice-Chancellor, Professor Stephen J Toope, and from the Black, Asian and Minority Ethnic (BAME) staff network, expressed outrage, sadness and frustration at ongoing racial injustice and resolve to continue working on addressing it within the University and beyond.

Universities stand for shared opportunity and a fundamental commitment to the creation of knowledge across all barriers of race, language, culture and background. The Vice-Chancellor wrote: "In the face of intolerance and historically entrenched racism, our community must strive to represent the alternative: openness to all with respectful engagement across our differences. We do not always live up to these aspirations." We recognise that much work is needed to tackle race inequalities at the University. Work to address racism at the University is ongoing and must not be another burden on BAME individuals.

As the Vice-Chancellor wrote in his 2018 blog post: "Pushing back against inequality should not only be the responsibility of those who are most affected by it. It is a responsibility for all of us. Equality and diversity must become deeply and irreversibly embedded in the University's core work – whether it is education, research or administration."

Here are some of the initiatives worked on by and available to staff and students.

Race Equality Charter

The University joined Advance HE's Race Equality Charter (REC) in 2016 and received the REC Bronze award in November 2019.

The REC is a national scheme that provides a framework for higher education institutions to recognise, investigate and challenge barriers to recruitment, progression and retention of Black, Asian and Minority Ethnic staff and students.

The work on REC and the institutional action plan to address racial inequalities at the University is coordinated by a self-assessment team chaired by the Pro-Vice-Chancellor for Institutional and International Relations, Professor Eilís Ferran, and Dr Mónica Moreno Figueroa, one of the University's two Race Equality and Inclusion Champions.

Initiatives from the institutional action plan are publicised on the dedicated website: www.race-equality.admin.cam.ac.uk. The aim is "to improve racial equality at the University by driving cultural and organisational change to ensure that we excel in attracting and supporting Black, Asian and Minority Ethnic staff and students, while creating an environment that is conducive to openly discussing race-related issues and challenging racism".

Admissions

In October 2019, the University welcomed a record 91 black undergraduates, which represented a 50% rise on the previous year. There is no doubt the publicity given to the Stormzy Scholarships has been a major factor in encouraging more black students to study at Cambridge. The award-winning grime artist announced in 2018 that he would pay the tuition fees and maintenance costs of four students over two years, for up to four years of study. But there has also been a concerted attempt to increase targeted outreach work. The University has strengthened its partnership with Target Oxbridge, which works closely with black students in schools to encourage more of them to apply to Cambridge and Oxford. And in 2019 the University produced a series of films for social media aimed at challenging myths about the Cambridge experience. Credit must also be given to the University's African-Caribbean Society. Members of ACS have given up their time to host access events, act as mentors, and attend College outreach activities providing inspiration for a new generation of students.

While we recognise the increase in the diversity of the student body is positive, we also acknowledge that admissions is only one strand of work to tackle racial inequality at the University and that creating supportive and safe conditions, free from racism and harassment, is a priority.

Support for staff and students

Our staff and student surveys show that many BAME staff and students face racism whilst at the University on a daily basis. We are aware of the magnitude of the problem and are working on improving our support services. Existing support options include the BAME staff network, training and development, and reporting structures.

Students have developed their own support through the Cambridge University Students Union (CUSU) BME campaign. The student counselling service enables BAME students to request a BAME counsellor, the introduction of which CUSU was instrumental in.

Wider initiatives

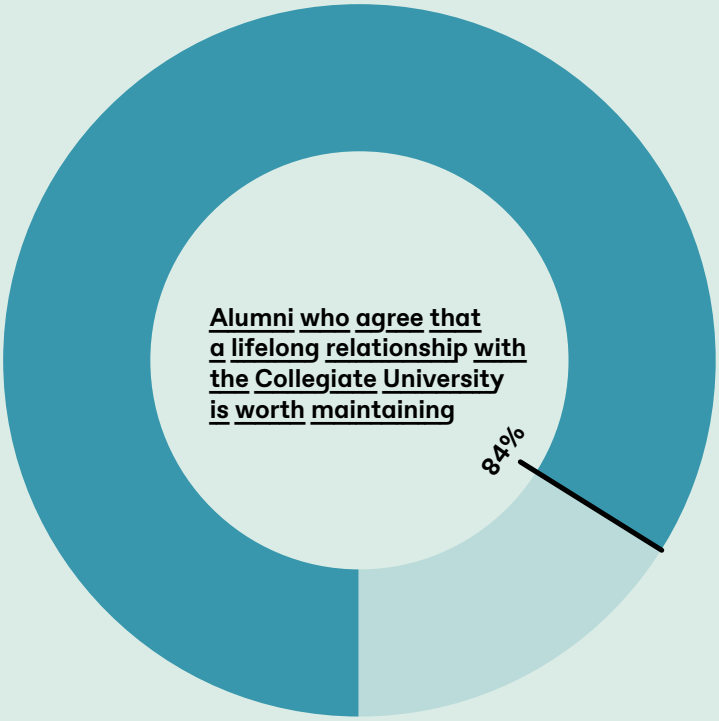
Students in recent years have fed back to their faculties and departments on the nature of their curriculum. Last year, CAM 88 (Michaelmas Term, 2019) covered calls to decolonise the curriculum in the article *How to be modern*. The portrait exhibition, *The History Makers: Black Cantabs*, first shown at the UL in Michaelmas Term 2018, arose from a project undertaken by students in the Black Cantabs Research Society, to spotlight black students through history.

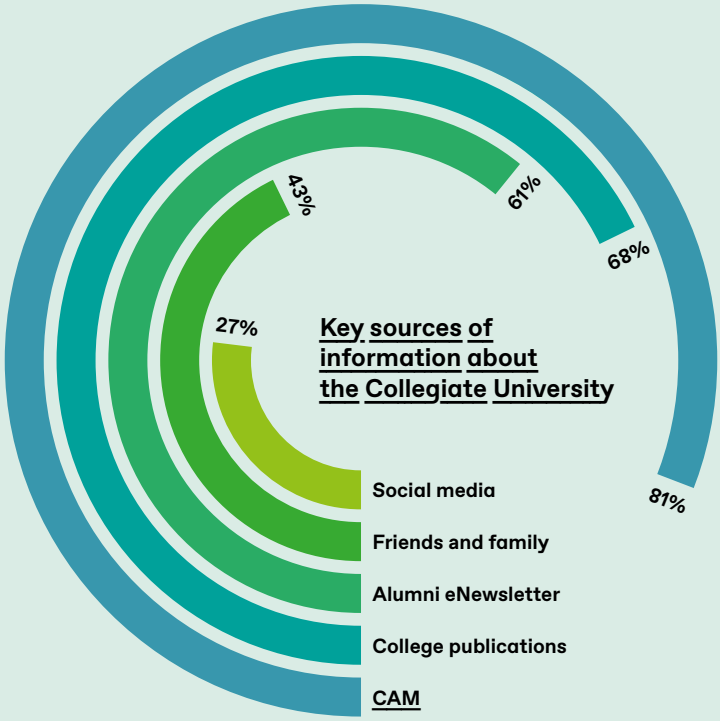
The history of the University is being further examined by the Legacies of Enslavement project, which was created in early 2019 at the request of the Vice-Chancellor, following public interest in the issue of British universities' historical links to the slave trade. It has been asked to advise him on the University's historical links with the slave trade and to propose future action in light of this. The project's advisory group has issued an initial report and is due to produce its final report in 2022.

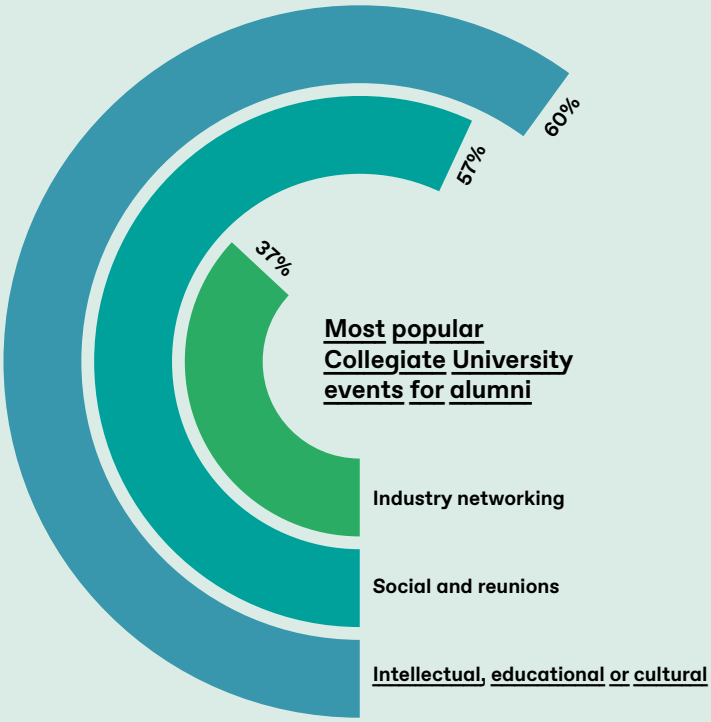
To find out more about the University's approach, please visit: alumni.cam.ac.uk/news/anti-racism-at-cambridge.

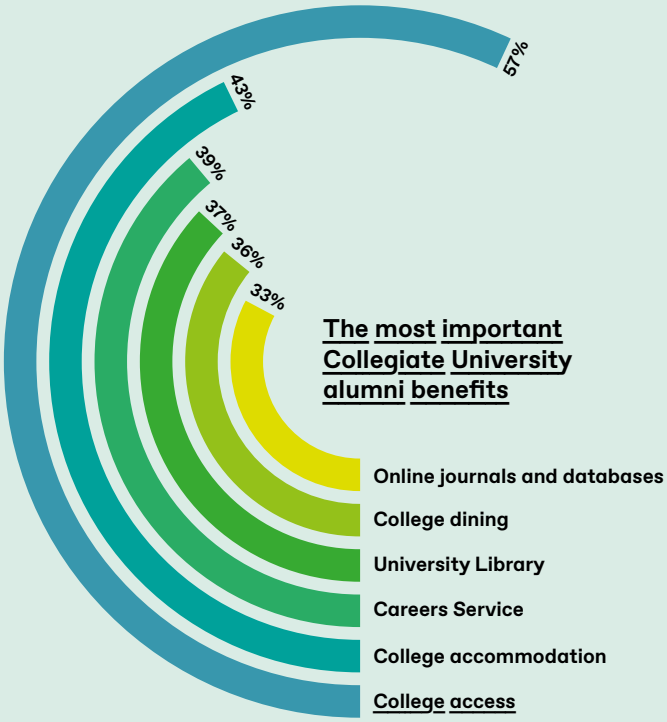
What do Cambridge alumni think about the Collegiate University?

We asked, almost 22,000 of you responded, and now the results are in – revealing that Cambridge graduates are positive about their connection and keen to get involved.





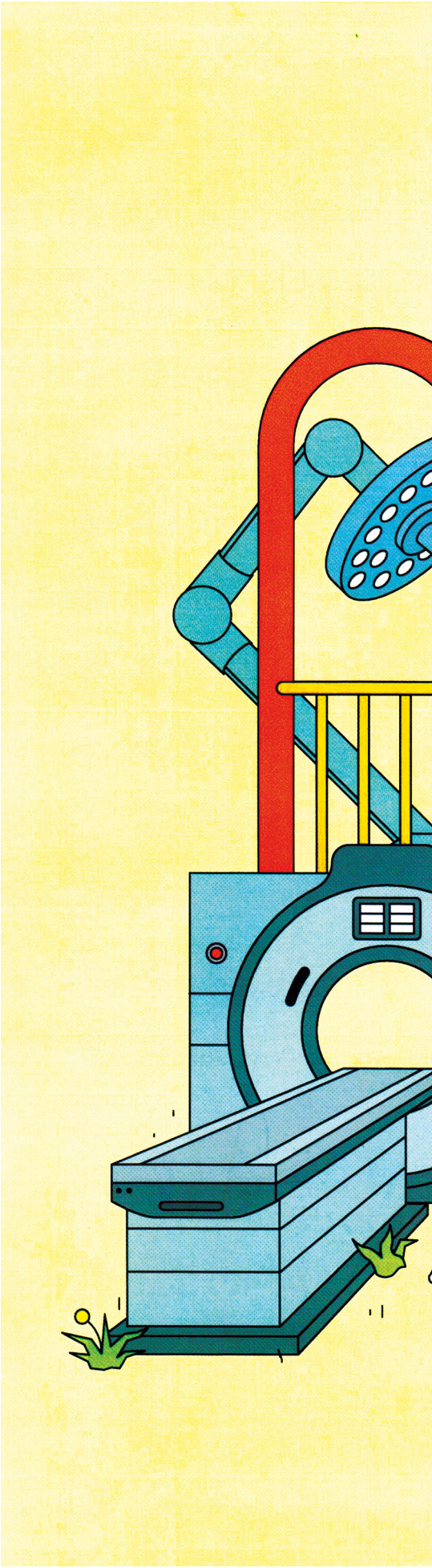




This idea must die: Paediatrics is about jabs, broken arms and nosebleeds

Professor David Rowitch explains why paediatrics is about lifelong disease prevention and mitigation.

ILLUSTRATION **GEORGE WYLESOL**



I was recently at a disease prevention conference where a geriatrician referred to an 'early-intervention' project – early intervention here meaning 'middle-aged people'. I raised my hand and said: "I'm a paediatrician, so middle-aged doesn't seem like early intervention to me!"

Beginning disease prevention in middle age is not just closing the stable door after the horse has bolted; those horses have left the field and they're not coming back. If we want to prevent disease, we need to find its very first origins and intervene a lot earlier. We need to get rid of the artificial divide between child and adult medicine, and think differently about how mental and physical health interact and play out across our lifetimes.

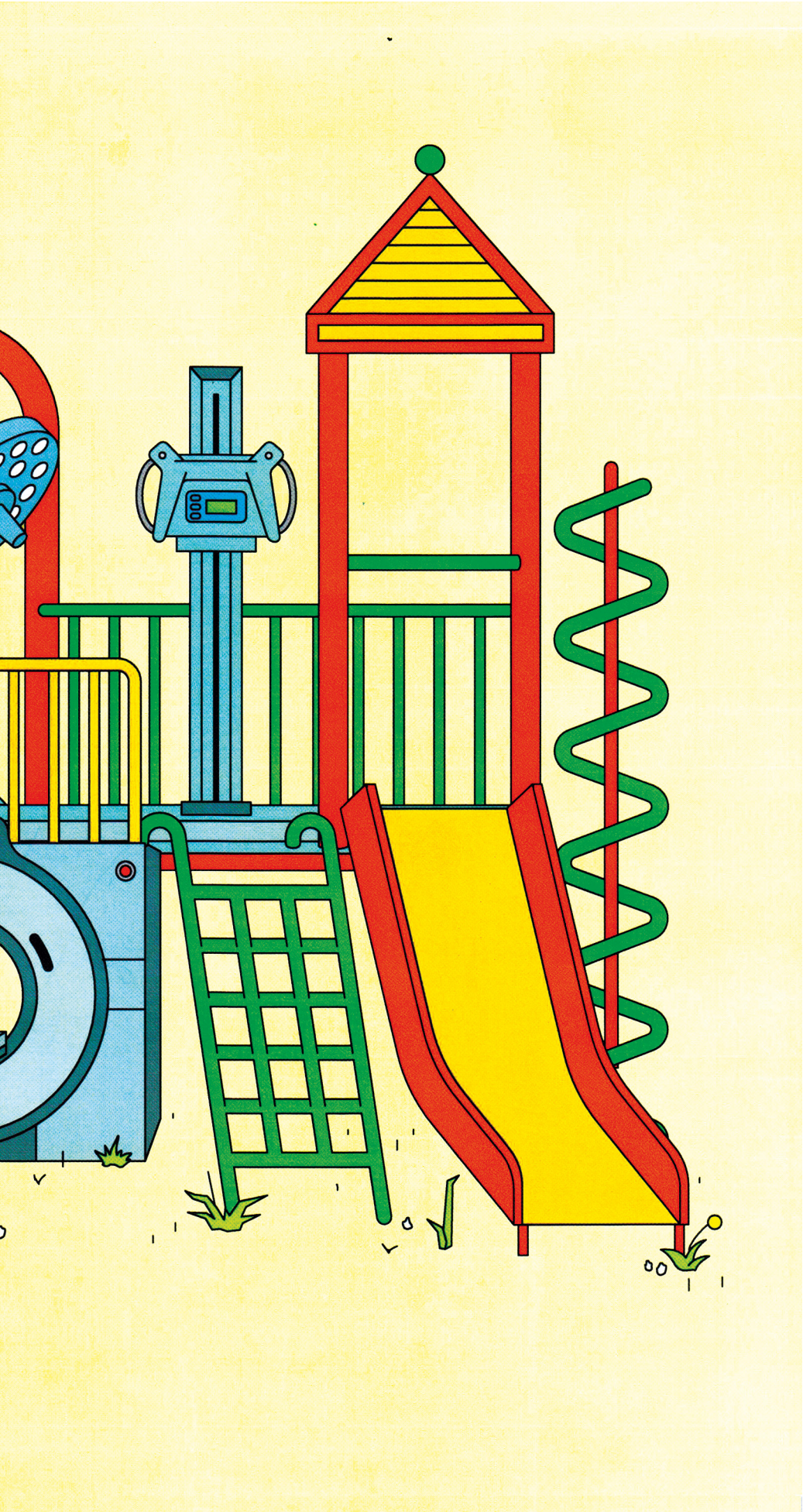
The definition of 'paediatrics' is far wider than giving jabs and the care of younger children that most people associate with the word. In fact, the new definition of paediatric care, as set out in NHS England's 2019 Long Term Plan, is a service that provides for those aged up to 25. Disease, after all, doesn't just stop when you get to 16 or 18 – and it doesn't just start when you reach middle age.

Take mental health problems, identified by the World Health Organization (WHO) as a major global challenge. According to WHO, half of all mental illnesses begin by the age of 14, and three-quarters by a person's mid-20s. Mental illness can affect the rest of a person's life, or, indeed, end it prematurely – globally, suicide is the second biggest cause of death among 15- to 29-year olds. That speaks to not just the origins but also the severity of mental health conditions in that age range. Perhaps a paediatrician of the future will be able to prevent anxiety and depression in an adult by starting a psychological intervention much earlier in a child who we know is at risk.

Nutrition is another area where early intervention can have lifelong results. A recent study found that introducing more vegetables into the diet of schoolchildren up to the age of five meant that they were less likely to become obese. But the same intervention done in older children didn't show the same benefit. Behaviourally, younger children are more malleable and better at adopting healthy food habits.

Likewise, there is evidence that your risk of conditions such as cardiovascular disease, high blood pressure and diabetes in later life could be raised by what happens to you even before you are born. One hypothesis states that stresses in the womb (for example, because of severe maternal diabetes) or because of preterm birth could cause chemical (epigenetic) changes in a gene. These changes could 'turn on' or 'turn off' a process, thus setting a lifelong chain of adverse health events in motion.

At the moment, healthcare systems are reactive. The view is: 'if it ain't broke, don't fix it' – only when we obviously 'break' down do we go to the doctor. However, it's likely that onset of symptoms of a disease comes many years or even decades after the disease process started.



Beginning prevention in middle age is not just closing the stable door after the horse has bolted. Those horses have left and aren't coming back

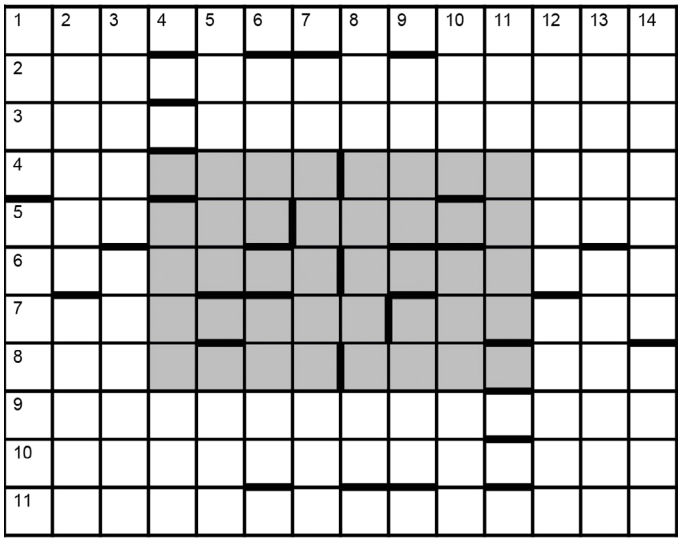
If we want to promote a different life trajectory, where people are healthier for longer, we need nothing less than a healthcare paradigm shift from reactive medicine to preventive medicine, and the magnifying glass needs to shift to a much earlier timeframe. If so, we could identify the origins of disease in time to build resilience and prevent a health risk from becoming a disease.

Perhaps, in the future, we may not distinguish between 'paediatricians' and 'adult doctors' at all. There will simply be 'doctors' who look to treating disease at the root. It falls to paediatrics to systematise this new paradigm and get it right in children and young people, capturing data in the long term to show that the best way of treating an adult is by treating the child.

There are multiple ways in which this approach could play out, putting it in the realm of academic research. The concept needs to be developed in concert with medical practice that takes a holistic approach to the care of body and mind. And, I am pleased to say this is just what is happening with the building of the new Cambridge Children's Hospital, a unique partnership between the University and the NHS, treating children in a whole new way for the adults they will become.

David Rowitch is Professor of Paediatrics and Academic Lead, NHS Cambridge Children's Hospital. To find out more, please visit: cambridgechildrens.org.uk.

No Shelter in Row 5 by Nimrod



Subtitle: _____

Instructions
All rows and most columns consist of two answers whose clues are run together in either order without overlapping; the break may or may not be marked by punctuation. Across answers that fall partially in the silver zone (ie those in Rows 4-8) are entered jumbled; likewise Down answers that do not (ie Columns 1-3 and 12-14). The lengths of unjumbled answers are to be deduced.

Two solutions are too long for the space available and overlap: in doing so they interrupt crossing answers. Leaving real words in the grid and keeping in mind the puzzle's title, solvers must deal with the situation in accordance with the conclusion of a work, the five-word subtitle of which (to be written under the grid) is cryptically represented by the 40 letters in the silver zone.

*An asterisk indicates that one answer in a pair is two words.

Rows

1 Trainer always fixes odds on boxer alias Prince, caught by big punch (being unable to get up)
2 Be too harsh on motor deliveries? Vicar elects to rearrange garage's last stop
3* Stop hosting 'soft' Public Image: old neglected singer John tracks right back in slower line
4 Silver parts so long slow movements when revolving do grass surfaces (7;7)
5* "Frills" rating in notes what results from devolving score in baseball rubber (6;8)
6 "Old land border I stole around" – worthy admits hard work maintains divinity (7;7)
7 Men dallying securing final goal choice including kinky nude swinger! (8;6)
8 Sedated orderly determined features with points taken in turns, outwardly (7;7)
9* Slyly look to catch a perjurer from Glasgow actually on shift in Italy
10 Indoors, wild mute swan (with a missing 12-inch ruler) shot
11 Presumption, maybe, with reorganisation under 'S', gas lamp rashly filled by amateur with sulphur

Columns

1 Beer-guzzling woman's NHS GP takes £1,000 cut (4;7)
2 Ducks see bats, as I do, circling rodent (futile heading off for edge of meadow) (6;5)
3 Covered, medic took off south from European capital city wanting rise in veld (5;6)
4 Ordered to control blooming tantrum!
5 Two rings would keep this beam up, restoring bolts very quickly
6* Not entirely over gout – so ruin house party?
7 For more than one cabinet reshuffling ravenous ministers first to go!
8 Cress sprinkled over roast lamb – they'd be begging for that in Waverley
9 Broody music elevated No.1 over one-time resident of No.10 and garden
10* Antique further deprives buddies of power, as will excluding some from lower order?
11 Vicious Prince covered by permit
12 Amused one exam's sent over with page missing notice (it finally provides ways in) (6;5)
13 Media people in hotel collaborated as sportsmen together to set me up with date (5;6)
14 "More than one spoke up to auditor going through last of the brew": letter's personal opening (7;4)

All entries to be received by 4 September 2020. Send your entry

- **by post to:** CAM 90 Prize Crossword, University of Cambridge, 1 Quayside, Bridge Street, Cambridge CB5 8AB
- **online at:** magazine.alumni.cam.ac.uk/crossword
- **by email to:** cameditor@alumni.cam.ac.uk

The first correct entry drawn will receive £75 of vouchers to spend on Cambridge University Press publications and a copy of *Fitzbillies: Stories and Recipes from a 100-Year-Old Cambridge Bakery,* published by Quadrille.

Two runners-up will also receive £50 to spend on CUP publications.

Solutions and winners will be published in CAM 91 and online on 11 September at: **magazine.alumni.cam.ac.uk/crossword**.

Solution to CAM 89 Crossword
Bits and Pieces by Nimrod

The bits and pieces, as hinted at by the first two normal clues, were (a) dances and (b) tools or implements, clued in that order, alphabetically in each list of 10 and presented in alphabetical order of dances. The missing, highlighted, items were JIG/SAW.

S	C	R	E	W	D	R	I	V	E	R	A	R
E	F	U	N	P	E	U	R	I	L	A	U	E
T	A	N	G	O	C	M	E	S	T	I	G	E
S	I	C	K	L	E	B	C	H	I	S	E	L
Q	E	H	O	K	R	A	E	N	A	E	R	A
U	N	S	P	A	N	A	S	U	S	U	A	L
A	C	E	J	I	G	W	S	A	W	P	E	L
R	E	N	E	W	A	L	S	P	E	R	R	E
E	L	E	S	R	R	T	O	L	L	C	A	M
H	A	M	M	E	R	W	V	A	L	E	T	A
O	T	I	C	N	A	I	I	N	A	R	O	N
R	H	E	A	C	N	S	E	E	T	O	R	D
A	E	S	C	H	O	T	T	I	S	C	H	E

Clue notes:
magazine.alumni.cam.ac.uk/crossword.

Winner:
Line Baribeau
(Darwin 1989)

Runners-up:
Hywel Carver (King's 2004)
Peter Smith (Emmanuel 1986)

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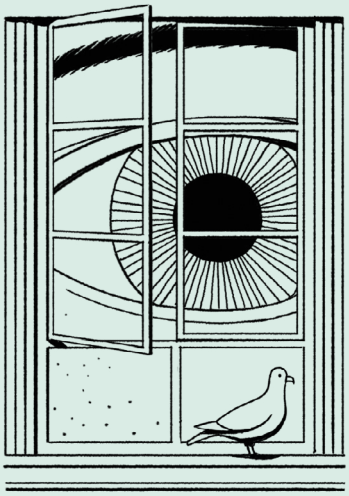

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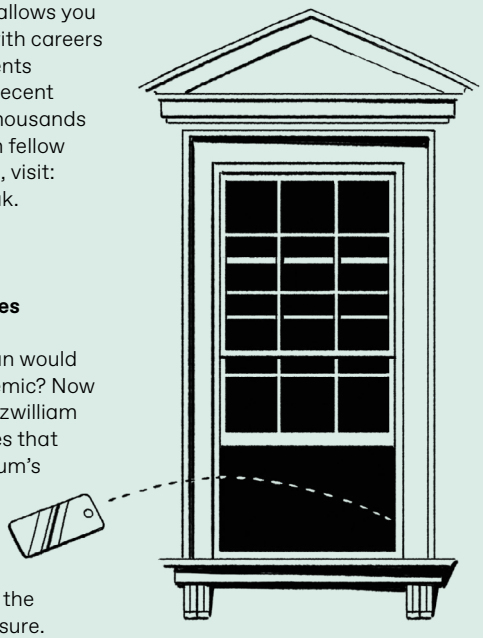

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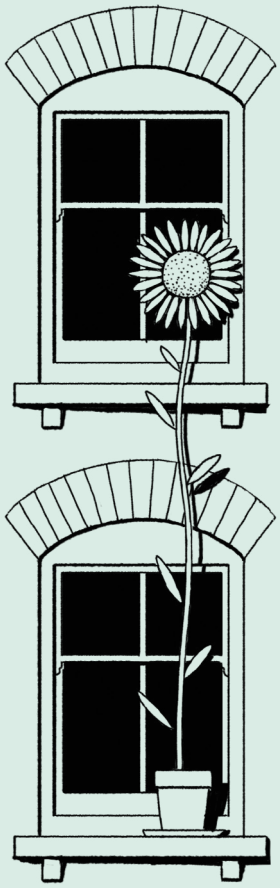
Global Cambridge has taken Cambridge ideas around the world – but our new digital series is truly global. Cambridge Conversations is an in-depth look at what we currently know about Covid-19. alumni.cam.ac.uk/events



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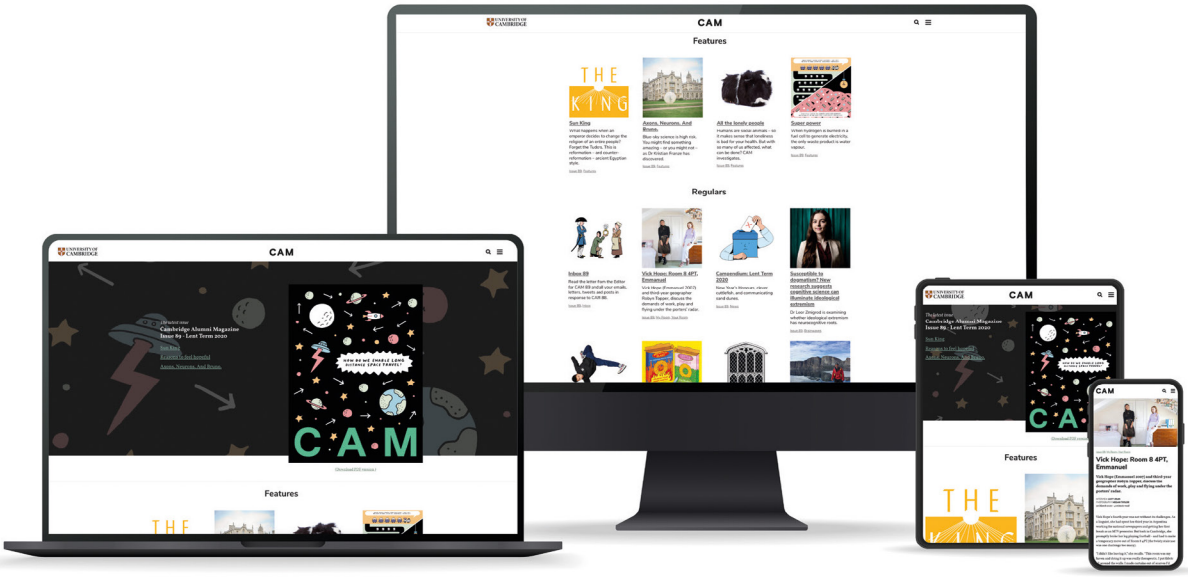

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