IDEAS **TECHNOLOGY** DESIGN **BUSINESS**

# WIRED

UK EDITION

## HE CREATED TWITTER

## NOW HE'S TAKING ON THE BANKS

(armed only with this)

**DRONE ALERT!**

Spy UAVs are just the start

P.126

**POWER SURGE!**

Let's build a fusion reactor – using eBay

P.42

AUG 12 £3.99
WIRED.CO.UK
THE FUTURE AS IT HAPPENS

08
9 771758 833011

## WHAT'S *REALLY* DRIVING JACK DORSEY

# BEAUTY. SELDOM SEEN.

Like the dramatic effect of a solar eclipse, one glimpse of the new BMW 6 Series Gran Coupé will create an everlasting impression. At every turn the new BMW 6 Series Gran Coupé exceeds expectations. The high definition BMW Professional Multimedia Navigation system comes as standard whilst additional innovations such as full-colour BMW Head-Up Display can be added at your request. This captivating new BMW is the first four-door coupé in our history. We guarantee you'll feel it's been worth the wait.
For more information contact your local BMW Dealer or visit **bmw.co.uk/6seriesgrancoupe**

# THE NEW BMW 6 SERIES GRAN COUPÉ.

## BMW EfficientDynamics
**Less emissions. More driving pleasure.**

Official fuel economy figures for the new BMW 6 Series Gran Coupé: Urban 26.4 – 41.5 mpg (10.7 – 6.8 ltr/100 km). Extra Urban 45.6 $CO_2$ emissions 183 – 148 g/km. BMW EfficientDynamics reduces BMW emissions without compromising performance developments


– 57.6 mpg (6.2 – 4.9 ltr/100 km). Combined 35.8 – 50.4 mpg (7.9 – 5.6 ltr/100 km).
and is standard across the model range.

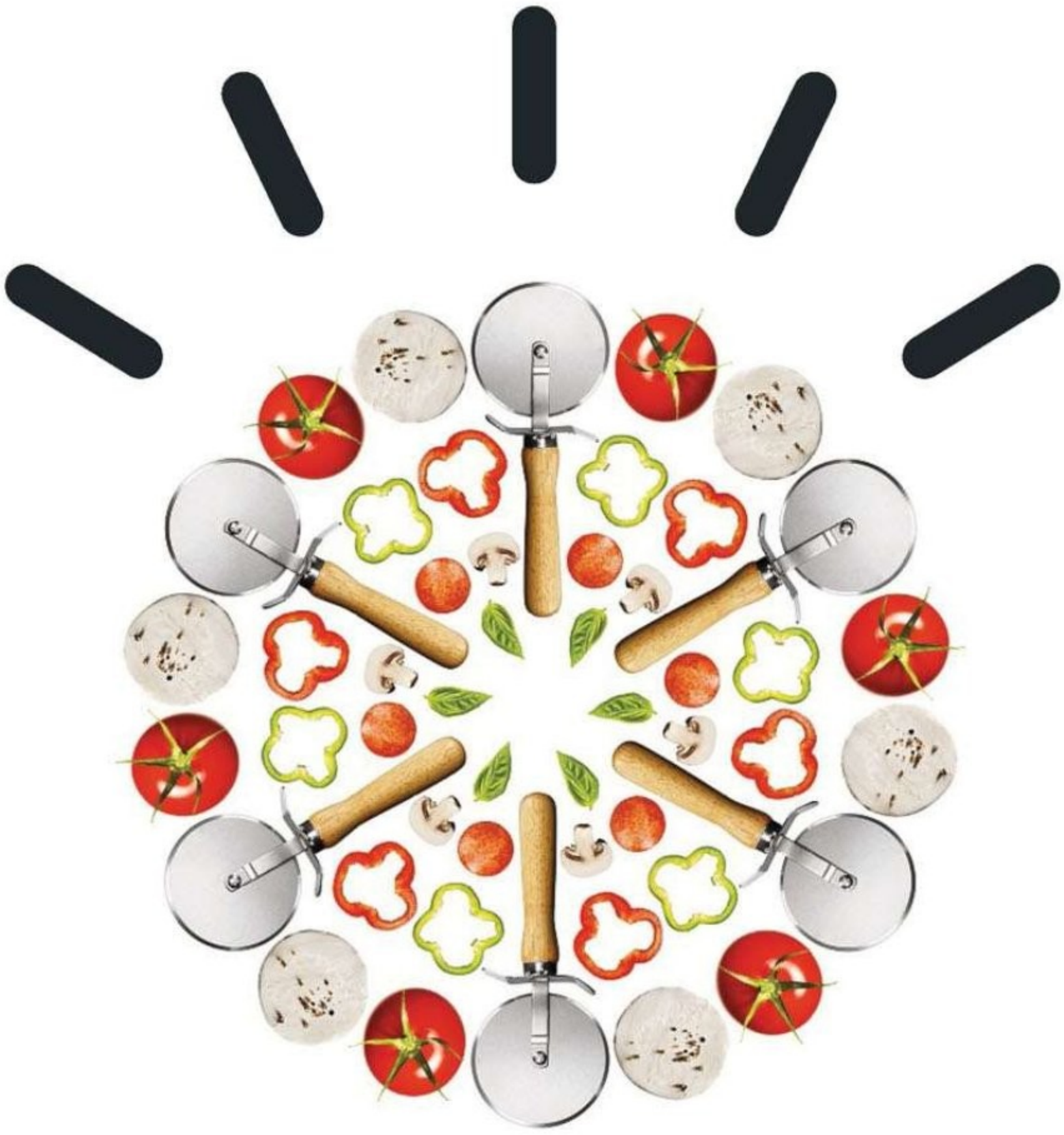
official partner to
London 2012

for the facts **drinkaware.co.uk**

Enjoy Caffrey's responsibly


# REDEFINING SMOOTH


A REFRESHINGLY SMOOTH EXPERIENCE



## How a midsize restaurant group is earning a bigger piece of the pie.

On a smarter planet, midsize businesses need analytics to better serve their customers, operate more efficiently and encourage growth. Papa Gino's Inc., the Boston-based pizza and sandwich chain with about 150 corporate employees, was sitting on a gold mine of untapped sales, marketing and operational data. However, they needed a better way to leverage all this powerful data to make better decisions for their company. Working with IBM® and Business Partner QueBIT, they deployed a business analytics solution based on IBM Cognos® software that quickly transformed their data into actionable business insights. Analytics helped them discover that reward members visit their restaurants 35% more frequently and spend 50% more on online transactions. With new insights into the impact of their loyalty program, they can develop offers based on purchase patterns to increase the size of orders and purchase frequency. To see how IBM and our Business Partners can help your midsize business work smarter, visit **ibm.com**/engines/uk/pizza. Let's build a smarter planet.

**Midsize businesses are the engines of a Smarter Planet.**

**Need to know more? Join us at**

facebook.com/MidmarketIBM

twitter.com/ibm_engines

IBM

# CONTENTS

061
"Mark Zuckerberg donated $100m in the US. How pleasing it would be to see him make a similar commitment in the UK" – *Jonathan Goodwin*



FEATURES



PHOTOGRAPHY (FRONT COVER): ART STREIBER; (THIS PAGE): KO SASAKI

*Right*: Ikuyo Matsuo, designer, Activelink, and exoskeleton creator

"WHEN YOU HOLD THE BREATH-HOLD FREEDIVING WORLD RECORD, FAR AHEAD OF ALL YOUR COMPETITORS, YOU APPRECIATE **THE EXCEPTIONAL PERFORMANCES** OF THE BREITLING SUPEROCEAN."

Airline pilot and extreme recordman Herbert Nitsch earned his place in the history books as the only breath-hold diver to smash the 200-metre mark, a truly incredible feat. Nicknamed "The Flying Fish", this exceptional athlete with nerves of steel is now aiming for the legendary 1,000-foot barrier (–305 m). On his wrist is the Breitling Superocean, a concentrated blend of performance, reliability and style. Water-resistant to the fabulous depth of 2,000 m (6,600 ft), this ultra-sturdy and ultra-functional watch is equipped with an officially chronometer-certified movement – as indeed are all Breitling models. For Herbert Nitsch, the Superocean is the perfect companion for all manners of feats.

£ 2670*

For your nearest stockist in Great Britain and Ireland telephone 020 7637 5167

BREITLING.COM

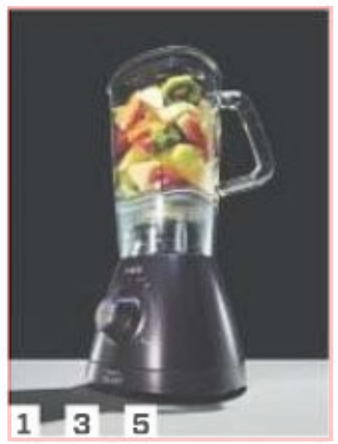
BREITLING
1884

INSTRUMENTS FOR PROFESSIONALS™

*RRP. Subject to change without notice.

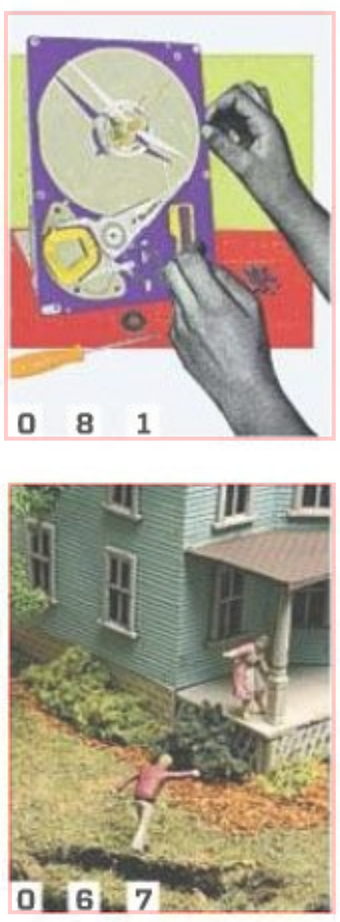


























PHOTOGRAPHY: BENEDICT REDGROVE; MILLER MOBLEY; KOURTNEY ROY; SUN LEE; GREGG SEGAL; ALEXANDER KENT; TODD ANTONY; WILSON HENNESSY; DAVID ARKY. ILLUSTRATION: DAN MATUTINA; ALEX ROBBINS; MICHELLE THOMPSON; PARKO POLO

SECTIONS


EDITOR **David Rowan**
ART DIRECTOR **Andrew Diprose**
EXECUTIVE EDITOR **Greg Williams**
MANAGING EDITOR **Duncan Baizley**

START EDITOR **João Medeiros**
PRODUCT EDITOR **Jim Hill**
ASSOCIATE EDITOR **Tom Cheshire**
ASSISTANT EDITOR **Madhumita Venkataramanan**

PICTURE EDITOR **Steve Peck**
DEPUTY PICTURE EDITOR **Dalia Nassimi**
DEPUTY ART DIRECTOR **Paul Rider**
DESIGNER **Ben Fraser**
TABLET DESIGNERS **Kieran Gardner, Claire Cheung, John Hitchcox**
TABLET PRODUCER **Lauren Hogan**

CHIEF SUB-EDITOR **Mike Dent**
DEPUTY CHIEF SUB-EDITOR **Simon Ward**
EDITOR AT LARGE **Ben Hammersley**

CONTRIBUTING EDITORS **Peter J Bentley, Michael Coveney, Russell M Davies, Alex Haw, Martin Raymond, Margaret Robertson, Vaughan Bell, Alison Flood, Jer Thorp, Geoff Manaugh, Charles Gant**

DIRECTOR OF EDITORIAL ADMINISTRATION AND RIGHTS **Harriet Wilson**
EDITORIAL BUSINESS AND RIGHTS EXECUTIVE **Mairead Aitken**

INTERNATIONAL PERMISSIONS MANAGER **Eleanor Sharman**
FINANCE DIRECTOR **Pam Raynor**
FINANCIAL CONTROL DIRECTOR **Penny Scott-Bayfield**

WIRED.CO.UK EDITOR **Nate Lanxon**
NEWS EDITOR **Duncan Geere**
ASSOCIATE EDITORS **Katie Scott, Olivia Solon**
JUNIOR STAFF WRITER **Liat Clark**
INTERN **Ian Steadman**

PUBLISHING DIRECTOR / DEPUTY MANAGING DIRECTOR
**Albert Read**

MANAGING DIRECTOR
**Nicholas Coleridge**

WIRED, **6-8 Old Bond Street, London W1S 4PH**

PLEASE CONTACT OUR EDITORIAL TEAM VIA THE FOLLOWING EMAIL ADDRESSES:

READER FEEDBACK: **rants@wired.co.uk**

GENERAL EDITORIAL ENQUIRIES AND REQUESTS FOR CONTRIBUTORS' GUIDELINES:
**editorial@wired.co.uk**

PRESS RELEASES TO THIS ADDRESS ONLY PLEASE: **pr@wired.co.uk**
ENQUIRIES ABOUT OUR INTERNSHIP PROGRAMME: **interns@wired.co.uk**

CHAIRMAN AND CHIEF EXECUTIVE,
CONDÉ NAST INTERNATIONAL
**Jonathan Newhouse**

PUBLISHER **Rupert Turnbull**
ASSOCIATE PUBLISHER **Rachel Reidy**
PROMOTIONS AND SPONSORSHIP DIRECTOR **Claire Dobson**

SENIOR ACCOUNT MANAGER **Max Mirams**
SALES EXECUTIVE **Tilly Bull**
ADVERTISING ASSISTANT **Natalie Futter**

BUSINESS DIRECTOR, WIRED CONSULTING **Sophie Cliffe-Roberts**

SENIOR COPYWRITER **Jack Dyson**
PROMOTIONS ART EDITOR **Mark Bergin**
TABLET PROJECT MANAGER **Liam Keating**

REGIONAL SALES DIRECTOR **Karen Allgood**
REGIONAL ADVERTISEMENT MANAGER **Heather Mitchell**
SENIOR SALES EXECUTIVES **Beth Hardie, Krystina Garnett**
HEAD OF PARIS OFFICE (FRANCE) **Helena Kawalec**
ADVERTISEMENT MANAGER (FRANCE) **Natalie Walter**
ITALIAN OFFICE **Valentina Donini**
ASSOCIATE PUBLISHER (US) **Shannon Tolar Tchkotoua**
CLASSIFIED DIRECTOR **Shelagh Crofts**
CLASSIFIED ADVERTISEMENT MANAGER **Lydia Lerner**
SENIOR CLASSIFIED SALES EXECUTIVE **Natalie Spence**
CLASSIFIED SALES EXECUTIVE **Katie Fitz-Costa**

DIGITAL DIRECTOR, CONDÉ NAST DIGITAL UK **Jamie Jouning**
HEAD OF PRODUCT MANAGEMENT **Michael Parsons**
HEAD OF PRODUCT DEVELOPMENT AND TECHNOLOGY **Pete Miller**

MARKETING DIRECTOR **Jean Faulkner**
ASSOCIATE RESEARCH DIRECTOR **Gary Read**
MARKETING MANAGER **Susie Brown**
MARKETING EXECUTIVE **Laura Paterson**

MEDIA RESEARCH EXECUTIVE **Dionie Newby-Bowes**
MEDIA RESEARCH EXECUTIVE **Cassie Norman**

CONDÉ NAST INTERNATIONAL DIRECTOR OF COMMUNICATIONS **Nicky Eaton**
GROUP PROPERTY DIRECTOR **Fiona Forsyth**
CIRCULATION DIRECTOR **Richard Kingerlee**

BRAND SALES AND MARKETING MANAGER **Odin Madsen**
SUBSCRIPTIONS DIRECTOR **Patrick Foilleret**
SUBSCRIPTIONS PROMOTIONS MANAGER **Claudia Wilson**
SUBSCRIPTIONS RETENTION MANAGER **Emma Carvalho**
SUBSCRIPTIONS MANAGER **Eleni Ruffels**
SENIOR SUBSCRIPTION MARKETING DESIGNERS **Gareth Ashfield, Anthea Denning**

PRODUCTION DIRECTOR **Sarah Jenson**
COMMERCIAL PRODUCTION MANAGER **Xenia Antoni**
PRODUCTION MANAGER **Joanne Packham**
PRODUCTION CONTROLLER **Alicia Shepherd**
PRODUCTION CO-ORDINATOR **Lucy Elliott**
DISPLAY AND COMMERCIAL PRODUCTION CONTROLLER **Louise Lawson**
DISPLAY AND COMMERCIAL PRODUCTION CO-ORDINATOR **Martin MacMillan**

ADVERTISING ENQUIRIES: **tel: 020 7499 9080; fax: 020 7399 2684**

**Directors: Jonathan Newhouse (chairman and chief executive), Nicholas Coleridge (managing director), Stephen Quinn, Annie Holcroft, Pam Raynor, Simon Kippin, Jamie Bill, Jean Faulkner, Shelagh Crofts, Albert Read, Patricia Stevenson, Chris Hughes**

recycle

Published by The Condé Nast Publications Ltd, Vogue House, Hanover Square, London W1S 1JU (tel: 020 7499 9080; fax: 020 7493 1345). Colour origination by Altaimage London. Printed in the UK by Wyndeham Roche Ltd. WIRED is distributed by Condé Nast & National Magazine Distributors Ltd (Comag), Tavistock Road, West Drayton, Middlesex UB7 7QE (tel: 01895 433600; fax: 01895 433605). The one-year (12 issues) full subscription rate to WIRED in the UK is £35, £48 to Europe or US, £58 to the rest of world. Order at www.magazineboutique.co.uk/wired/W173 or call +44 (0)844 848 5202, Mon-Fri 8am-9.30pm, Sat 8am-4pm. Enquiries, change of address and orders payable to WIRED, Subscription Department, Lathkill St, Market Harborough, Leics LE16 9EF, United Kingdom. Change of address or other subscription queries: email *wired@subscription.co.uk* or call 0844 848 2851. Manage your subscription online 24 hrs a day at www.magazineboutique.co.uk/youraccount.  The paper used for this publication is recyclable and made from renewable fibrous raw materials. It has been produced using wood sourced from sustainably managed forests and elemental or total chlorine-free bleached pulp. The producing mills have third-party-certified management systems in place, applying standards such as ISO 9001 and ISO 14001. This magazine can be recycled either through your kerbside collection or at a local recycling point. Log on to www.recyclenow.com and enter your postcode to find your nearest sites.

008

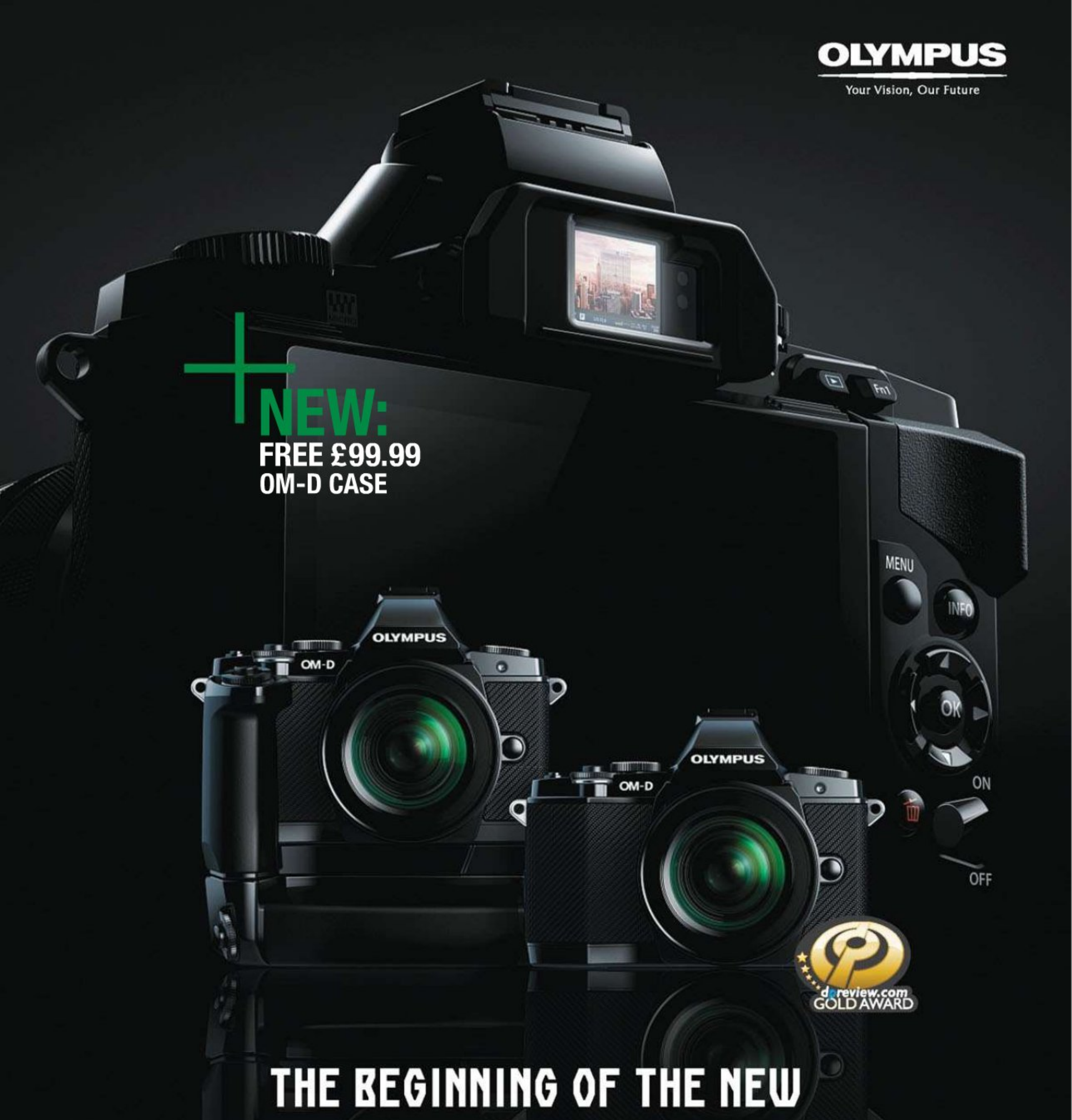
WIRED LOGO: STEVEN TABBUTT, CREATED USING PENCIL, GOUACHE, GESSO AND PAPER COLLAGE OVER A WIRED LOGO. FINAL ADJUSTMENTS MADE USING PHOTOSHOP

OLYMPUS

Your Vision, Our Future

+ NEW:

FREE £99.99
OM-D CASE




# THE BEGINNING OF THE NEW

## OM-D: CREATE YOUR OWN WORLD

A new digital SLR era is about to begin. Digital SLRs, which simply replaced film with an imaging device, did not change significantly in terms of size, weight and user interface. The revolutionary, new mirror-less camera, the OM-D, has an exceptionally light and compact body. Its Electronic Viewfinder enables photographers to check the Art Filter effect, colour temperature and exposure levels in real-time. When shooting, you can instantly create a truly unique world and preserve it in exceptional quality. The world will be transformed from something you see to something you take part in. The OM-D is a groundbreaking, new digital interchangeable-lens camera, perfect for people who want to take part, create, and share.

OM-D

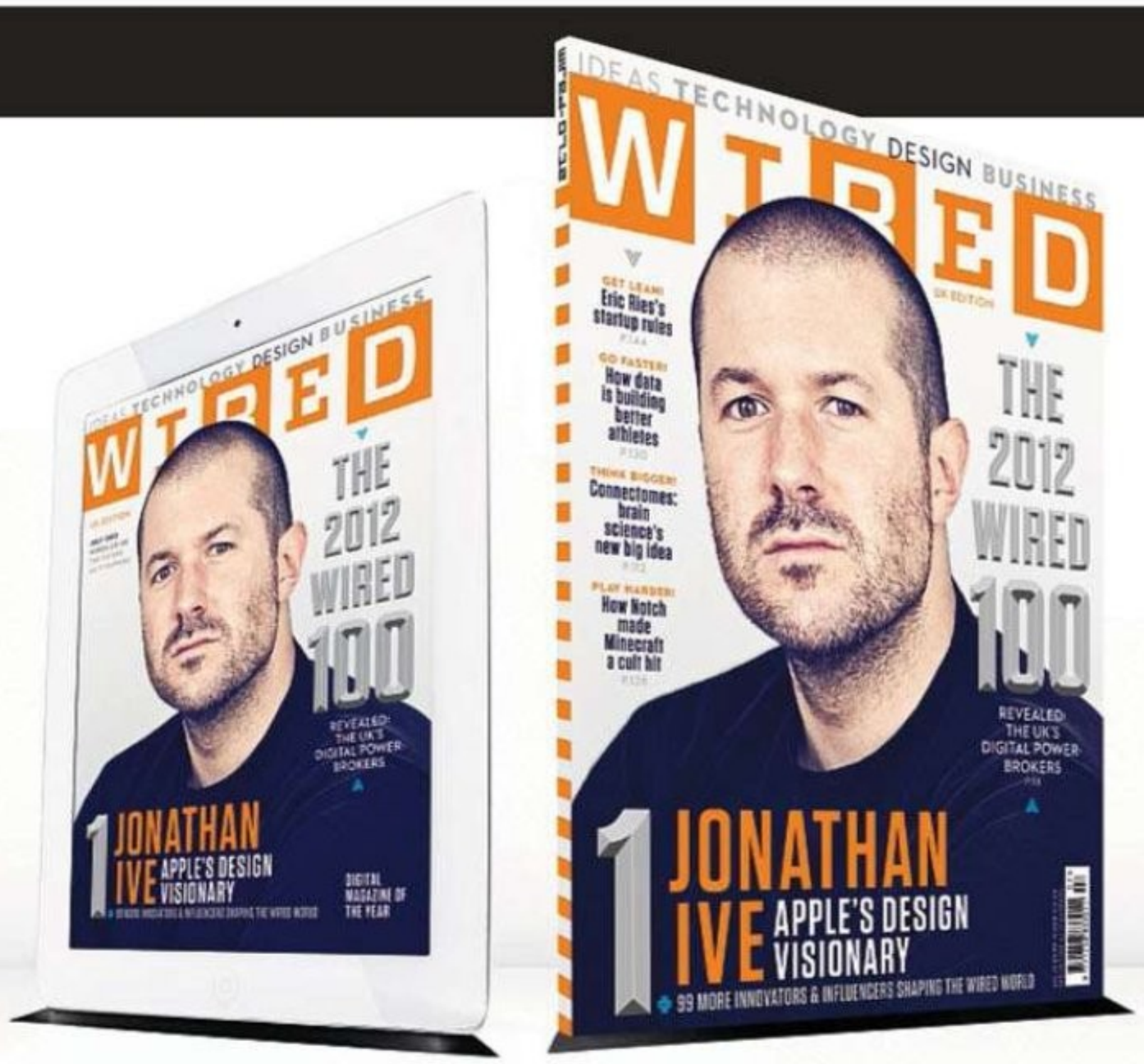
OLYMPUS OM-D

Buy an OM-D between June 1st and July 31st and claim a free two part case worth £99.99. See www.olympus.co.uk/promotions for terms and conditions.

# RANTS

### CAMERA TRICKERY

**"Delighted that *@WiredUK* has let slip that the iPhone version of WIRED is ready to go (*right*) – when can I get it? *#thatbetternotbeapdf*"** *@bertiearcher*




### WIRED TWEETS

***@WiredUK*** **got its Apple woes sorted, last month's iPad edition out two weeks late. This month, Jonathan Ive on the cover. Coincidence?** *@toychicken*

**"No company has managed [deep design] better than Facebook" (How to spot the future, 06.12) – have you used the mobile app?** *@avidfanman*

**Reading about the connectome in *@WiredUK*. Could worms be the perfect criminals as their DNA is always identical?** *@jhrfc*

**I seem to have got a month behind reading the mag. Think you could delay the next issue a month while I catch up?** *@Matt_D_Ford*

**No aftershave samplers in this month's *@WiredUK*. That's me not playing out on Friday.** *@Robbomagic*

**07.12 The 2012 WIRED 100: It was always going to generate ripples of chatter, comment and gripes across the digital universe, but it seems universally agreed that Apple's design visionary Jonathan Ive is a worthy leader of this year's power-broker list. But what about the rest of the rundown? Let us know. Contact us: rants@wired.co.uk**

### UNDO

Joey Primiani was the creator of Google's Cortex technology and Backpane's tech cofounder (Troy Carter, 06.12). Also, the CubeSat is 1,000cm³, not 10cm³ (The satellite I made myself, WIRED 07.12).

### XX < XY

Although I feel like WIRED expands my mind, I find the constant stream of white males tiring. Aren't there women and people from different backgrounds that you could feature too, to give a wider view of the world? Sarah Szalavitz (WIRED 04.12) said that women make the majority of household purchase and investment decisions and yet there is such a slim representation in your magazine. If business success depends on an influx of women to the boardroom, why isn't WIRED, a magazine that I see as exciting and innovative, doing more to push this further? ***Sheena Patel, via email***

### WIRED 100: TROUBLE AT THE TOP...

**So, the social-media counts on your Troy Carter cover were in danger of being out of date at the time you went to press? We'd never have noticed; the numbers are so big, who keeps count? However, we HAVE noticed the binary nature of Michael Lynch's employment status with Hewlett-Packard (#2 in the WIRED 100). Didn't see that coming, did you? But you're not alone lacking foresight. Reed Hastings's view of entrepreneurial endeavour can be summarised in William Goldman's words: "Nobody knows nothing." Makes me wonder why all the VCs in your Top 100 are looking quite so self-congratulatory. Do you want to tell them, or shall I?** ***Paul Arthur, via email***


### ... AND FURTHER DOWN

In a highly mean-spirited profile of me in the latest edition of your magazine, you make several untrue, unsubstantiated allegations about my publication, *The Kernel* (WIRED 100, 07.12). You state that it is "low-budget" without having any knowledge of my company financials. In fact, our editorial budget is very healthy. Our freelance budget is, I suspect, considerably larger than yours. You should apologise for your insupportable claims and for so crassly attempting to inflict damage on a commercial competitor. ***Milo Yiannopoulus, founder,*** **The Kernel,** ***via email***

# CONTRIBUTORS

## Kourtney Roy

Based in Paris, Roy ought to know a thing or two about style – so she was the ideal choice to photograph the founders of Wish Want Wear, a lending library for high-fashion items. "The cofounders were savvy and fun ladies," says Roy. "It's a great idea – I'd borrow a ball gown, but I'd have to try not to spill champagne over myself."

## Gregg Segal

Segal took to the rooftop of Kaggle's San Francisco HQ to capture portraits of its data-scientist founders, Jeremy Howard and Anthony Goldbloom. "I wanted to convey an alchemy of nerd and cool – which they didn't object to," says Segal. "Data science can be applied to anything – I'd worry it might make life a bit too predictable."

## Tricia Wang

Splitting her time between China and New York, Wang is a sociologist and ethnographer. This month, she explains how internet activists in China are policing corruption and seeing that services such as school dinners are delivered. "More and more we see citizens are contributing to social change," she says.

## Todd Antony

Intrepid photographer Antony spent time on Glasgow's dark side for a feature on an anthrax outbreak among local heroin users. "I wanted the images to reflect the seriousness of the story," he says. "Before taking a single shot of Inspector Robertson, I spent 45 minutes chatting to him. He has some amazing – and scary – stories."

## Madhumita Venkataramanan

Coming to WIRED via Mumbai and New York, Venkataramanan is our newest team member. This month, she visits the Science Museum's storehouse in Wiltshire, where nuclear missiles are stored next to old cookers. "I was unprepared for just how large it was," says our assistant editor. "It's spooky and cold – and yes, they even have a ghost."



## Making WIRED

### The science storehouse

**Benedict Redgrove, "Overmatter", p104:** "*Raiders of the Lost Ark* was what came to mind when I stepped into the massive hangar. The lights cracked on, slowly illuminating a huge BOAC plane. And then some more things lit up: a Polaris missile, the *Blue Peter* lifeboat, the first hovercraft, missiles and jet engines, diving bells – all tightly packed in. It was like the fullest garage you have ever seen."

### Shooting from a safe distance

**Todd Antony, "Anthrax has hit Glasgow", p96:** "As we were shooting the Gorbals estate (*above*) in Glasgow from across the river, my assistant and I spoke to a woman who suggested that we try to get into a flat on the 13th floor of one of the buildings, as the view was great. We politely nodded in agreement – but earlier that day the police had strongly recommended that we shouldn't even cross over the bridge."

THE ALL NEW CHRYSLER **300C**

# THE QUIET AMERICAN.

IT'S HERE. THE LONG AWAITED 300C. THE AMERICAN LUXURY CAR,
REDEFINED. DESIGNED TO CHALLENGE EUROPEAN DOMINANCE.
AND AT THE SAME TIME STAYING TRUE TO ITS ROOTS.

DIFFERENT IS WHAT WE DO

WE RECOMMEND A TEST DRIVE. CHRYSLER.CO.UK

THE MODEL SHOWN IS THE CHRYSLER 300C EXECUTIVE. FUEL CONSUMPTION FIGURES FOR THE CHRYSLER 300C RANGE IN MPG (L/100KM): URBAN 29.4 (9.6) – 29.7 (9.5), EXTRA URBAN 47.9 (5.9) – 49.6 (5.7), COMBINED 39.2 (7.2) – 39.8 (7.1). $CO_2$ EMISSIONS 191 – 185 G/KM

# BROWZZZE?


# OR BROWSE?

Experience our fastest ever
browser on the BlackBerry Bold 9900.
**blackberry.co.uk/browse**

BlackBerry Bold.

# FROM THE EDITOR

I realised how sexy data analytics has become over breakfast at Jimmy's Café in the Silicon Valley suburb of Belmont. I'd always assumed that it was the genius software engineers or the design visionaries who were tech's hottest properties. But across the table, DJ Patil, the PhD number-cruncher who coined the term "data scientist", was explaining that zero-cost memory storage had created the internet's next gold rush. Without enough specialists to go round, he said, "data scientists are the new rock stars".

So this month we sent Neal Pollack to live among the data scientists and learn exactly how their skills are solving multi-billion-pound problems. From cracking the human genome to optimising your LinkedIn network, their ability to turn raw data into actionable information is creating a burst of innovation that makes you wish you'd given more time at school to your algebra homework. Kaggle.com is a web platform for data-science competitions. To win $1,000, for example, simply create an algorithm to "identify people who have a high degree of psychopathy based on Twitter usage". Already, 66 teams are working to crack that one...

At our WIRED2011 conference in London last October, US WIRED editor-in-chief Chris Anderson (*above*) came on stage with a UAV produced by his 3D Robotics business (and flew it uncomfortably close to a 3D-printed Stradivarius violin). In this issue, Anderson explains why drone technology is now so cheap and accessible that any of us can tap into quasi-military-grade tech, with little specialist knowledge. We're busy planning this October's WIRED conference, by the way, and delegates will enjoy an equally high calibre of speakers at WIRED2012 (October 25 and 26). Find out more at wiredevent.co.uk. Among the 40 or so speakers, you'll hear from Mark Suppes – who is featured in this issue – on his project to build a nuclear-fusion reactor using parts sourced on eBay...

PHOTOGRAPHY: FRED MACGREGOR; VICTORIA LING; SCOTT GRUMMETT

## THIS MONTH IN THE iPAD EDITION

Subscribe to WIRED now at just £2 a print issue – and get the iPad edition free: wired.co.uk/sub or call 0844 848 5202

Download the iPad edition to hear microbiologist Tim Brooks talk about an anthrax outbreak among heroin users.

Our feature on the Science Museum's storehouse has an overspill of its own, with a 360° and a gallery of extra images.

Read more of what Peter Diamandis, founder of the X Prize, thinks about the future in our extended interview.

David Rowan, Editor

- D&AD Award: Covers 2012
- DMA Editor of the Year 2011
- DMA Magazine of the Year 2011
- DMA Technology Magazine of the Year 2011
- BSME Art Director of the Year, Consumer 2011
- D&AD Award: Entire Magazine 2011
- D&AD Award: Cover 2010
- Maggies Technology Cover 2010
- PPA Designer of the Year, Consumer 2010
- BSME Launch of the Year 2009

# START

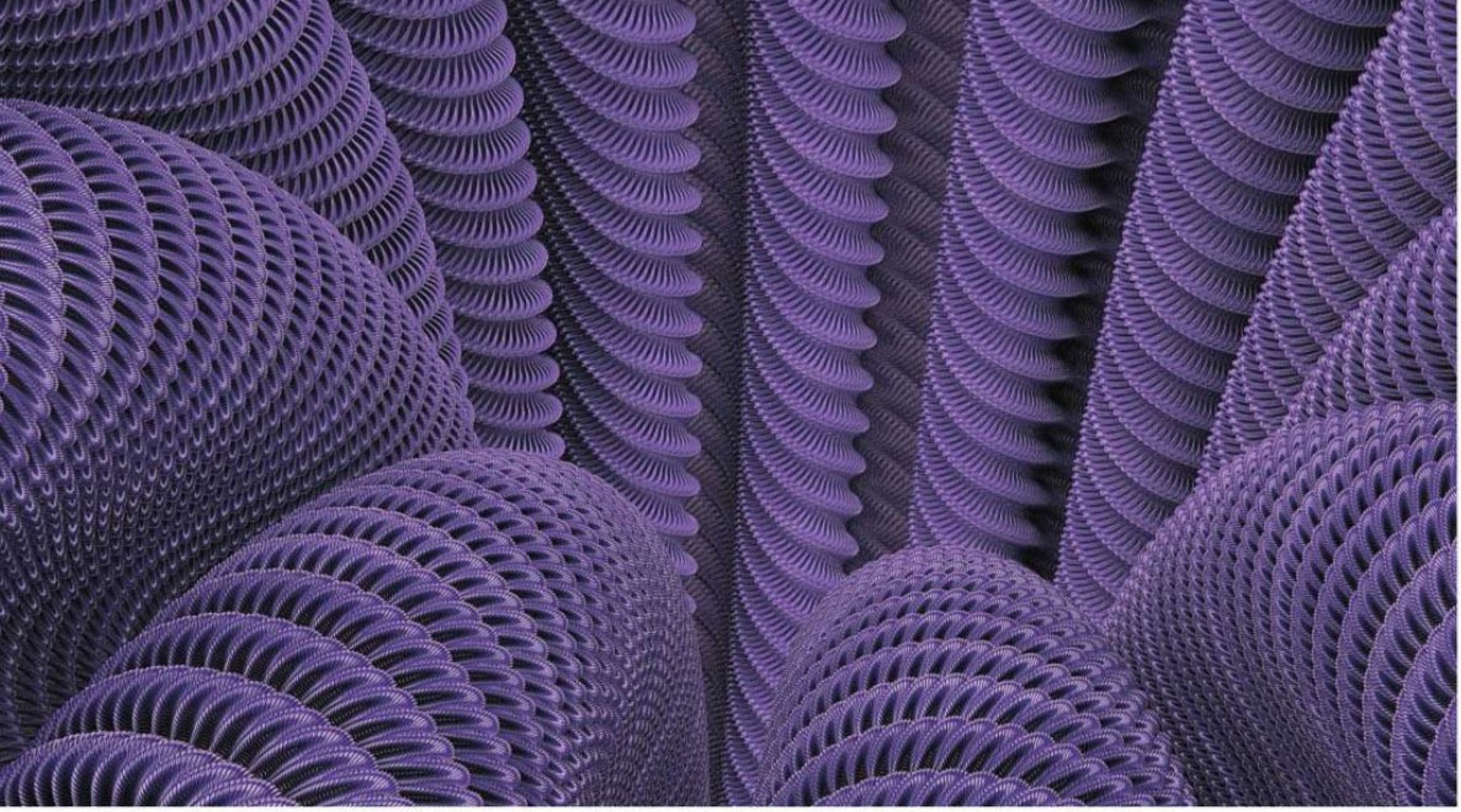
NEWS AND OBSESSIONS
THIS MONTH: 08.12

- DIY NUCLEAR FUSION
- WISH WANT WEAR
- THE POPE'S RECYCLABLE ALTAR
- OLYMPIC EVOLUTION
- FERRARI'S HYBRID ENGINE

EDITED BY JOÃO MEDEIROS

# Inside the infinite loop

This complex geometric form has existed in mathematicians' minds for years – but until April it was believed that the flat torus was impossible to render accurately in 3D ⟶»



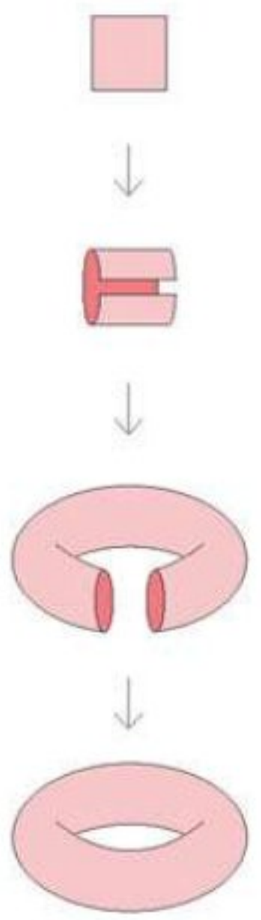
IMAGES: VINCENT BORRELLI; SAÏD JABRANE; FRANCIS LAZARUS; BORIS THIBERT

A **flat torus is a theoretical square with "pairwise identified" sides –** like the wraparound screen in *Pac-Man* where characters exit through one side of the square and reappear on the opposite side. "[Mathematician] John Nash proved it was theoretically possible in the 50s, but no one had been able to show its shape," says mathematician Francis Lazarus, one of the four-person French team who produced the images.

In the past, it's been visualised as the inner tube of a bicycle wheel but this shape is not a mathematically correct representation. "The distance between two points becomes distorted," says Lazarus. "There is no correspondence between two points on the flat torus and the same on the 3D surface." To correct this defect, mathematicians in three labs – the Institut Camille Jordan in Lyon, the Laboratoire Jean Kuntzmann and the Gipsa-Lab, both in Grenoble – built an algorithm that warped the inner-tube shape by piling an infinite number of "corrugations" or ripples on to it, until the distance between points became accurate.

The resulting object (*pictured*) is a completely new type of shape: a smooth fractal. "People thought the theory was too out-of-reach and abstract," says Lazarus. "But we have converted it into an algorithm – one that can be implemented by mathematicians in real life." Coming to a theme park near you: the flat torus water-tube rapids ride. **Madhumita Venkataramanan** *tinyurl.com/bq7y6w3*

S T A R T



**A flat torus in four steps**

1. Picture a two-dimensional square made of soft, malleable material
**2. Enter the third dimension by bending the shape into a tube**
3. Bend and stretch the tube until its remaining edges meet
**4. The resulting abstract shape is a flat torus (not a bicycle's inner tube)**

| WIRED | TIRED | EXPIRED |
|---|---|---|
| *Ender's Game* | *The Hunger Games* | *Battleship* |
| Klouchebag | Klout | Whuffie |
| google.com/pacman | books.google.com/ngrams | Google+ |
| IKEA cameras | Descriptive cameras | Polaroid cameras |
| Averia | Neue Haas Grotesk | Helvetica |

# THE **NEW** WAY TO DO TV

**BeoPlay V1** is made for the way you live and play. Hang it, suspend it, lean it, whatever works for you. It is available in two sizes – 32″ and 40″ – and features powerful built-in stereo sound. Connect it to your Blu-ray player, game console and Apple TV, and control it with one perfect remote control.

Find your local store at **beoplay.com/FindStore** and come experience the all-new **BeoPlay V1**.

**BeoPlay V1:** From £1,999
Energy Class C. Price depends on screen size & accessories.
Bang & Olufsen stores are independent retailers, prices may vary.

beoplay.com

B&O PLAY

# Tower of power

**No, it's not a mirage. This giant structure could be key to supplying energy to barren, remote towns**

**This flower is built to thrive in hot areas. Developed by** Israeli company AORA, the 35-metre-high Tulip, which has just gone into service in Almeria, Spain, produces 100kW of electricity and 170kW of usable heat from the Sun's rays. Fifty-two ground-level mirrors focus the Sun's heat on to a collector at its summit. There, it heats high-pressure air to 1,000°C, which powers turbines to produce electricity. One Tulip can generate enough power for about 50 homes.

Because the turbines are powered by air rather than steam, the system uses 90 per cent less water than traditional solar-power generators – useful for locations where water is scarce. Excess heat can be used to power separate systems, in this case a nearby desalination plant. And the tower and mirrors take up less space than traditional solar-power collectors, so AORA's Tulips can be sited close to where their electricity will be used – reducing energy lost by transmitting power through long cables. Towers can also be linked in modular grids, allowing one to be taken out of service for maintenance without interrupting supply.

This is the second Tulip installation – the first, near Rehovot in southern Israel, powers a local kibbutz – and is seen as a proof-of-concept. The company expects orders for another 25 or 50 as a result, mostly in Spain and Italy. A single tower-and-mirror system takes seven months and £325,000 to build. AORA plans to build further demonstration plants in Mexico and the US next year, with clusters of Tulips eventually feeding whole towns. Here's to a blossoming future.
**David Baker** *aora-solar.com*

When the Sun goes down or is obscured by clouds, the system switches to conventional or biofuels to maintain supply

## STREET SURFING: FREE WI-FI ACCESS HITS THE ROAD

**Need to browse and stream whilst pounding the pavement? Your smartphone may soon be talking to a smart street. Madrid-based company Via Inteligente has built the iPavement – Wi-Fi paving stones that give free internet access to passers-by. "We want to convert analogue cities into digital spaces," says Mario Piattini, scientific adviser to the company.**

**Each 24kg stone contains a 5GB micro-processor chip, powered by a 1kW underground cable. The operating temperature range for the iPavement's calcium carbonate stones is between -30°C and 75°C, making it suitable for cold and tropical climates.**

**As you connect on the fly, a host of cloud-based pop-up apps offers localised information and services on your smartphone. Published through Viacities OS 2.0 – the company's own operating system – apps include a digital street library of locally written works, a map pointing out nearby restaurants and attractions, a neighbourhood daily-deals newsletter and a real-time alert system about disrupted public services near the user.**

**The iPavement is currently being tested in the Puerta del Sol square in Madrid and will appear at the International Building and Construction Show in Dubai in November... and maybe on a high street near you soon.**
MV *ipavement.com*

PHOTOGRAPHY: BOAZ DOVEV; KOURTNEY ROY. ILLUSTRATION: PARKO POLO

# The four-day fashion fixers

New-season outfit caught your eye? Cost of buying it exceeds monthly outgoings? Read on...

**Want to dress in *haute couture* straight from** the catwalk? Step forward Wish Want Wear, an online hire service that lets its users wear the latest designer clothes at a fraction of their cost. For a few days, women can rent outfits from that season's shows – without breaking the bank.

The concept was born from a need cofounders Suruchi Bhargava, Suruchi Saxena and Uttara Parikh had as students in London. "We were trying to dress well on a tiny budget, and feeling the pressure on our wallets," says Bhargava, 33. "The idea hit us when we saw [handbag rental store] Bag, Borrow or Steal featured in the *Sex and the City* movie."

*Left-right*: Wish Want Wear founders Suruchi Bhargava, Uttara Parikh and Suruchi Saxena

Inspired by the "rent, not buy" model adopted by UK companies such as LOVEFiLM and Zipcar, Wish Want Wear launched in London in September 2011, with £1.2 million from an angel investor based in India. The site is free to join, open to all and has 25,000 registered users, according to Bhargava – rising by 60 per cent a month. The dresses are from the current season and are available for about ten per cent of the retail price for a four-day loan. Brands available include Chanel by Vintage Heirloom, Temperley London, Just Cavalli, Red Valentino and M Missoni. At the end of each season, several styles are removed from the site and sold privately. The site is adding a host of new features in the coming months, including a wedding boutique. "We want our wardrobe to be an option for women with budgets of all sizes," says Bhargava. The days of Moss and Middleton stealing the limelight could be numbered. **MV** *wishwantwear.com*

# The Olympic evolution

From croquet to BMX cycling, WIRED tracks 116 years of official events

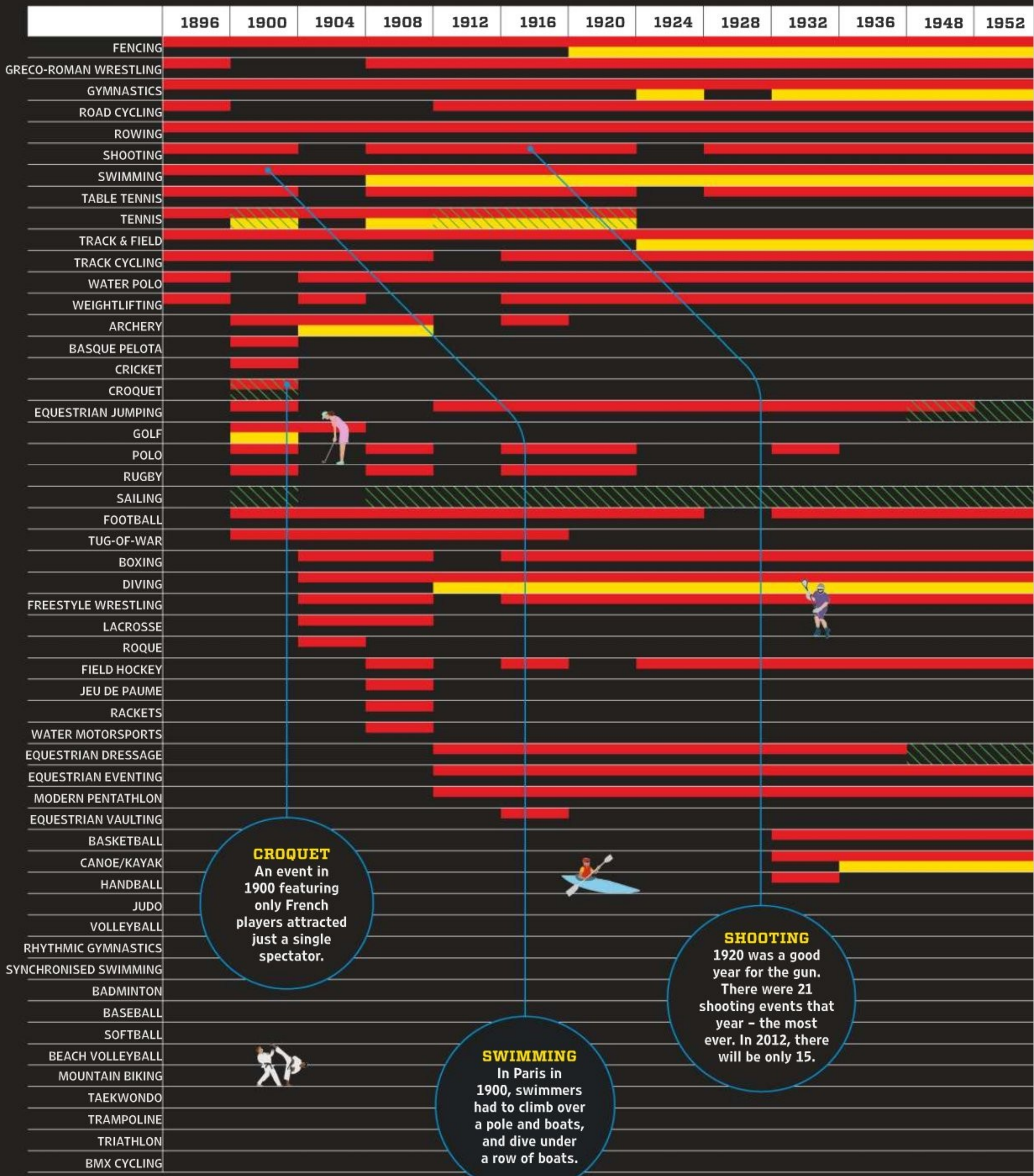



ILLUSTRATION BY ADAM SIMPSON

**What counts as an Olympic sport? It depends on the year: live pigeon-shooting was a hot new event in** 1900 – but like 184 other events, it only lasted one Olympiad. Yet there are still firsts: this year will have the inaugural women's boxing bouts. Here's a look at some long- and short-lived events. **Rachel Swaby**

INFO PORN

1956 1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012

**RUGBY**
88 years after its last event, men's rugby will return in 2016, and women's rugby will debut.

**SOFTBALL**
Largely dominated by the US, softball was eliminated after the 2008 Games in a 52-52 IOC stalemate.

**BEACH VOLLEYBALL**
2012 marks the first time women competitors can wear something other than a bikini.

SAMSUNG

# Samsung GALAXY S III

## lets you do two things at once

**Pop up Play** lets you watch a video in a separate moveable window while surfing the web, replying to a text or sending an email.


designed for humans, inspired by nature

pebble blue marble white

4.8" HD Super AMOLED Display | Intelligent Camera

**samsung.com/gs3**

Together with O2

## SCREENED MORNING APPS

WIRED

***Sleep Cycle alarm clock***
This app uses the iPhone's accelerometer to monitor sleeping patterns, based on your tossing and turning. The goal? To wake you when your sleep is at its lightest, within a 30-minute window. *iOS, 69p*

***TED***
An archive of more than 1,100 TED talks at your fingertips. It lets you sync talks for offline playback, so no 3G needn't mean no brain food. The ideal commute companion. *Android, iOS, Free*

***Remember The Milk***
A long-time WIRED favourite, *Remember The Milk* is a clean and intuitive app that gives you polite reminders about your daily chores. *Android, BlackBerry, iOS, Free (pro upgrade available)*

***Reeder***
Add your favourite news sites to Google Reader and *Reeder* pulls all the latest content to your device. Images are cached for offline viewing, too, and a slick interface makes reading a pleasure. *iOS, £1.99*

***Train Times***
This BlackBerry app taps into the UK's National Rail Enquiries database to show you real-time info about where your next train is. Similar versions exist for iOS and Android. *BlackBerry, £4.99*

WEIRD

***Snake '97***
The original time-suck on your phone was *Snake*. This retro app returns you to the age of 2G, SMS storage limits and a two-week battery life. *Windows Phone, 79p; Android, Free; iOS, 69p* **Nate Lanxon**

PHOTOGRAPHY: LEON CSERNOHLAVEK

## EARLY ADOPTER

**What's exciting...**
**ALEKS KROTOSKI,**
Broadcaster, technology researcher and social psychologist

"I'm obsessed with technology utopias – specifically, the myopia of the philosophers and technologists who dream them up after the invention of a new gadget. Read Carolyn Marvin's ***When Old Technologies Were New*** for perspective, *then* build your next app."

# Nature's noise-buster

**Michel André listens to oceans – from the** Universitat Politècnica de Catalunya in Barcelona. The 48-year-old director of the Labratory for Applied Bio-acoustics oversees a network of 28 underwater hydrophone arrays that monitor sounds caused by marine animals, human activity and the environment. They are attached to existing underwater observatories which scan for signs of illicit nuclear testing or for neutrinos passing through the Earth. André's project, Listening to the Deep Ocean Environment (Lido), began 15 years ago with a sensor that helped ships detect approaching whales to avoid collisions. But now he is more interested in the damaging sounds humans make. "Even animals that don't 'hear' in the normal sense, such as squid, are being harmed by man-made noise," he says.

Human sounds mean trouble for sea life. Michel André can help

His proposed solution is a system of 30 to 40 hydrophone arrays that can be attached to buoys and distributed where activity such as exploration for oil or gas is taking place. These can communicate wirelessly in real time with each other, and with the team carrying out the work. "If an animal comes into range, workers can choose to suspend what they are doing until it has left the area," he says. There is no regulatory requirement for marine projects to protect wildlife in this way, but André hopes that pressure from environmental activists will spur action.

"Sound travels far," he says. "We need to find out how animals react." **David Baker** *listentothedeep.com*

Lido founder Michel André in Barcelona. He is campaigning for a global, round-the-clock hydrophone presence

START

# MINIMISED FRAME, MAXIMISED 3D.

LG
Life's Good

The new CINEMA SCREEN design on LG CINEMA 3D TV features a stunning, minimised frame to provide the ultimate immersive 3D viewing experience.

It's amazing when it's off, breathtaking when it's on.

www.lg.com/uk/CINEMA3D


WHAT HI-FI? SOUND AND VISION
★★★★★
LG 47LM670T
MARCH 2012

Interactive magazine

SEE EXCLUSIVE CONTENT
DOWNLOAD THE BLIPPAR APP AND BLIPP THIS PAGE

CINEMA 3D Smart TV

PHOTOGRAPHY: TOM VACK COURTESY OF KRAM/WEISSHAAR

The sitter exerts low pressure on the legs of the chair (blue/green), but high pressure on the seat and back (red)

# Posture-mapping

**Ever wished your chair felt more like** a sports car's? The new Audi R18 Ultra Chair, a carbon-fibre design that weighs only 2kg, combines the lightweight technology of its namesake with crowdsourced ergonomic data. "Race cars are tested over thousands of test laps on secret tracks," says designer Clemens Weisshaar, 35. "We wanted to bring that method to furniture design." He and his partner Reed Kram set up an installation at the recent Milan Furniture Fair. Almost 1,500 visitors sat, fidgeted and slouched in the chair – while watching 30-second bursts of real-time video depicting the forces they were exerting on it. The thermal-imaging-style colours (*above*) represent varying intensities of pressure, measured by hundreds of tiny sensors in the chair: blue/green is low stress, red is high. "We wanted users to interact with our design and build a rich data set of their real-world testing," says Weisshaar.

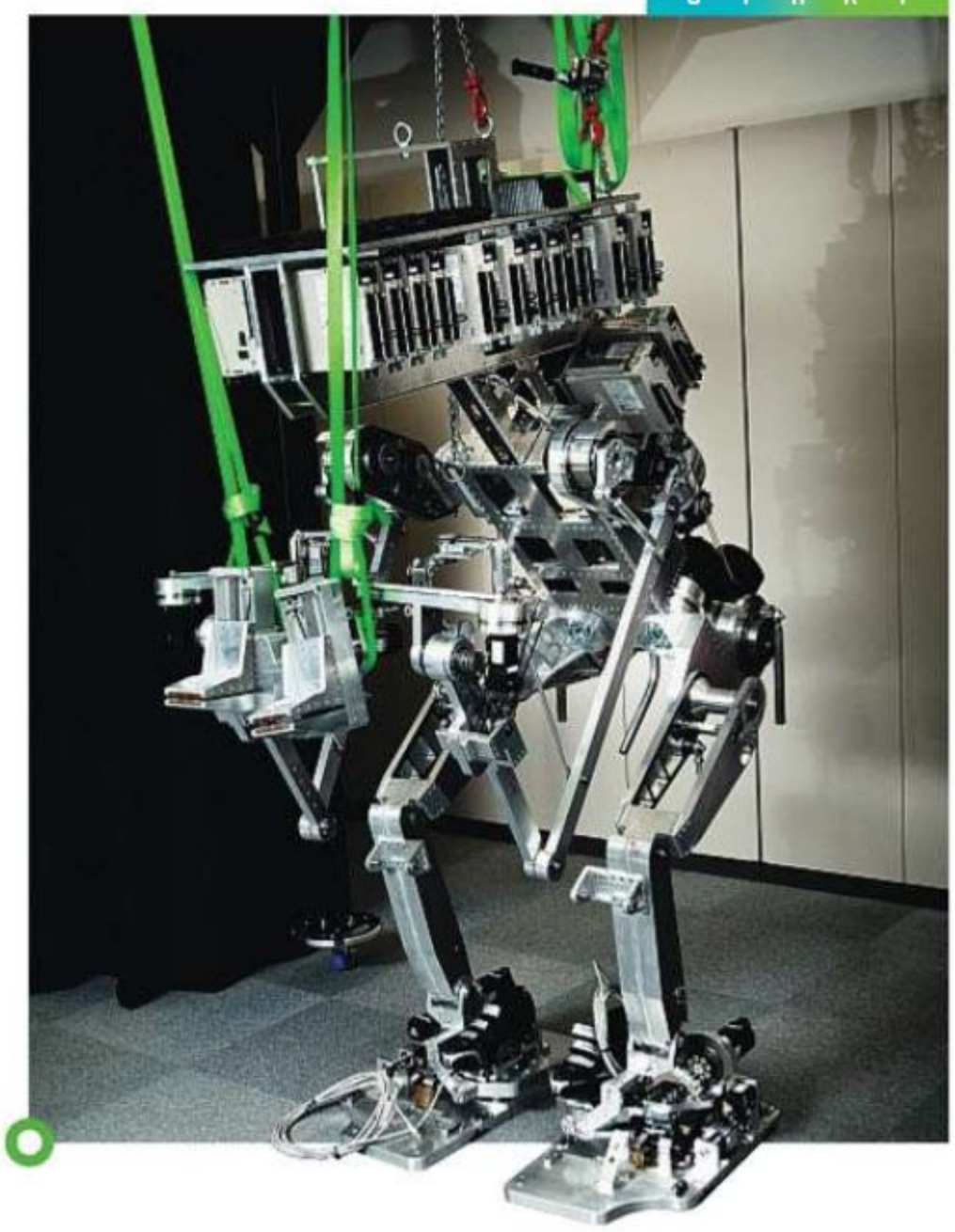
Audi's chair is built on sensory data from 1,500 fidgeting volunteers

After crunching the user data and incorporating it into their design, Weisshaar and Kram will display the final iteration, which will come flatpacked Ikea-style, at DesignMiami/ in December. **MV** *r18ultrachair.com*

The Audi chair's design borrows elements directly from the Audi car, including its rear wing: Kram and Weisshaar layered soft rubber with firm carbon composites to make the flexible backrest

PHOTOGRAPHY: KO SASAKI

S T A R T



# People carrier

Ikuyo Matsuo has developed two wearable robots – inspired by Ripley's *Aliens* suit

**If you've got a heavy load to carry – and that could** include yourself – Activelink, a Kyoto-based robotics firm, has developed the Power Loader, a suit named after the exoskeleton controlled by Ellen Ripley in *Aliens*. "I'm weaker than the average man," says Ikuyo Matsuo (*left*), who designed the Power Loader. "That's why I think I'm better at working out which part of the body needs to be assisted and how. When I try to lift my leg, if the Power Loader is moving correctly, it feels easier. But if I don't control it right, it increases the burden. You need to be sensitive enough to notice the difference – a burly guy just wouldn't get it." Our ageing society will boost demand for such mechanical assistants, according to Hiromichi Fujioto, the founder of Activelink. "First we'll use the technology to assist heavy labour in construction," he says. "But from 2020 onwards, the demand will be universal."

There are two Power Loader models. The MS-02 (*above*) is an aluminium-alloy mountable version that lets you lift 100kg by detecting the strength and direction of the forces you apply. The PLL-02 (*left*) weighs just 45kg. Activelink's recruitment policy ensures its staff includes men and women of varied ages and sizes, so the Power Loaders can be exposed to different users. "They are difficult to design," says Go Shiorgauchi, the company's head of technology. "If we tailor them to a specific user, they become awkward for others." So, now we have the Power Loader, let's talk about building a dropship... **Shin Asada**
*psuf.panasonic.co.jp/alc/en/index.html*

The lighter model, the PLL-02, has six motors and 12 degrees of freedom

The 230kg MS-02 model uses 20 motors and has 20 degrees of freedom

## THE BIG QUESTION

"What is the future of travel and tourism?"

**IAN YEOMAN,**
**PROFESSOR OF TOURISM, VICTORIA UNIVERSITY OF WELLINGTON**

"In Tokyo and Seoul, 30 per cent of bookings are on the day of arrival through the mobile phone. We point our phone at a hotel, use AR to view information and book on Expedia. Next is soft singularity – internet contact lenses or auto-translation software will bring rapid change."

**CLAIRE BOONSTRA,**
**COFOUNDER, LAYAR**

"The journey starts before you even know you want to go. Any resort ad or travel article will be a point of discovery and purchase. You can hold your phone over it and be seduced with a 360° video and ratings-based offers. Tap to buy or share it before continuing with your day."

**GEORGE WHITESIDES,**
**CEO AND PRESIDENT, VIRGIN GALACTIC**



"We will soon be able to experience space travel, which may open up high-speed intercontinental travel to the rest of us. Our vehicles will demonstrate the technologies needed to break out of the Mach 0.8 box that air travel has been stuck in for 40 years."

**AIGERIM SHORMAN AND SHANA ZHENG,**
**COFOUNDERS, TRIPTROTTING**

"People reach out to their social networks to help them plan trips. Until now, that network has only been people you know. Services like ours extend that to people all around the world with similar travel interests, allowing travellers to ask questions directly to local people."

**PROFESSOR DIMITRIOS BUHALIS,**
**DIRECTOR, BOURNEMOUTH UNIVERSITY ETOURISM LAB**

"Mobile will empower context-based and real-time services to meet tourists' personal needs. My graduate student Zornitza Yovcheva is working on AR smartphone apps which overlay information on physical objects and store tourists' views."

**ESTHER DYSON,**
**COMMERCIAL SPACE-TRAVEL INVESTOR**

"Extra value will be attached to 'real' experiences, including space travel, even though they will be annotated by tools such as iPhone walking guides and Google Glasses. And in a world of ubiquitous automation, I foresee a fancy hotel brochure advertising 'human room service'." **MV**

snapdragon™
by Qualcomm

# Breathe fire into your mobile games.

Inside the best mobile games beats the heart of a dragon. Snapdragon processors by Qualcomm give you the most immersive gaming experiences. Better graphics, faster connectivity and longer playtime.

Learn more at **qualcomm.co.uk/snapdragon**

# Optimism's X man

## Peter Diamandis launched the X Prize – now he plans to mine asteroids

**Peter Diamandis has a perspective too expansive for a single planet. Decades of Nasa timidity convinced him the only way to get off it was to build a private space industry. His breakthrough idea was to offer big prizes for solving epic challenges. He began with the $10 million (£6.5m) Ansari X Prize, which resulted in the first repeatable private flight to the edge of space. Later X Prizes tackled issues such as fuel efficiency and health care costs, drawing in bright, idealistic people to solve earthly problems. To that end, he founded Singularity University. Now in its fourth year, the ten-week summer school trains next-generation leaders in using fast-evolving technologies to address what he calls "humanity's grand challenges". Then there's his most recent undertaking: a company unveiled in April devoted to mining asteroids. The technologies that power such dreams, as Diamandis writes in his book (coauthored with Steven Kotler)** ***Abundance: The Future Is Better Than You Think****, **are propelling us towards an era of unprecedented prosperity. We asked him what tomorrow will bring.** Ted Greenwald






PHOTOGRAPHY: NIGEL PARRY

**WIRED: Have you always wanted to change the world?**
Peter Diamandis: No. My first ambition was to get off the world. My childhood dreams were focused on being part of the effort to make humanity a multiplanetary species. I believe we have a moral obligation to back up the biosphere, take it off-planet, and give ourselves the safety of ubiquity.

**What sparked an interest in space travel?**
As a child, it was the Apollo programme and the *Star Trek* series on TV. A key memory: when I was eight years old, I sat my parents down and gave them a lecture on the Apollo programme. My dad gave me $5 – the first money I ever earned in aerospace.

**How did you end up studying medicine?**
My father, who grew up picking olives on the Greek island of Lesbos, was a doctor. So my family expected me to become a physician. But I divided my life between pre-med and space cadet. In 1980, during my sophomore year at MIT, I realised that the school didn't have a student space organisation. I made posters for a group I called Students for the Exploration and Development of Space and put them up all over campus. Thirty-five people showed up. It was the first thing I ever organised, and it took off! We had chapters at Princeton and Yale. Thirty years later, there are dozens of chapters around the world.

**When did you give up on the government's ability to open the space frontier?**
It was the 500th anniversary of Columbus in 1992. The first Bush administration was supposed to start a massive effort to go back to the Moon and on to Mars. It fizzled. That's when I got it: this was never going to happen. Any time a new Congress came in, it would cut Nasa's budget. Commercial industry was the only way to generate long-term funding. I thought, how might I create the economic engine to open space regardless of the government's ups and downs? That's when I cofounded Zero Gravity, which let customers experience weightlessness on parabolic aeroplane flights.

**How does experiencing weightlessness drive space exploration?**
Two forces have opened most frontiers: tourism and resources. People go for the experience or for the gold, spices and tobacco. I had tried to get on Nasa's zero-g plane and couldn't. I thought there must be a market for this, so in 1993 I partnered with Nasa engineer Ray Cronise and Byron Lichtenberg, who had flown two Space Shuttle missions, and we raised $500,000. We walked into California Space Authority's office and pitched the idea. They said the regulations wouldn't allow an aeroplane to do parabolic flight with passengers' seat belts unstrapped. I said that's bullshit. For 11 years I tried to get permission from the US Federal Aviation Administration (FAA). We finally became operational in October 2004, and we've flown 300 flights for 12,000 customers, most famously Stephen Hawking.

**You unstrapped Stephen Hawking's seat belt in zero gravity?**
He told me, "One of my dreams is to fly into space." I said I couldn't fly him into space, but I could fly him into zero gravity. On the spot he said yes. The next day I put out a press release announcing our intention to fly Stephen Hawking. I got two calls that day. One was from our aircraft partner, who said, "Are you crazy? We're going to kill the guy!" The other was from the FAA saying, "You're only licensed to fly able-bodied people." I was like, fuck that. We're going to give this world-famous expert on gravity the opportunity to experience zero gravity! It took six months to line up the approvals.

**Where did the idea of incentive prizes come from?**
It came from Charles Lindbergh's memoir, *The Spirit of St Louis*. In 1919, a hotel owner named Raymond Orteig put up a $25,000 prize for the first nonstop flight between New York and Paris. Nine teams spent $400,000 to try to win. Lindbergh had the least experience. He was called the flying fool, but he won. Aviation didn't get easier, but his flight changed people's belief in what was possible. I thought: this is how I'm going to get my butt into space! Getting the public to change its beliefs is the underpinning of an X Prize.

**How did you settle on suborbital flight as the benchmark for the first X Prize?**
When I read Lindbergh's book in 1994, the cost of going into space had not changed in 30 years. There was no commercial incentive to reduce it. By the time I finished the book, I had written in the margins "X Prize" – X was the person who would give the money – and "suborbital flight". It took five more years to find the Ansari family, who funded it. We named it the Ansari X Prize in their honour, and the X stuck around. Scaled Composites won it with SpaceShipOne in October 2004.

**When did you realise the X Prize could be a series of challenges to address a variety of other problems?**
The $10 million Ansari X Prize drove $100 million in investment by the competitors, and resulted in 26 designs from seven companies. SpaceShipOne was inducted into the Smithsonian, and it's hanging in the National Air & Space Museum in Washington DC, right above Apollo 11, next to Spirit of St Louis. At that point, we had to decide: do we declare success and shut down because we're out of money, or do we turn what we've learned into a platform for creating more breakthroughs? I was invited to speak at Google, and afterwards a guy in a backpack and T-shirt walked up and said, "I'm Larry Page. Let's have lunch." He funded the foundation to look at other areas,



S T A R T

## Countdown to blast off

**Peter Diamandis has been pushing for the exploration of space since he was a college kid. Here's a timeline of his achievements.** Bess Kalb

**1980**
As a sophomore at MIT, forms Students for the Exploration and Development of Space.

**1987**
While working toward a graduate degree at MIT, founds International Space University.

**1992**
Envisions a for-profit company (Zero Gravity) that would let customers experience zero-G.

**1996**
Announces the X Prize, a $10 million challenge to build a reusable sub-orbital craft.

**2001**
Space Adventures, cofounded in 1998, sends a millionaire "space tourist" to the ISS.

**2004**
Awards the first X Prize to Scaled Composites, which won with its SpaceShipOne craft.

**2006**
With Google cofounder Larry Page, expands the X Prize Foundation beyond spaceflight.

**2008**
Takes the X Prize ethos to academia and cofounds Singularity University.

**2012**
Founds Planetary Resources – backers include Larry Page, James Cameron and Ross Perot.

# CONDÉ NAST COLLEGE *of* FASHION & DESIGN

## OPENING JANUARY 2013

**Be the first through the door of London's exciting new College of Fashion & Design**

**Vogue Fashion Certificate**
Ten weeks: starts January 2013

**Vogue Foundation Diploma**
One year: starts October 2013

To find out more and apply visit
**www.condenastcollege.co.uk**

Applications now open

and the scope of the X Prize was broadened to address more of humanity's grand challenges in exploration, including space and oceans, life sciences, education, global development, energy and the environment.

**What do you now have in development?**
Perhaps the most important one is the Qualcomm Tricorder X Prize. It's a $10 million challenge aimed at developing version 0.9 of the *Star Trek* tricorder, the medical device that allowed Dr McCoy to assess someone's health status. By 2020, the US will be short of 91,000 doctors. There's no way we can educate enough doctors to make up that shortfall. You'll talk to this device, cough on it or do a skin prick, and it'll diagnose 15 disease states more accurately than a qualified doctor.

**You cofounded Singularity University to train people to think about the exponential pace of technological change. But it has become a magnet for entrepreneurs.**
I tell people it's two sides of the same coin. The X Prize sets the targets and gives the inspiration, and Singularity University students are the activators, the instigators. We're training people to think globally and exponentially. They spend the first five weeks learning about artificial intelligence, robotics, sensors, networks, synthetic biology and nanomaterials. In the next five weeks, their job is to conceive of a product, service or company capable of positively affecting a billion people within a decade. We've spun off 24 companies. About half of them have received funding or won awards.

**Why do you think we're headed towards an era of unprecedented abundance?**
As I watched what small teams accomplished with change-the-world technology, it struck me that the world's biggest challenges are also its biggest market opportunities. Think about AI and robotics. Each of these fields will displace and reinvent billion-dollar industries. In the next five years, people will program living systems the way we program computers. I became convinced that abundance is where we will end up. A Maasai tribesman in Kenya today has better mobile communications than President Reagan had 25 years ago. If they're on a smartphone, they have access to more information than President Clinton did 15 years ago.

**Could anything derail us from this path?**
Yes: the risk aversion we've developed as a society. Lawyers have ubiquitous power. If someone is always to blame, if every time something goes wrong someone has to be punished, people quickly stop taking risks. Without risks, there can't be breakthroughs.



## % WIRED INDEX

**665**
People who have worked on *Star Wars: The Old Republic*

**3 MINUTES**
Av. time spent per month on Google+ by PC users

**3.86%**
Percentage of Google+ users from Bangalore, India, the city with most Google+ users globally

**12.3 BILLION**
Profit in dollars made by Hollywood films in 2011

**150,000**
Hours each day wasted by humans solving Captchas

**55**
Percentage of DNA humans share with bananas

**1,980,930**
Number of Tweets about the 2012 Academy Awards that were posted as it was showing

**1,500 YEARS**
Collective time spent by users on apps within Spotify since December 2011

*For sources, see page 142*

**Your most recent enterprise, Planetary Resources, aims to mine asteroids. What resources are you after?**
Unlike oil reserves or even the oceans, which are limited, resources in space are infinite. Asteroids called carbonaceous chondrites, also known as dirty ice-balls, are up to 20 per cent water. You can use solar energy to break up water molecules into hydrogen and oxygen, which is rocket fuel, so you can create filling stations for deep space operations or oxygen and water for human consumption. Launching water beyond Earth orbit costs $20,000 per kilogram using the lowest-cost launch vehicle, so you save a lot by mining it in space. Another category of asteroid is rich in platinum-group metals such as palladium and osmium, which are used in medical devices, computer harddisks, LCD screens and other electronics. They're rare on Earth, but not in space.

**What's your timeline?**
Our priority for two to five years is finding targets. Within 24 months, we'll be putting up a series of imaging systems that can identify near-Earth-approaching asteroids. The next-generation system will include propulsion, so it can go out to the asteroids and start the first stage of remote sensing. The generation after that, which should be ready in a decade, will land and begin the early stages of what will ultimately be processing. This is a decade to multidecade proposition – but then, so were X Prize and Zero Gravity.

**How do you maintain your optimism amid the barrage of global bad news?**
Our brains are wired to look for negative information. The amygdala is the danger centre. Our senses are routed through it before they get to the cortex. When we heard a rustle in the branches, we thought "tiger", not "wind". That's why, in the news, if it bleeds it leads. But the facts are absolutely clear. The world is getting better at an extraordinary rate. The technologies available for solving problems are becoming more powerful and empowering more people. Will there be problems? Disasters? Pandemics? Of course. But humanity picks up and keeps moving. In the US, lifespans nearly doubled in the last century. Per-capita income more than tripled, and the cost of food, energy, transportation and communications have dropped exponentially. That's my source of optimism. That and a realisation I made early on that if there's a problem, I'm going to solve it. Once you see the world that way, it's a different place.

**iPad extra!**
Download the WIRED app to read an extended version of this interview

# WORK BETTER ONLINE WITH RELIABLE SERVICES

## *Everything you need to work better online from Fasthosts*

That's not just a web-hosting package, a domain name, a virtual or dedicated server, broadband, hosted email or online backup. **It's a service your business can rely on**.

You'll get **award-winning technology**, but you'll also have the **support** of people who can help you work better online. If you need to call us, you'll find our team of **IT experts** happy and eager to help. It all adds up to a service your business can rely on.

Plus, with ***up to 70% off**** selected products and **NEW dedicated servers** there's no better time to buy.

Find out how your business can work better online
*call* ***free*** *on* ***0800 6520 444***
*or visit* ***www.fasthosts.co.uk***

fasthosts™

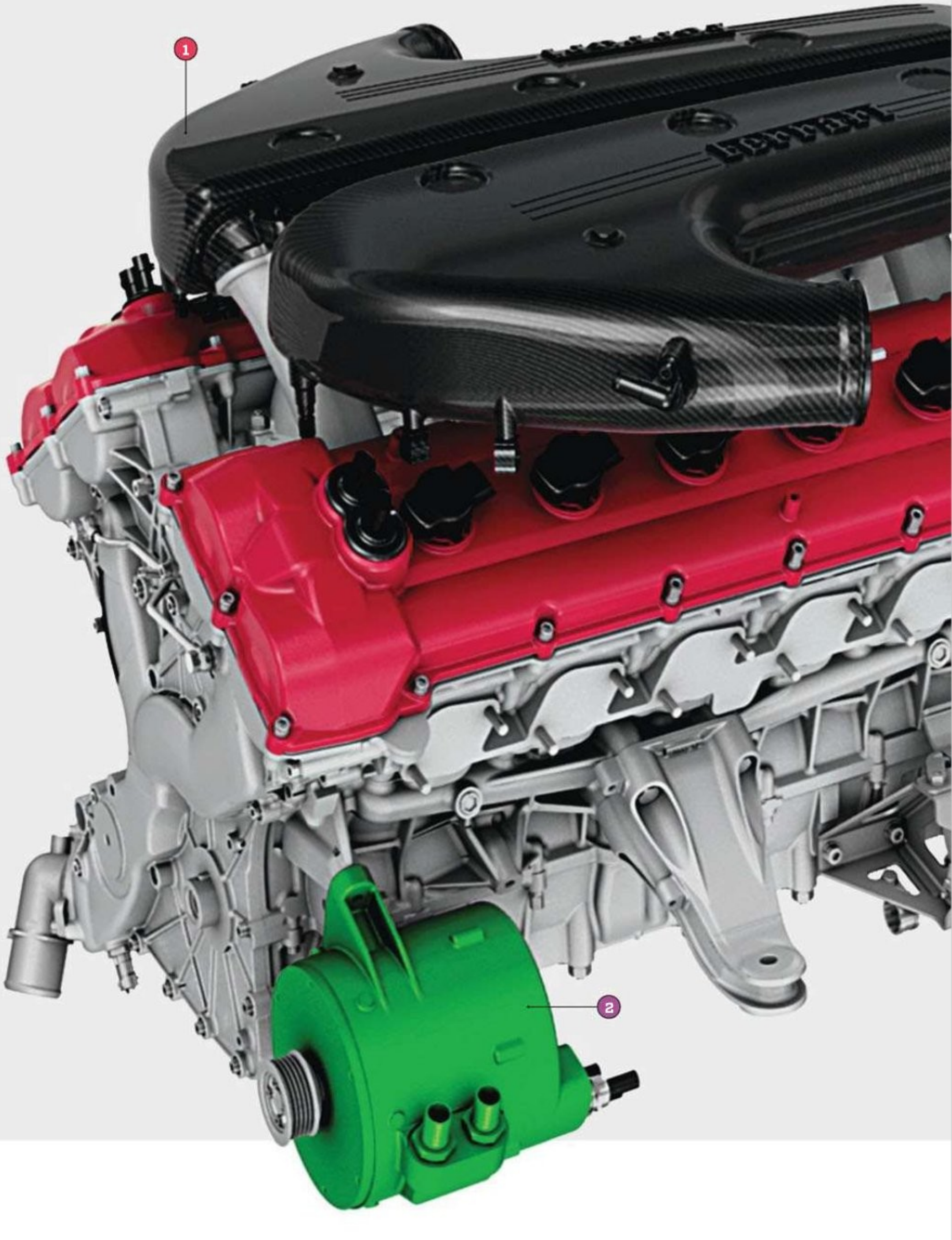
**hosting | domains | NEW dedicated servers | virtual private servers | reseller hosting**

# Lean, half-green machine

This new hybrid engine produces 35 per cent fewer emissions – but it still roars like a Ferrari

**At the Beijing Auto Show in April, Ferrari unveiled its latest HYbrid** Kinetic Energy Recovery System (HY-KERS) concept – a power train for the road that has inherited technology engineered for the Formula 1 circuit. Though the car won't drive battery-only, even at low revs (in order to retain the distinctive Ferrari engine sound), the HY-KERS will match the output of a conventional supercar engine while reducing emissions by 35 per cent, keeping it in line with EU law for urban driving. The project is entering commercial development and is reported to be the hybrid heart powering Ferrari's successor to the Enzo. It will be unveiled later this year. Here's how it sets the pace. **Jeremy Kingsley** *ferrari.com*

**iPad extra!**
Download the WIRED app to explore Ferrari's HY-KERS engine in 360°

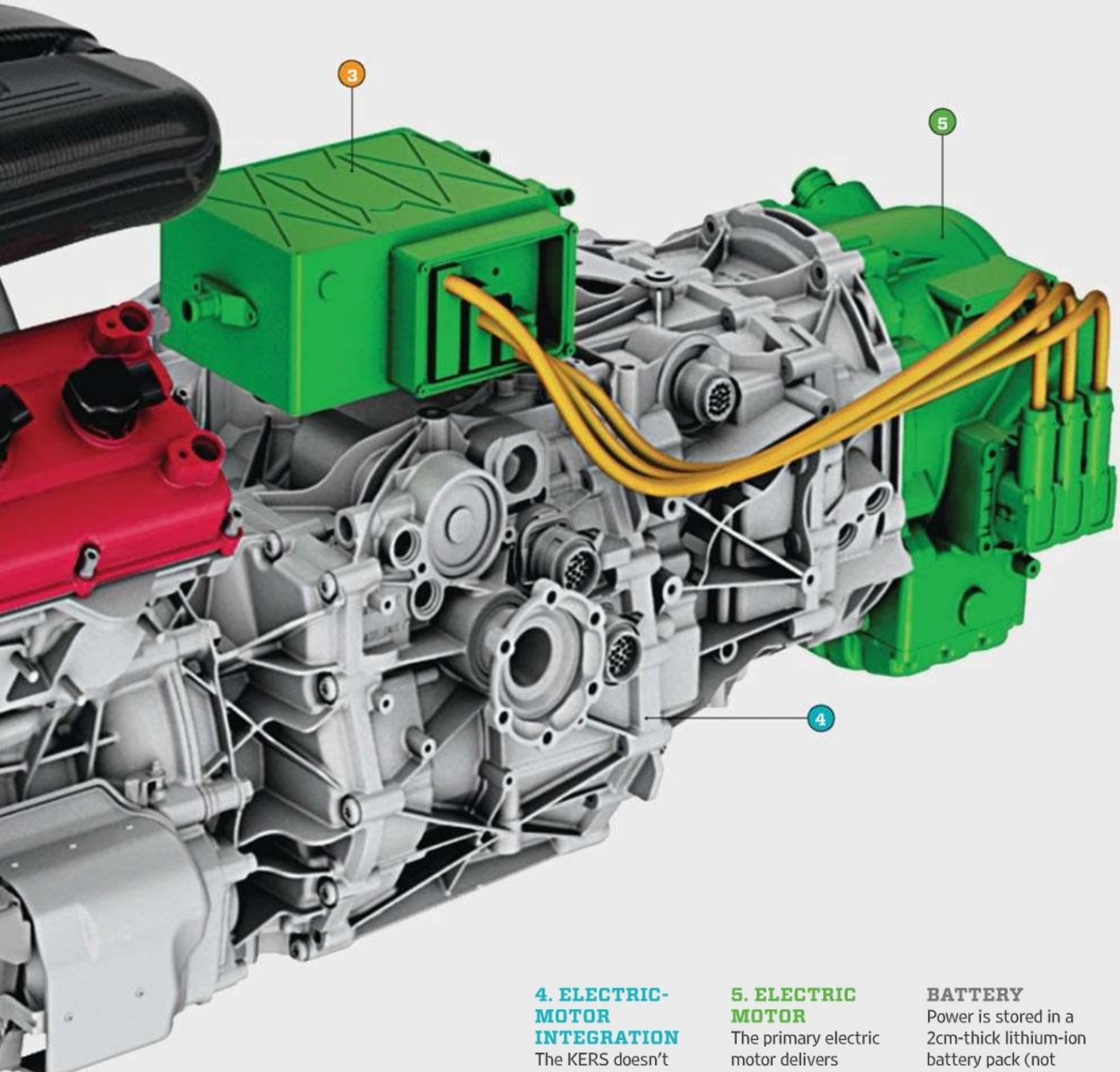


# TECH TORN APART

### 1. V12 ENGINE
The 12-cylinder engine is a pretty efficient internal-combustion model, packing 800hp. A three-stage "multi-spark" used during combustion ensures that all fuel is ignited. This is intended to make the car ten per cent more efficient.

### 2. AUXILIARY ELECTRIC MOTOR (KERS)
A second electric motor charges the battery as needed, recovering kinetic energy when braking. The motor is dedicated to auxiliary onboard electrical systems.

### 3. HYBRID POWER UNIT
The hybrid power unit manages the battery and electric motor. Its software uses algorithms developed by Ferrari's F1 team to control KERS, along with the power management of the auxiliary systems.




### 4. ELECTRIC-MOTOR INTEGRATION
The KERS doesn't need a starter motor: the rear battery-powered electric motor turns the gears, and in turn the drive-shaft and engine – the same way F1 cars are started in the pits.

### 5. ELECTRIC MOTOR
The primary electric motor delivers power to one of the two clutches in the transmission. When braking, the motor recharges the battery from the kinetic energy of negative torque.

### BATTERY
Power is stored in a 2cm-thick lithium-ion battery pack (not shown), lying below the car floor. All extra weight is added under the floor and between the wheels, below the vehicle's centre of gravity, so as not to compromise handling.

# Flat-pack construction for the masses

Pope coming to visit? Better get out your recyclable pop-up altar...

**When the Pope rolls into town, you can expect a big turnout. So you're going** to need a huge space – and a giant one-use altar with impeccable green credentials. Enter Stuttgart engineering firm Werner Sobek, designer of this pop-up pedestal for last September's papal visit to the Freiburg Airfield in Germany.

The altar, measuring 52m by 38m and with a 15m-high roof, was built over two months without glue or welding. Instead, steel parts were clamped together into a base frame, which was then covered with laminated wood and a polyester membrane. Once the event was over, the frame was dismantled to be used on other projects and the membrane turned into carrier bags.

More than 80 per cent of the materials used ended up being recycled or reused. "We encourage a strong tendency towards using components that can be completely dismantled," says Albert Schuster, project leader at Freiburg. "But not all manufacturers yet offer fully recyclable products." We suspect his prayers will soon be answered. **David Baker** *wernersobek.de*


PHOTOGRAPHY: ZOOEY BRAUN. ILLUSTRATION: BEN MOUNSEY

## SCRATCHING OUT A SOLUTION TO AFRICA'S SOLAR-POWER LOTTERY

**For Africans in remote areas, affordable solar power is now an SMS away. "In many African countries, about 80 per cent of the population lives off the electric grid," says Simon Bransfield-Garth, CEO of Cambridge startup Eight19. Solar energy is available, but "people find it impossible to afford the initial bulk cost of installing a solar panel". To address this, Eight19 has introduced IndiGo, a solar lighting and battery-charging system that spreads out the cost by giving users pay-as-you-go access to electricity, through credit from their mobile phones. Eight19 supplies users with a 2.5-Watt solar panel, a battery and mobile charging controller, plus two 55-lumen LED lamps and connecting cables. To power up, users buy a scratchcard for the local equivalent of 90p and text their card number to Eight19; they receive a code, which they enter into the battery hub for instant power. One scratchcard provides a week's worth of light and mobile charging. The company, born of Cambridge University's Optoelectronics Lab in 2010, will roll out 4,000 home-lighting kits in Kenya, Malawi, South Sudan and Zambia over the next few months. More power to them.** MV *eight19.com*

PICNIC FESTIVAL 2012

# PICNIC FESTIVAL 17+18.9.2012 AMSTERDAM

*ABOUT*

## NEW OWNERSHIP: THE SHIFT FROM TOP DOWN TO BOTTOM UP

EARN YOUR FREE TICKET
PICNICNETWORK.ORG

*ANOTHER ACTIVITY BY* PICNIC

*POWERED BY*

Nationale Postcode Loterij · vodafone · Hogeschool van Amsterdam, Media, Creatie en Informatie · upc · waag society · Picnic Innovation Mash Up · Picnic City Salons · Picnic Business Club · Picnic Community

## WHAT'S INSIDE: REGAINE FOR MEN EXTRA STRENGTH

# Hair-raising explosive

The trichological treatment relies on a highly combustible organic compound derived from starch

**Every month WIRED's chemist Dr John Emsley deconstructs an everyday product. He is the author of 110 research papers and ten books, his most recent being *Nature's Building Blocks, 2nd edition* (OUP)**

**INGREDIENTS**
Minoxidil
**Alcohol**
Water
**Glycerol**
Cetyl alcohol
**Citric acid**
Lactic acid
**Stearyl alcohol**
Polysorbate 60
**Butyl hydroxytoluene**
SD alcohol 40-B
**Propellants**

### MINOXIDIL
This compound was designed as a treatment for high blood pressure, but men who tested it reported that their hair started to regrow.

### ALCOHOL
Also known as ethanol, it acts as a solvent for the minoxidil, which is an organic molecule and so needs an organic solvent to solubilise it.


### CITRIC ACID
This stabilises the solution's pH and is used in making the explosive hexamethylene triperoxide diamine (HMTD).

### LACTIC ACID
Present in dairy, bread and meat, it's produced in the body as a by-product of metabolising carbs. It's a vital component of healthy skin.

### POLYSORBATE 60
This has water- and oil-seeking properties and acts as an emulsifier. It is used in powdered hot-chocolate drinks to ensure smoothness.

### GLYCEROL
A by-product of soap and biodiesel manufacture, this is also produced in the body. Here, it helps to reduce moisture loss from the scalp.

### CETYL ALCOHOL
A saturated fatty alcohol, AKA 1-hexadecanol, that acts as an emulsifier. Cetyl alcohol keeps all of the ingredients suspended in solution.

### SD ALCOHOL 40-B
This is alcohol made undrinkable by the addition of Bitrex, once listed in the *Guinness Book of World Records* as the bitterest substance.

### PROPELLANTS
Propane, butane and isobutane are used to propel Regaine from the can. Propane has three carbon atoms ($C_3H_8$) and the butanes four ($C_4H_{10}$).

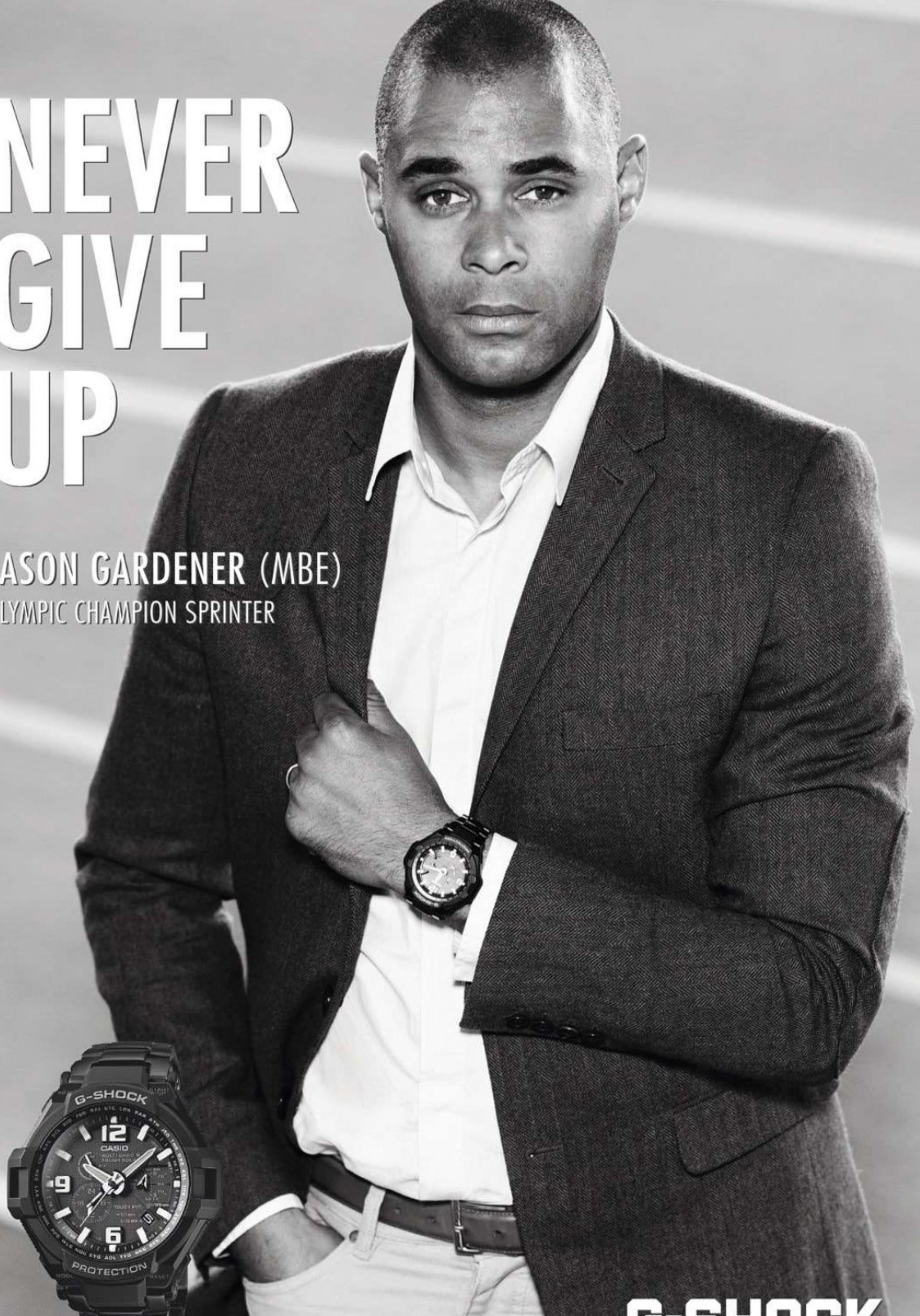
### BUTYLATED HYDROXYTOLUENE
This is a powerful antioxidant added to ensure that the other ingredients do not ever become chemically degraded.



PHOTOGRAPHY: SCOTT GRUMMETT

# NEVER GIVE UP

JASON GARDENER (MBE)
OLYMPIC CHAMPION SPRINTER




GW-4000D AVIATOR

G-SHOCK.CO.UK/PREMIUM

G-SHOCK
PREMIUM

PORTRAIT BY WILLEM JASPERT

## JOGGERS TURNING CITIES INTO A *DRAW SOMETHING* SESSION

Still running in circles? Joggers are mixing it up by running in shapes with the *FigureRunning* app. Ahead of runners tracing Olympic sports icons in cities around the world, here are some previous bests. MV *figurerunning.com*


Alan Klein ran 13 kilometres to draw a slim-looking Superman in London, April 2012

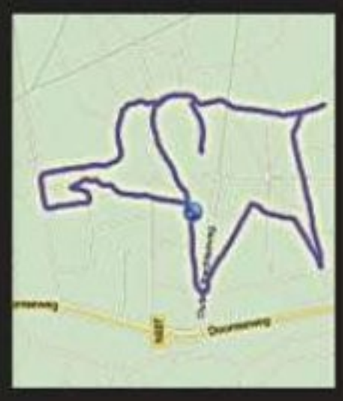

This antipodean figure run is a shoe, traced by Kate Cassidy in Brisbane, Australia, April 2012


A cowboy – walked by a family in Leiden, the Netherlands, over the course of two weeks in September 2011

Two running men, traced for the Dutch edition of *Runner's World* in Amsterdam, May 2011

The hand of Miriam, a good-luck symbol, which was run in March 2011 in Tel Aviv, Israel


A spring flower was the first figure run in Prague, when the Android app was tested last December



This elephant was created in Utrecht with a beta version of the iPhone app, by Jan Kroon in April 2011

A portrait of Saint Nicholas in the Netherlands, traced by Burt van Ree in August 2011



# And here's my nuclear reactor

Want to create fusion power at 100 million degrees? Mark Suppes has the answer: start looking on eBay

**For the past four years, Brooklyn web designer** Mark Suppes has been building a nuclear-fusion reactor in the corner of a friend's cluttered warehouse – even though he has no background in nuclear physics, has never even studied electrical engineering and has a full-time website job at *The New York Times*.

Suppes, 34, was inspired by a video made by Robert Bussard, one of fusion's pioneers, on the technology's potential to solve the world's energy problems. "I couldn't think of a better project to get involved in," he says.

Suppes's reactor – which incorporates parts sourced on eBay – is about the size of a filing cabinet and looks like something out of *Back to the Future*: "The whole thing is really cool, ancient technology," he says. "Pipes and pumps and tubes. I am using an electron gun from an old cathode-ray tube from the 50s."

At its centre is a core of deuterium atoms that, when heated to 100 million degrees Celsius, should fuse into helium and release a huge amount of safe, clean energy. The challenge, though, is how to achieve such a high temperature (about six times hotter than the Sun's core) without using more energy than is created. He isn't alone in trying to solve the problem. The US Navy is tackling the issue at a base in California, an international project is under way in southern France, and Iran is rumoured to be working on a reactor; but, as far as he knows, Suppes's is the only small-scale project and the only one to use superconducting magnets – the key, he says, to making the reactor efficient.

Suppes is getting advice and support from the open-source community. So far he has spent about $50,000 (£30,000) of his own money plus about $3,000 raised via Kickstarter.

"Bussard estimated that a working reactor would generate revenue of about $100 billion a year," he says. "There is plenty of small-scale research still to be done but to fully validate this technology would ultimately require about another $200 million, which so far has proved more than most investors can swallow."

**David Baker** *prometheus-fusionperfection.com*

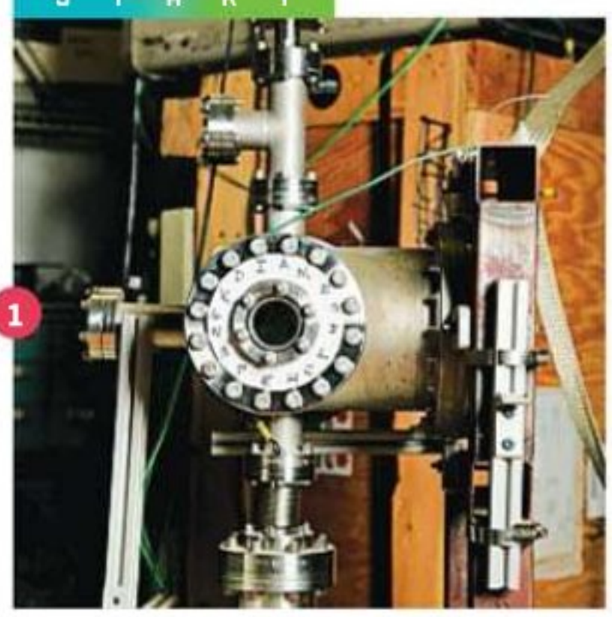

1 The vacuum chamber where fusion should take place eventually

2 The upper power supply delivers 30kV; the lower one's 2.5kA powers the coils

3 The polywell core, in the vacuum chamber, has these six electromagnets

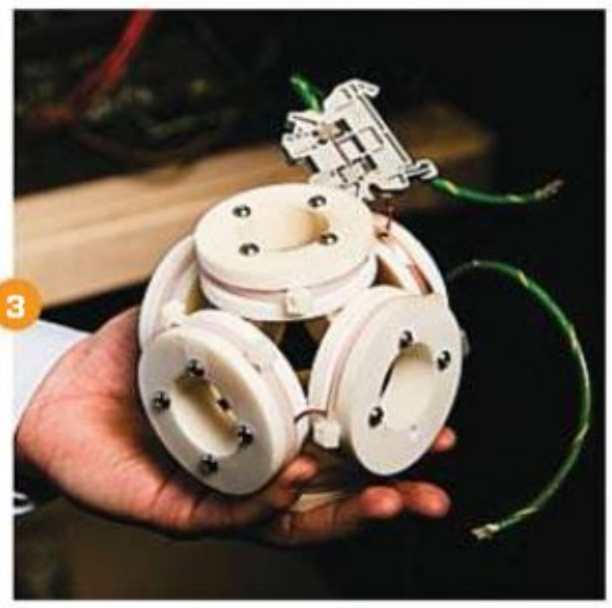
PHOTOGRAPHY: MILLER MOBLEY


S T A R T



1

2



3

## EARLY ADOPTER

**What's exciting...**

**ILSE CRAWFORD**

Head of department, Design Academy, Eindhoven

"The **Mine Kafon** by Massoud Hassani is a low-cost, wind-powered de-mining device. Hassani is an Afghan refugee who grew up in Kabul, where he played with wind-powered toys. This product is an extension of those. Made of bamboo and bioplastic, the enormous ball rolls across the valleys, exploding mines as it goes."

# WIRED

## READER PANEL


### WIRED NEEDS YOU

We are looking for readers to join the WIRED reader panel, where you can give us feedback on the magazine, tell us what you'd like to see and suggest how we can give our readers even more.

### REGISTER NOW

By going to *wired.co.uk.* **PLUS** Every time you complete one of our quick and simple online surveys, your name will be entered into a draw for some great WIRED prizes.

## BE MOVED BY ULTRASOUND

In a future where everything is connected to the Internet of Things, radio-tagged objects will be easily manipulated by digital controls. But until then, a team of computer scientists at the University of Bristol has found an alternative way to move ordinary, untagged objects remotely – using targeted ultrasound.

"We have 144 tiny ultrasound speakers that can beam air-pressure waves," says Sriram Subramanian, senior lecturer in human-computer interaction. "These focused jets can move specific objects around an interactive surface."

Ultra-tangible technology could be used in gaming, entertainment and education. "Let's say a group of kids wanted to learn how objects rolled down an incline," says Subramanian. "You could use an iPad as a plane, and place an ultra-tangible object on it to simulate how it really moves."

The heaviest object moved so far is a 25g polystyrene bead, and the team is working on manipulating larger objects by ultrasound levitation. In July, designers and artists will meet in Bristol to brainstorm disruptive uses for the technology. Let's hope they get some tangible results. **MV**

*big.cs.bris.ac.uk/projects*

ILLUSTRATION: MATTHEW BILLINGTON

# Beat rush hour with altitude

**Stuck in a traffic jam? Take to the air with a truly off-road vehicle**

**The PAL-V One (Personal Air and Land Vehicle) is a** three-wheeler that handles like a motorbike on the ground, before unfolding its rotor and tailfin to take to the sky as a gyrocopter just a few minutes later. The prototype shown here has a maximum speed of 180kph – the same in the air as on the road.

Flying at altitudes of up to 1,200m, the PAL-V is exempt from commercial flight regulation, so you can take to the sky to beat a jam – no flight-plan required. "You can fly over a mountain, and drive at the other end," says Netherlands-based cofounder Robert Dingemanse.

The same engine powers wheeled-driving and the propeller's forward-motion thrust (as a gyrocopter, the rotors on top are not powered by the engine but autorotated by air flow), and the craft adapts to each configuration to comply fully with road and aviation demands. After several successful test flights the company is looking to fund a commercial design, aiming to bring the craft to market by 2014. Want to place an order? Expect to pay upwards of £190,000 – and try not to break it this time, 007. **Jeremy Kingsley** *pal-v.com*

**iPad extra!**
Download the WIRED app to see the PAL-V One on the road and in the air

S T A R T

**PAL-V One: under the bonnet**

- **Maximum speed** 180kph (road and air)
- **Range (road/air)** 1,200km/350-500km
- **Fuel economy (road/air)** 12kpl/36lph
- **Maximum altitude** 1,200m
- **Maximum power** 170kW

# WIRED

NEXT ISSUE

# WIRED

A FREE, 36-PAGE
SUPPLEMENT WITH WIRED

## EUROPE'S 100 HOTTEST STARTUPS 2012

SEPTEMBER 2012
IN ASSOCIATION WITH
Hennessy

ON SALE AUGUST 2

# The revolution will be live-streamed

From databases of corruption in India to iPhones streaming Occupy Wall Street via a helium balloon, activists are building tools that use tech creatively to spur social and political change

**Technology is the activist's new weapon,** playing a role in the Arab Spring, the Haiti earthquake response and the London riots. But it's not just Facebook and Twitter that empower local changemakers – increasingly they are building tools through their own startups or social enterprises. The Omidyar Network, which funds such startups, and the UK Department for International Development, with WIRED's support, are running a conference in London on November 13 in which these issues will be explored in depth (further details from *Katyhaile@timebased.co.uk*). Here are seven startups spurring social change. **MV** *omidyar.com*

## FELIPE HEUSSER
### Smart Citizen Foundation, Chile

Hatched in a London pub in 2008, the Smart Citizen Foundation is the brainchild of its executive chairman, Chilean lawyer Felipe Heusser. His primary concern while working for the Chilean ministry of foreign affairs was thinking of ways to increase Latin American citizens' access to public information. So he decided to start a non-profit to do just that. "When we started two-and-a-half years ago, technology still wasn't seen as a tool for change," says Heusser, 32. "We wanted to use tech to access more information, to aggregate and gather citizens to promote a cause, to examine tonnes of financial and political data – our added value was technology." The foundation's recent tools include a Smart Access app, which lets citizens submit anonymous freedom-of-information requests to specific government agencies and compiles all responses into the Inspector of Interests, an open database that publishes MPs' public assets alongside how they vote, and reveals conflicts of interest. It also produced the Citizen Balloon, an iPhone tied to a helium balloon that live-streamed a bird's-eye view of the Chilean student protests in July 2011. "I heard from my friends in the States that the same iPhone balloon was used in the Occupy Wall Street movement a few months later," says Heusser. The NGO's next step: wider Latin American and Caribbean domination. *ciudadanointeligente.cl*

ILLUSTRATION: MATTHEW HOLLINGS

## JENNIFER PAHLKA
### Code For America, US

**Jennifer Pahlka wants the US government to work like a lean startup. "The spirit in the tech-startup world is iterative – start fast and experiment constantly," says Pahlka. "I want that spirit to infuse government." In January 2010, Pahlka, now 42, quit her job to found Code for America (CFA), a non-profit that connects civic hackers with city administrators to solve local problems. The flagship project is the fellowship programme, in which 26 skilled coders take a year off from their jobs to help urban bureaucrats. CFA coders have worked with ten cities, including Boston, Seattle and Chicago. They have created 20 mobile and web apps for issues such as education, street art and transport. All data sets, software and APIs are open source. Rather than pit technologists against government, "we want to find innovators within administrations," Pahlka says. "We want to make it unacceptable to do things the old way."** ***codeforamerica.org***

## SWATI RAMANATHAN
### ipaidabribe.com, India

Swati Ramanathan started out with a lofty goal: to eliminate small-scale corruption in India. "What bothered me is having to pay bribes for basic services such as a driving licence," she says. On August 15 2010, she launched ipaidabribe.com, one of ten projects run by Janaagraha, the non-profit she manages with her husband in Bangalore. The idea was to crowdsource data on bribes – which cities and departments are most corrupt, how much people pay. "We wanted to analyse the anatomy of corruption," says Ramanathan, 48. With over 16,000 reports, ipaidabribe.com is now used in every major city in India, and has been adapted in Kenya and Pakistan. "Next, we want to create a global online coalition against corruption," says Ramanathan. *ipaidabribe.com*

## ESRA'A AL SHAFEI
### MidEastYouth, Bahrain and the Middle East

Esra'a Al Shafei doesn't trust any government in any part of the world. "Whatever they claim, they will never care as much about transparency and open data as citizens do," she says firmly. So instead, she started a blogging network to amplify diverse voices in the Middle East and north Africa. From its origins in Bahrain, the network quickly spread into other nearby countries, including Saudi Arabia, Iran, Syria, Palestine, Lebanon, Turkey and Tunisia. "We don't want to promote any single ideology – just listen to what the youth are talking about," says Al Shafei, 25. "Religion, gender, politics, we want nothing to be underground." The platform includes crowdvoice.org, a base for the writings of activists all over the world. MidEastYouth has also launched MidEastTunes.org, a discovery engine for underground Middle Eastern musicians; an LGBT-story-exchange platform called ahwaa.org; and an iPad app tracing the history of revolution in the Middle East and Africa. "My passion is access to information," she says. "Ignorance can be deadly." *mideastyouth.com*

## OSCAR SALAZAR
### Citivox, Mexico

"Social media is a noisy place," says Oscar Salazar. "It's hard for decision-makers to follow the conversation." Salazar's solution is Citivox, a data-analytics startup that scrapes social network and government data, then analyses and visualises it for government clients so that they can overhear what citizens are saying. "People are constantly complaining about community issues on Facebook and Twitter, so we just separate signal from noise," says CEO Salazar, 34. The for-profit startup, which launched with $300,000 in September, has worked with 15 government representatives – including the government of Mexico, Yemen election officials and the chamber of commerce in Bogota. Clients pay a monthly fee for access to analysis and Salazar says he will reach profitability by year-end. Citivox will soon move into the consumer space by launching an online advice and information exchange for citizens. "We want to empower every citizen to start improving his or her community," he says. *citivox.com*

## 'BOSUN TIJANI
### CCHub, Nigeria

The Co-creation Hub works to help technology accelerate social change in Nigeria. "Tech can improve healthcare and education, help farmers and engage citizens in governance," says 'Bosun Tijani, the CEO and founder. Tijani has built a centre in Lagos which houses locals with innovative ideas. "We have a community of creative professionals whom we encourage to look for issues at the bottom of the pyramid," says Tijani, 34. CCHub then connects the entrepreneurs with investors, who can mentor and fund ideas. The programme supports 21 ventures, and has worked with the Indigo Trust and the World Bank to provide seed funding. CCHub is also mapping innovation clusters in Lagos so the government can support them. *cchubnigeria.com*

ILLUSTRATION: MATTHEW HOLLINGS

## SVITLANA ZALISHCHUK
### New Citizen, Ukraine

Founded on the eve of the January 2010 presidential election in Ukraine, New Citizen is a hub for 56 Ukrainian non-profits. "The idea was to unite the efforts of many civic actors to enhance citizens' influence on politics," says founder Svitlana Zalishchuk. "By communicating and collaborating via new media, we became visible to politicians." The 29-year-old former TV journalist, who previously worked for Ukraine's deputy prime minister, says simple tools such as Google Groups became critical for her cause, along with popularity on Facebook, Twitter and big Russian social networks. In preparation for this October's parliamentary elections, New Citizen launched the Chesno or "Fair" movement. The idea, borrowed from a similar campaign in Romania, involves assessing all electoral candidates against a set of criteria, and asking officials to disqualify those who do not meet the criteria. Two political parties have already signed an agreement. *newcitizen.org.ua/en*

# 1&1 WEB HOSTING
# SUMMER SALE!

SAVE UP TO **80%** ON TOP HOSTING PACKAGES!


## Best value hosting solutions!

- Linux and Windows packages
- Unlimited Traffic
- 1&1 Click & Build Applications
- MySQL 5 Databases (1 GB each)
- PHP 5, PHPDev, Zend Framework, Perl, Python, Ruby, SSI
- 1&1 Online Office and 1&1 Mobile Online Storage app
- Maximum availability via Geo-redundant 1&1 Data Centres

**ALL HOSTING PACKAGES**

**£2.49 per month***

**SAVE UP TO 80%**

**PLUS, SECURE YOUR .co.uk DOMAIN FOR £0.99!***

1&1

MEMBER OF united internet

Call **0844 335 1211** or buy online

**www.1and1.co.uk**

* Offers valid for first year only. Visit www.1and1.co.uk for full promotional offer details, terms and conditions. Prices exclude VAT.

# WIRED

WIRED.CO.UK


Do you think you should be writing for wired.co.uk, or are you doing something online that we should know about? Email *nate.lanxon@condenast.co.uk* with a link – we'd love to hear from you

# FETISH

OBJECTS OF DESIRE
THIS MONTH: 08.12
- CARBON-FIBRE BIKE
- BRIGHT TABLE-LAMP
- GIANT-SIZED FAN
- FAST FOOTWEAR
- COOL KITCHEN KIT

EDITED BY JIM HILL

## FUTURE-PROOF FRAME

OPEN CYCLE HARDTAIL 0-1.0

This strong, light hardtail blends different types of carbon fibre through the frame: tough, lower-modulus carbon fibre at the impact points and lighter, stiffer carbon elsewhere. The frame interior can accommodate standard gear-shift cables, but Open also specifies a choice of electric or hydraulic systems. Our bike has ENV wheels fitted and weighs only 8.6kg. *£4,700 opencycle.com*

PHOTOGRAPHY: WILSON HENNESSY

PHOTOGRAPHY: WILSON HENNESSY

## POLISHED PROPELLER-HEAD

SZOSTAK BIG FAN

This huge floor-standing fan was designed and made in Poland by Witold Szostak. It uses 80 pieces of hand-sanded polygonal teak-wood arranged in a 1m-diameter circle. The propeller is also teak, turned by a 150W Bosch motor. A potentiometer ensures that the transition between a gentle breeze and a more blustery setting is silky smooth. *£TBC witoldszostak.com*

## LIGHT METAL

TOM DIXON FIN TABLE-LAMP

Designer Tom Dixon has taken the heat sink, a tucked-away electronics component which aids cooling, and made it the main feature of his Fin free-standing light. The heat-dissipating effect allows the use of six high-powered LEDs inside, and the domed acrylic lens bends the light into a broad, bright beam. And yes, there's little danger of this lamp overheating. *£395 tomdixon.net*

### BALL CONTROLLER
ADIDAS PREDATOR LZ

To give footballers greater ball-control, the LZ (Lethal Zones) boot has textured rubber and memory-foam patches on five key areas of its upper surface. The sticky, textured pattern on the sides enhances grip for high-speed dribbling; rubber ribs cover the forefoot to cushion and trap the ball at first contact. A size 8.5 in this light, pacy boot weighs just 225g. *£160 adidas.com*


### GLOVES FOR FEET
VIBRAM FIVEFINGERS SPRINT

The FiveFingers philosophy is about allowing the bones in your feet to move freely, so the tip of its shoes is divided into five parts – one for each toe. As well as exercising under-used foot and ankle muscles, this shoe allows a wide range of movement. The rubbery Vibram sole is also highly flexible and suitable for indoor and cross-country running. *£90 vibramfivefingers.com*

# SPEEDY STEPPERS

**LIGHTWEIGHT SPORTS SHOES TO IMPROVE YOUR GAME**

### BAREFOOT RUNNING
VIVOBAREFOOT EVO II LADIES

The Evo II is designed to enable the foot to move naturally while running. Vivobarefoot's signature hexagonal mesh provides strength for cross-country running, and the spaces between allow the canvas to breathe and cool the foot. Its thin, puncture-resistant rubber sole is versatile enough for running on smooth track and over rough terrain. *£89 vivobarefoot.com*


### ASYMMETRIC ENHANCEMENT
SKORA FORM

Having the laces running diagonally down the outer side looks odd, but SKORA claims this encourages a more natural gait. Instead of building up the heel, as with most running shoes, its sole is more evenly sprung, enhancing the "barefoot" feel. The goat leather outer-upper brings strength and permeability; soft sheep-leather makes for a comfy lining. *$195 skorarunning.com*

PHOTOGRAPHY: ALEXANDER KENT; ROGER STILLMAN. WORDS: JIM HILL

## RUNNING STITCHES

NIKE FLYKNIT RACER

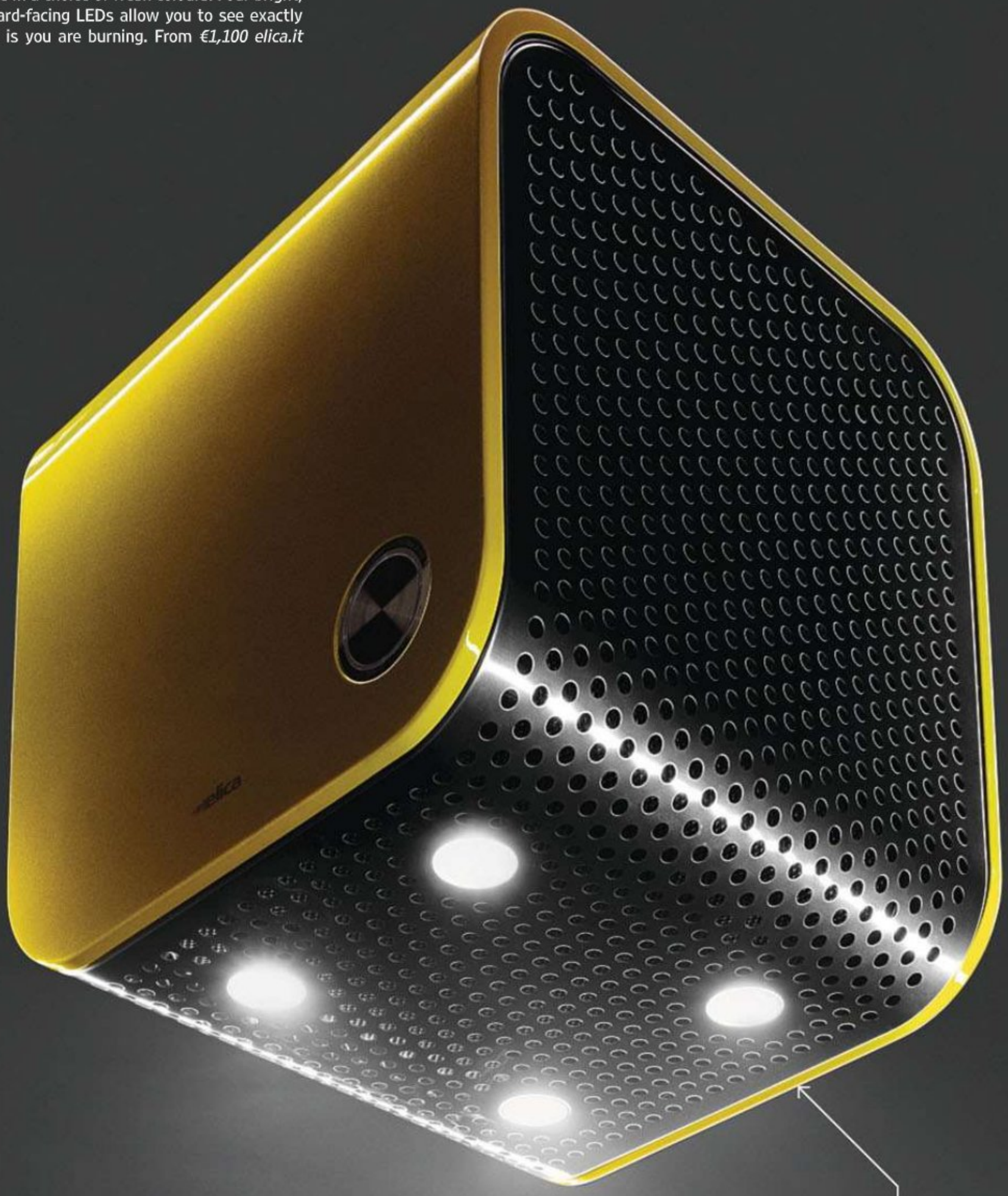
A single piece of woven material forms the upper part of this ultra-lightweight running shoe. It hugs the foot like a knitted sock, while allowing the skin to breathe through the wide mesh. The synthetic material is stiff enough to hold its shape, but is still pliable so as to move with your ankle as you run. The size-nine shoe shown here weighs a mere 160g. *£150 nikeinc.com*

The Flyknit's upper is a wraparound piece of synthetic mesh

## COOKING WITH CUBES

ELICA 35CC

This cube-shaped cooker hood measures only 35cm across, but with extraction on three sides it can draw in almost all the fumes from a hob. The perforated stainless steel allows a suction air-flow of 650m³/h, and the solid steel outer part is available in a choice of fresh colours. Four bright, downward-facing LEDs allow you to see exactly what it is you are burning. From *€1,100 elica.it*




Two neatly interlocking C-shaped steel panels create the cube shape

### HANDMADE COFFEE
AEROBIE AEROPRESS

This coffee-maker relies on muscle power to brew a connoisseur cup of Joe. Pushing down on the plunger increases air pressure, forcing hot (rather than boiling) water through the coffee grinds at a constant rate. It takes about 20 seconds to depress fully, pushing the liquid through a paper filter. This gentle extraction process is said to give a richer taste. *£22 hasbean.co.uk*

### SPARKLING REDESIGN
SODASTREAM SOURCE

To put the fizz back into SodaStream's famous beverage carbonator, designer Yves Behar has applied his "reduce and refine" philosophy to the latest model. To add sparkle, simply push down the top of the machine until enough gas from the replaceable $CO_2$ canister has been added to your drink. An LED display shows the strength of carbonation. *£70 sodastream.com*

# GASTRONOMIC TECH

**ADVANCED EQUIPMENT FOR KITCHENS OF DISTINCTION**

### MEAT MASHER
MICROPLANE MEAT TENDERISER

Bristling with blades, this easy-to-wield meat tenderiser minimises the effort needed to prepare red meat for cooking. Instead of relying on brute force to break the muscle fibres with a hammer, 5mm steel slicers chop through them using a fraction of the force. We'd definitely recommend replacing the plastic safety-guard after use, though. *£TBC microplane.com*

### MEAN MEASURING
KIKKERLAND CUBE-JIGGER

Jiggers provide accurate servings for alcoholic beverages – this ingenious cube offers six measures in one utensil. Inspired by square Japanese sake cups, from which you sip using the corners, designer Josh Owen's vessel pours out amounts commonly called for in recipes. Filling a side up to a level surface gives you one cup, one tablespoon, one teaspoon and more. *£34 joshowen.com*

PHOTOGRAPHY: ALEXANDER KENT; DAVE LIDWELL. WORDS: JIM HILL





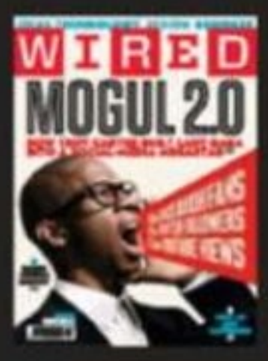










# 12 ISSUES FOR £24 – SAVING 49%

## THAT'S 5 FREE ISSUES + DIGITAL ACCESS

# SUBSCRIBE TO WIRED MAGAZINE...






SUBSCRIBE TO THE PRINT COPY AND ENJOY FREE ACCESS TO THE iPAD EDITION EVERY MONTH, WORTH £17.99. ALL YOU NEED IS YOUR SUBSCRIPTION NUMBER:

1. GET YOUR SUBSCRIBER NUMBER BY GOING TO WIRED.CO.UK/SUBS/ACCOUNT
2. UPDATE YOUR iPAD TO THE LATEST iOS5 SOFTWARE
3. DOWNLOAD THE CURRENT WIRED UK APP FROM THE APPLE APP STORE
4. TAP THE WIRED UK APP, THEN ENTER YOUR SUBSCRIBER NUMBER FOR FREE ACCESS TO THE MONTHLY iPAD EDITION











# WIRED CONSULTING

PHOTOGRAPHY: NICK WILSON

IDEAS

TECHNOLOGY

DESIGN

BUSINESS

WIRED NOW OFFERS A CONSULTING SERVICE
FOR COMPANY EVENTS AND PROJECTS.
EMAIL US AT: CONSULTING@WIRED.CO.UK

# IDEAS BANK

**BRAIN FOOD AND PROVOCATIONS**

THIS MONTH: 08.12

**MARK WALPORT_TRICIA WANG_JONATHAN GOODWIN_BEN HAMMERSLEY_FRED DESTIN**

**MARK WALPORT_**

## The precautionary principle can be deadly

It seems paradoxical that, as medical scientists make huge advances in discovering the mechanisms of common diseases, fewer and fewer innovative drugs are reaching the market. Indeed, the pharmaceutical industry worldwide is in difficulty – it is becoming harder and harder to make new drugs. But there is one major exception to this trend. New drugs for cancer continue to be developed, often remarkably quickly.

In 2002, researchers at the Wellcome Trust Sanger Institute found that the gene BRAF was mutated in the majority of patients with the skin cancer malignant melanoma. In 2011 a new drug, vemurafenib, targeted to mutations in BRAF, was licensed for therapy. Why is cancer therapy different when it comes to speedy approval of drugs?

We all want our drugs to be safe – and so an essential part of the pathway to the development of a new drug is approval by a regulator. In the US it's the Food and Drug Administration, in the UK the Medicines and Healthcare products Regulatory Agency and the European Medicines Agency. No one doubts the need for good regulation to ensure drug safety. However, there are increasing worries that regulation is driving up the costs of drug development and driving down productivity. If this is preventing effective drugs from reaching the market and also driving up to unaffordable levels the price of the drugs that do make it, it is very bad news.

The problem is that the incentive system for regulators is weighted too much towards an extremely cautious position. The cause is asymmetry: a regulator can get sacked for allowing something harmful to happen. But a regulator cannot get sacked for preventing something from happening that might have caused good. So, if there appears to be any risk from allowing something to happen, it's much easier and safer to stop it. Of course, this is a caricature, but it contains a germ of truth.

The job of the medicines regulator is to balance the risks from the disease with the benefits and possible side-effects of the therapy. So why are we doing better for cancer therapy? It is because of an obvious balance between benefits and risks. Untreated cancer is frequently lethal. The risk-benefit ratio for new treatments is easy to understand.

The principle of treating cancer is to kill the abnormally dividing cells. Many drugs achieve this in a relatively unselective way, killing any cell that is dividing. Everyone has accepted that cancer therapy is often associated with unpleasant side effects, from vomiting to failure of the bone marrow, even fatality. But if the alternative is death, then patients, doctors and drug regulators are prepared to take the risk.

But what if the disease is not lethal? The balance of risks and benefits may differ for the patient, the doctor and the regulator.

When a vaccine against rotavirus, which causes infantile diarrhoea, was developed in the US in the 90s, it was found very probably to cause a form of bowel obstruction called intussusception in a tiny minority of children. Because rotavirus infection is nasty, but not life-threatening in rich countries, US regulators rejected it. Yet this decision meant the vaccine was then not developed for use in countries such as India, Pakistan and Bangladesh, where rotavirus kills, and the jab had the potential to save many thousands of lives.

Vaccines must be safe, but the risk-benefit equation for a vaccine in the US is different from the risk-benefit in south Asia.

Asymmetry in regulation goes beyond medicine. We will have the best regulators if they are held to account for both permissive and preventative decisions. Regulation must balance risks and benefits. This cannot be achieved if regulators are held accountable only if things go wrong.

The example of medicine shows that, sometimes, more harm can flow by denying those who would benefit from a new medicine than from exposing them to proportionate side effects. Common sense, proportionality and judgment are the skills we must seek in those we choose to regulate our lives.

*Sir Mark Walport FRS FMedSci is director of the Wellcome Trust*

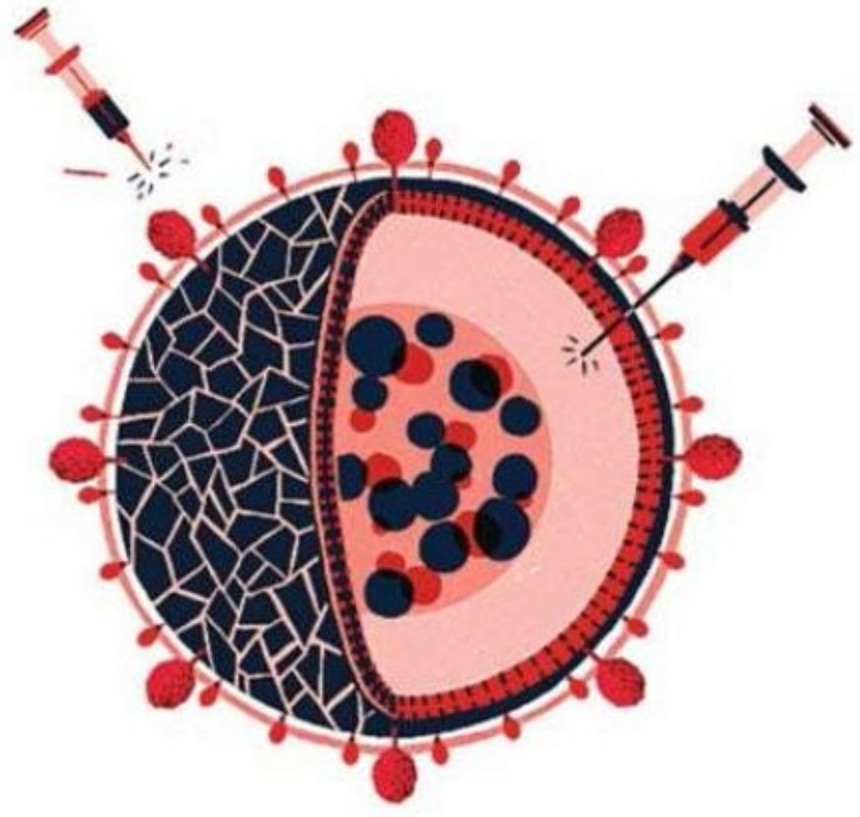


ILLUSTRATION: THOMAS BOSWELL

## TRICIA WANG_

# Building transparency in China, one lunch at a time

**We often think of internet-**powered revolutionary change as enacted through a model of forcing political change through civil disobedience, such as the Arab Spring or Occupy Wall Street. But, here in China, I've been documenting the emergence of a model that uses crowdsourced fundraising, social-media transparency and social pressure to forge a collective action that is apolitical and effective in changing policy from below. It's called Free Lunch.

On Sina Weibo, China's largest microblog, more than a million Chinese citizens have raised RMB ¥30 million (£3m) to provide free lunches to malnourished children in over 160 rural schools in one year.

The programme originated with Chinese journalist Deng Fei, who made a name for himself exposing child kidnapping and organ harvesting. When he received a tip from a teacher that schoolchildren in the countryside were too impoverished to eat lunch, he investigated the situation and realised that the problem was nationwide. He quit his job as a journalist and dedicated his time to solving the problem. He started posting pictures of children, accompanied with requests for donations from his estimated 200,000 followers at the time (he now has two million).

Free Lunch was launched at a difficult time for fundraisers: researchers had revealed a massive scandal at the Red Cross Society of China where donations were being used to pay for an official's mistress. Donations to the Red Cross fell by four fifths and charities faced widespread mistrust.

Well aware of the need to make Free Lunch trustworthy, Deng Fei implemented a combination of online and offline tactics to build layers of transparency. Participating schools can't just take food and distribute it. Every day they must publicly post their accounting to Sina Weibo. A sample 140-character post will include details that mostly look this: *December 22, 2011; Thursday. Hunan Xinhuang Dapingpo Primary School Free Lunch. Today 41 people ate a meal. The menu: meat and radish, boiled eggs, stewed potatoes. Rice 10*2.2=¥22, meat 3.2*¥13=¥41.6, eggs 41*¥0.7=¥28.7, radish 6*¥1=¥6, potatoes 6*¥1=¥6. Oil 1.3*¥7.5=¥9.75 and firewood 40*0.2=¥8. In total ¥122.05, ¥2.98 per person. We do not have classes on Friday. Happy new year!*

In addition to using social media, Free Lunch recruits a local group of retired village officials to oversee the school's accounts and confirm that the children are actually being fed. Also, his two million Weibo followers are encouraged to closely monitor schools' online accounting. Deng Fei and the schools publicly respond to every Weibo inquiry about how the funds are being used.

Any financial misreporting results in schools losing their funds, so teachers are careful to post accurate information, with some spending an hour drafting the 140-character posts to Weibo on their phones (most schools don't have computers). What we are seeing is a collective social shift in the way information feedback and accountability are being conceptualised. Free Lunch sets a new bar for providing donors with updates; annual reports no longer suffice.

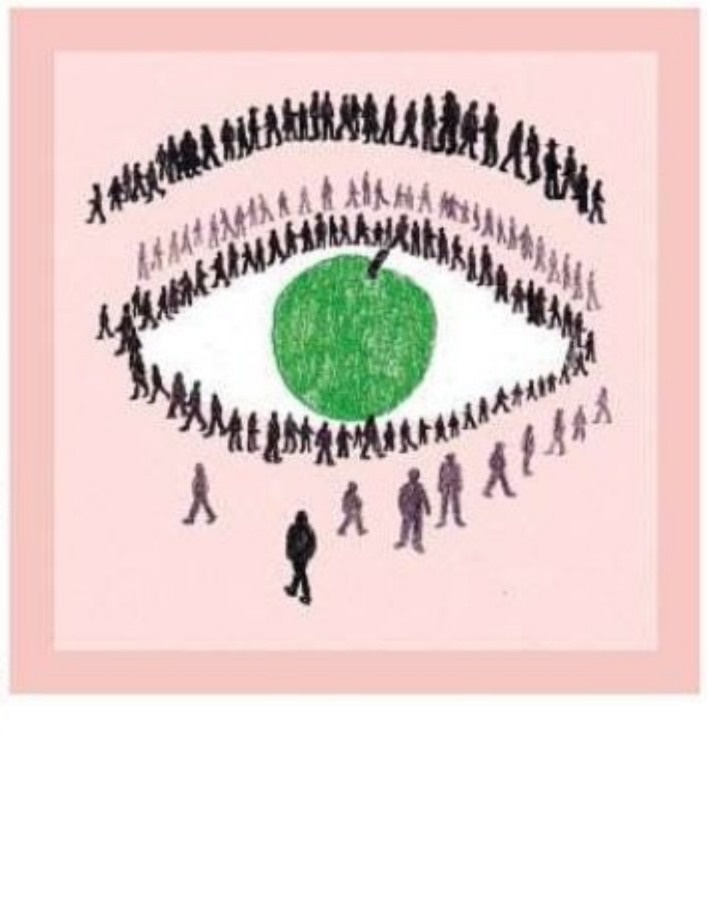
The innovation is not just in the use of social media, but also in information transparency that earns the public's trust one post at a time. In effect, Free Lunch doesn't just crowdsource funding: it also crowdsources monitoring, which results in a jujitsu act of getting individuals to see themselves as members of a community who can create the change they want to see. As a result, the rhetoric has shifted away from blaming the government towards holding the community itself responsible for the outcome.

Free Lunch has proved itself as a model. Seven months after it launched, the government invested ¥16 million in a similar programme.

Programmes such as Free Lunch are introducing new cultural values and practices to China. They also reveal that crowdsourced fundraising that doesn't track real-time effectiveness may not be suitable for non-Western contexts. Free Lunch leverages people's compulsion not just to do good, but to engage in shared responsibility.

This kind of innovation builds the foundation for future macro-innovations in transparency. It hacks the system using existing tools, creating viruses of hope that even one person can contribute to social change.

*Tricia Wang is a China- and US-based cultural sociologist who uses a range of ethnographic methods to create commercially relevant insights about people's interaction with the internet. Her writing and talks are at* triciawang.com



## JONATHAN GOODWIN_

# Zuck, it's now time to give something back

**When Titus Salt died in** 1876, the tributes were unprecedented. He was "the greatest captain of industry in England", according to the *Bradford Observer*; *The Times* gushed that he was "upright in business, admirable in his private relations... the best representative of the employer class in this part of the country, if not in the whole of Britain."

Salt made money – a lot – after taking over his father's modest wool business. Through entrepreneurial skill and by creating alpaca cloth, he became one of the country's main employers.

On the day of his funeral, 100,000 mourners left their homes to line the streets... homes and streets which he'd built for them in one of the most impressive philanthropic projects in British history. Concerned about pollution – and determined to centralise his operations – Salt created a village a few kilometres from the smog of Bradford on the banks of the river Aire.

Named Saltaire, its centrepiece was a massive Italianate factory – warm and light for the men and women who worked

ILLUSTRATIONS: MIKE MCQUADE; ALEX ROBBINS

there. In the surrounding area he constructed hundreds of new houses, all connected to mains drainage and nearly all with their own outside lavatory. He also built churches, bathhouses, schools, a hospital and almshouses. Saltaire inspired other industrialists, and model villages were built by George and Richard Cadbury, Joseph Rowntree and the Lever Brothers – who created Port Sunlight as the home of their soap dynasty, now part of Unilever.

These men were concerned about the physical well-being of their employees but the villages they built were also a statement of philanthropy. Salt and co believed it was their duty to give something back to the community. Theirs were truly the first substantial corporate social responsibility programmes. And they weren't too bad for PR either.

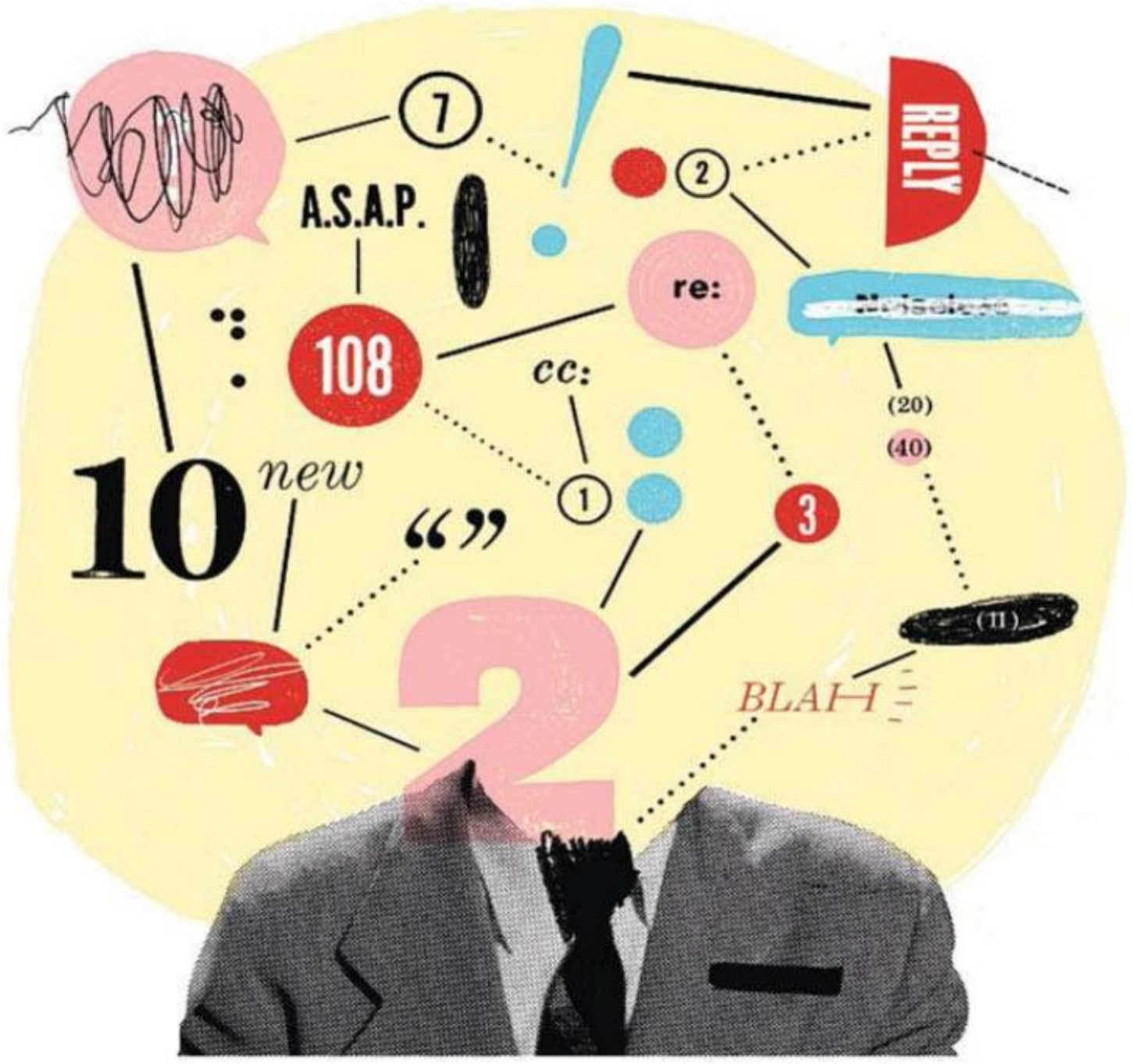
Today, as the digital giants such as Facebook and Google drive forward, they would do well to glance back at Victorian Britain. These businesses deserve praise for having done so much to bring our online communities together in undeniably worthwhile ways.

Yet digital companies' investment in Europe – including the UK – is at an all-time low. Facebook has the highest revenue per employee of any company in the world, but critics outside the US not unreasonably ask, "What have they done for us lately?" And they're not just talking about tax revenues.

The debt crisis caused charitable donations to fall steeply. It's great to see philanthropists such as Pierre Omidyar (see p47) and Bill Gates set up bases in London, but the UK continues to be hit hard. It's time the digital giants took a pinch of Salt from our history, stepped up and helped fill this gap.

Mark Zuckerberg donated $100 million to schools in New Jersey. How pleasing – and corporately sensible – it would be to see him and others make similar commitments in the UK. The Facebook Academy has a nice ring to it.

*Jonathan Goodwin is founder of Lepe Partners and co-created the Founders Forum, a gathering of leading entrepreneurs*




BEN HAMMERSLEY_

## Let's talk about how soon we can have that chat

**Airplane mode is shouting** at me. I've had enough. This can't go on any more. I need to turn my phone back on. There is, you see, nothing noisier than a phone that's turned off. Because you are aware, and nervous, that when you turn it back on again you'll be confronted with a backlog of messages and voicemails. We now talk about information overload and the tyranny of being always connected, devices in pockets, and false feelings of vibrations making you grab at your phone at random moments. The constant battle to not keep checking your inbox.

But perhaps it's not actually the technology that is the problem, but the social arrangements you have with the people you talk to. If by habit or design your correspondents have grown to expect you to have your phone on all the time, it can become oppressively difficult to disconnect without risking a social backlash, or even outright suspicion. These social norms, that people expect a reply to a text almost immediately and an email as soon as possible, have seemingly never been negotiated or at least discussed out loud. They have simply evolved unspoken. However, when you do have this conversation, it can have miraculous effects. One experiment I've been conducting is to have an out-of-office reply permanently running on my email. Email me and it'll reply, "Thank you, I have received the message, but I'm not checking my email more than once a day, and if the message is urgent please call me." It gives my number, that week's travel plans and timezones, and advance warning of my holiday dates. This is useful information for my correspondents, practically speaking, but it also reportedly takes away their stress. By sending me an email about a subject, they have passed that project over into my court, and by knowing that I am going to reply, but just not today, my colleagues tell me that they are thereafter able to cease worrying about that thing, whatever it is. Many emails, it seems, are procrastinated over, not because the writer doesn't know what to say, but because they dread starting the inevitable tit-for-tat email chain that will take up their entire afternoon. And by making it clear that the reply will be slow in arriving, I've found myself receiving a much better class of email, written to be worth the wait.

Perhaps the best email strategy is to turn it off. A new study, by Gloria Mark and Stephen Voida, of the University of California, and Armand Cardello of the US Army, looked at the effect of removing email entirely. Thirteen "information workers" were stripped of email for a week and had both their computer usage and their heart rate monitored. The conclusion was that without email the workers focused for longer, multitasked less and had lower stress levels. And they

reported that their at-work personal relationships improved: if they needed something from someone, they had to go and ask in person. To me, this seems to be both experimentally and intuitively better.

Reducing email to zero is impractical, but we need to be more mindful of the tempos of the communications tools we use, and how we impose them on ourselves and others. Text messaging – whether SMS, BBM, iMessage or *WhatsApp* – is replacing calls, simply for the etiquette of not interrupting someone's day. Perhaps we also need more tools, and more discussion, to promote social norms that are more forgiving of slow replies. A return to the rhythms of the daily postal delivery would, for many things, not be a disadvantage. By allowing ourselves to communicate more slowly, we might find we have more to say. As the majority of the UK has been online and digitally connected for a significant time, now is the right moment to talk about how we expect to have conversations with each other. I'll be starting this conversation soon. If you'd like to join it, email me at *ben@benhammersley.com*. I'll get back to you. Though perhaps not right away.

*Ben Hammersley is author of* 64 Things You Need to Know Now for Then: How to Face the Digital Future without Fear *(Hodder)*

**FRED DESTIN_**

## Only a startup mentality can thrive in the chaos era

**We all feel as if the world** is accelerating at warp speed. How do we maintain relevancy, balance and purpose as we wrestle our bloated inboxes? I want to explore how to function, thrive and achieve balance in this brave new world.

We have entered an age of chaos (in the mathematical sense), marked by accelerated change and unpredictability. Witness 2008's "de-correlation crisis" and Instagram's sale; outcomes best seen as fractal.

The cloud is a seismic shift in how the economy operates and the culmination of a long process towards value-chain fluidity that started with accelerated globalisation.

To frame the impact of cloud, look back at Ronald Coase's theory of the firm. Coase says that the efficient boundary of any firm should stop when the external transaction costs are lower than the equivalent internal transaction costs. It is easier for companies to hire for the long term than to look for talent every day. You can focus on a very narrow core expertise set with a small team of talented people.

The cloud in turn ushers in the age of platforms and markets, where everything that can be priced dynamically will be. With the friction gone, you have the building blocks for a world of chaos, a world of fractal outcomes. We have known this to be true for a while in financial markets.

The advent of chaos is the core reason why you should work for startups or corporations that behave like them, because startups are the natural evolutionary answer to this new environment. Most corporations are defined by the quality of their planning processes, which in turn become objectives against which execution happens and achievements are measured. Corporate behemoths, faced with change, stumble and fall. In fluid markets where everything can be priced and exchanged dynamically, startups thrive. They are the elemental unit of a cloud economy, highly adaptable and insanely good at one thing. But large corporations cannot adapt at the speed necessary to remain best of breed in all aspects of their business. The same can generally be held true for the individuals that work for them. In startups, skills need to evolve fast; adaptability is a core skill.

Recent advances in neuroscience and psychology point to other reasons why this creative chaos may actually be good for us. Although there is nothing inherently "good" or "moral" about technological progress, there is something fundamental about the process of invention and innovation that appeals to all us. If life is a long arc, movement fundamentally gives it meaning, and innovation is an expression of that.

Mihaly Csikszentmihalyi attempted to understand what he termed "completely focused motivation". He defined the notion of "flow", the notion of being "in the zone", where one experiences no self-consciousness, but rather the merging of action and awareness. The key conditions under which flow is achieved are the following: one must be engaged in an activity inherently rewarding, with ambitious but attainable goals; benefit from a sense of personal control; and receive direct and immediate feedback. Compare the large corporation with the startup; the small and nimble environment of the growth company is designed to generate the conditions under which flow is possible. Large corporations were designed for the industrial revolution; work was modified to fit industrial processes. The corporation bends the individual to its requirements; no wonder work in these conditions makes us unhappy.

Abraham Maslow studied "exemplary people" such as Einstein. He defined two levels of needs: "deficiency needs" or "d-needs" (esteem, friendship and love, security and physical needs) and "being needs", higher-level needs that lead to self-actualisation and betterment. The search for purpose and meaning is personal and never-ending, but difficult to achieve when the basic needs are not met. Startups are much better at providing these (self-esteem, confidence, sense of achievement and recognition), freeing us to find purpose.

We need to modify our longing for order and embrace chaos. This means designing companies that deal with it, design work (and life) to achieve "flow". You need work environments adapted to this new world that will help you towards the goals or flow and purpose. Status and career are fleeting; inspiration and meaning are not.

*Fred Destin is a seed- and early-stage investor with Atlas Venture, backing companies such as Zoopla and DailyMotion*


ILLUSTRATION: MATT CHASE

# WIRED INSIDER

EVENTS, NEW PRODUCTS, PROMOTIONS AND COMPETITIONS TO LIVE THE WIRED LIFE

COMPILED BY NATALIE FUTTER

## 1 KNOMO iPHONE WALLET

**Knomo's leather wallet boasts a highly practical design with a handy pouch at the front to hold your iPhone, where it receives regal treatment, cushioned within its dedicated velveteen phone-pocket. With plenty of room for cards and cash, it's ideal for those who like to have everything in one place.** *knomobags.com*

## 2 COURVOISIER XO IMPERIAL COGNAC

Courvoisier XO is a unique blend of over 40 fine cognacs, each patiently evolved and nurtured. Recognised as one of the finest XOs in the world, its depth and intensity of flavours strikes the perfect balance with chocolate, vanilla and spice notes complimented by fruity aromas of apricot and pear. *courvoisier.cognatheque.com*

## 3 TAG HEUER MIKROGRAPH WATCH

**TAG Heuer's Mikrograph is a major innovation in accuracy, thanks to its column-wheel integrated chronograph. This 150-piece limited edition in rose gold celebrates the original Mikrograph – the first mechanical stopwatch to be accurate to 1/100th of a second – by displaying the same tiny fraction with its central hand.** *tagheuer.com*

## 4 BLIPPAR AUGMENTED REALITY

*BlippAR* is an image-recognition phone app that brings print and products to life through augmented reality. Put simply, it turns any image – be it photo, logo or ad – into an interactive experience just by pointing your smartphone at it. Go to the *blippAR* website or try it out for yourself on the LG advert on page 26. *blippar.com*

## 5 2012 DO LECTURES FESTIVAL

**The aim of Do Lectures is to inspire its audience to go and do amazing things, and from April 25 to 29 this year it did just that. On an idyllic farm in west Wales, speakers discussed topics from technology to sport and design, exploring diverse themes. Its engaging attendees included Mind Candy's Michael Acton Smith.** *dolectures.com*




PHOTOGRAPHY: SUN LEE

breast cancer care

# Support for the woman behind the cancer

When breast cancer and its treatment overshadow everything, we see the woman underneath. Breast Cancer Care is the only UK-wide charity dedicated to providing emotional and practical support for anyone affected.

breastcancercare.org.uk/thewoman

# PLAY

**THIS MONTH: 08.12**
- **ROLLER-COASTER DESIGN**
- **THE GOOGLE ORCHESTRA**
- **SCIENTIFIC SUPPER CLUB**

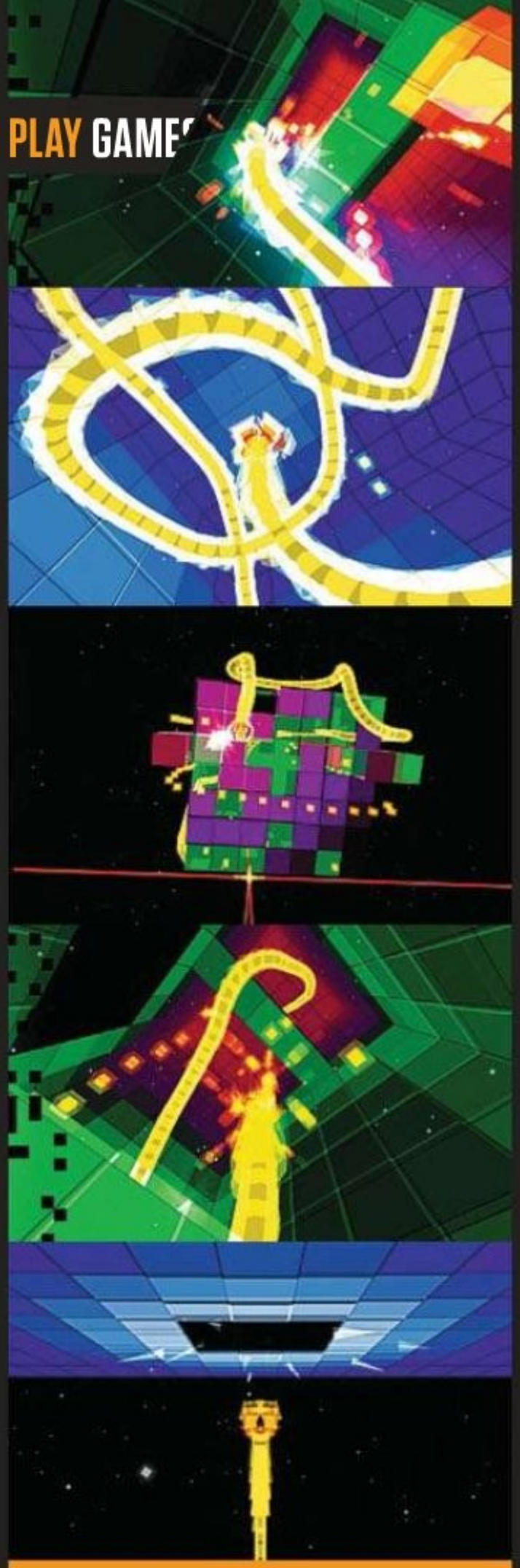
**EDITED BY TOM CHESHIRE**

## HOUSING-BUBBLE ART

Thomas Doyle makes perfect, tiny homes – then wreaks untold havoc upon them. "I was looking at the iconic house," says the New York-based sculptor, "and thought it was an interesting juxtaposition to work with disastrous scenes." Doyle, 35, spends months crafting each piece, starting with a foam and plaster core for the earth. He then builds houses at 1:43 scale, and causes calamity to strike. Figurines are left in the aftermath trudging along with suitcases or burying the dead. "There's no explanation for the disaster, it just is," he says. "Either something just happened or is about to." Doyle's works are showing as part of the *American Dreamers* exhibition at the Palazzo Strozzi, Florence, until July 15. Disaster permitting... **Tom Cheshire** *thomasdoyle.net*



*Firing for Effect* measures 110cm in diameter; both elements are encased in a glass globe



## SNAKE BITES BACK

Remember being glued to *Snake* on your Nokia (*see p25*)? Well, the serpent is back – as a 3D avatar based on user-generated rules. "As you play, the levels mutate," says Truro-based game-developer Matt James. The game's objective is still the same – "You're a snake, you collect objects, you avoid eating your tail" – but a new algorithm lets it track your gameplay and throw up extra elements.

In 2010, James, now 34, met Lane Hauck, the creator of *Snake*'s arcade progenitor, *Blockade*, in San Diego. Using Hauck's recollections, James wove a historical narrative into the game. "As you play, you can unlock areas that tell the story of *Blockade*," says James, "and pop-ups, audio and text chart the history of *Snake*." The game, available on Xbox and PC, is called *qrth-phyl*. Meaning? "Like the game," says James, "it can be whatever you want it to be." MV *hermitgames.com/qrthphyl.php*



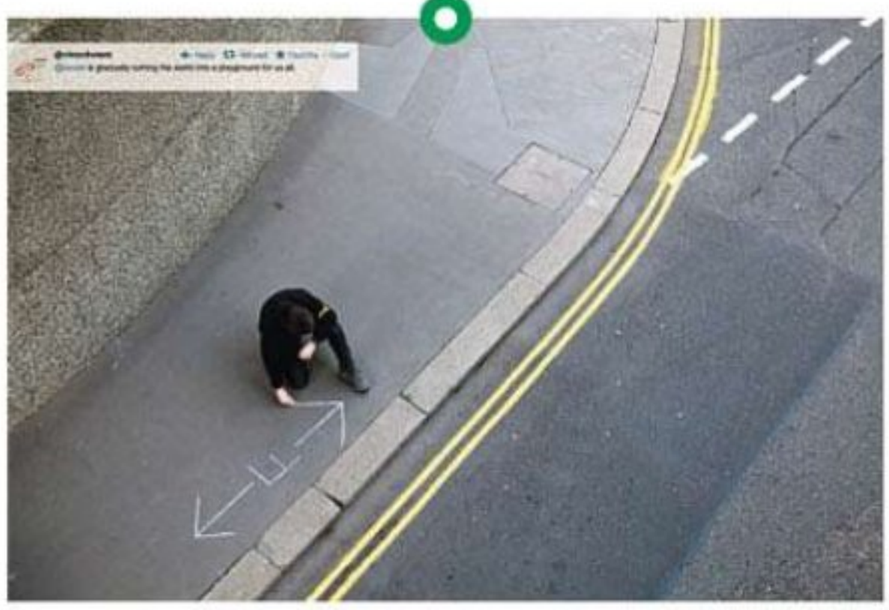
# Follow and shoot

*Use Twitter? Then you'd better look your best, in case Travis Hodges gets in touch*

**Travis Hodges takes following people on** Twitter literally: the 30-year-old photographer tracks down users of the microblogging service so he can take their photograph – then asks them to select the next candidate. Hodges started the project, called "Follow Me", last summer. "A friend persuaded me to sign up [to Twitter] after I'd been resisting social networking," he says. "I did so on the proviso that I wasn't going to use it as a faceless communication tool. The idea was to go and meet these people, then follow the connections wherever they led me." The first subject was one of his early follows, *@cigaretteBurns_*, who screens obscure films. *@cigaretteBurns_* then pointed him to *@AlOverdrive,* another photographer, who introduced him to *@deedeesvintage* (*pictured right*) – leading to a digital pass-the-parcel comprising 13 portraits shot around the UK.

Each picture aims to show something of the tweeter's online persona. "The 'twintros', as they've been named, have been written by the person before," says Hodges. "It's a quick, short burst to give an idea." He doesn't see an end point to the project, either: "It's something that could continue throughout my career." WIRED thinks he should stick to the essence of Twitter and stop at 140 characters. **TC** *travishodges.co.uk*

**iPad extra!**
Download the WIRED app to see more of Travis Hodges's work

*@deedeesvintage*, 07.11; suggested by *@AIOverdrive*

*@warriorgrrl*, 02.12; suggested by *@Lisamargreet*

*@vivschwarz*, 02.12; suggested by *@warriorgrrl*

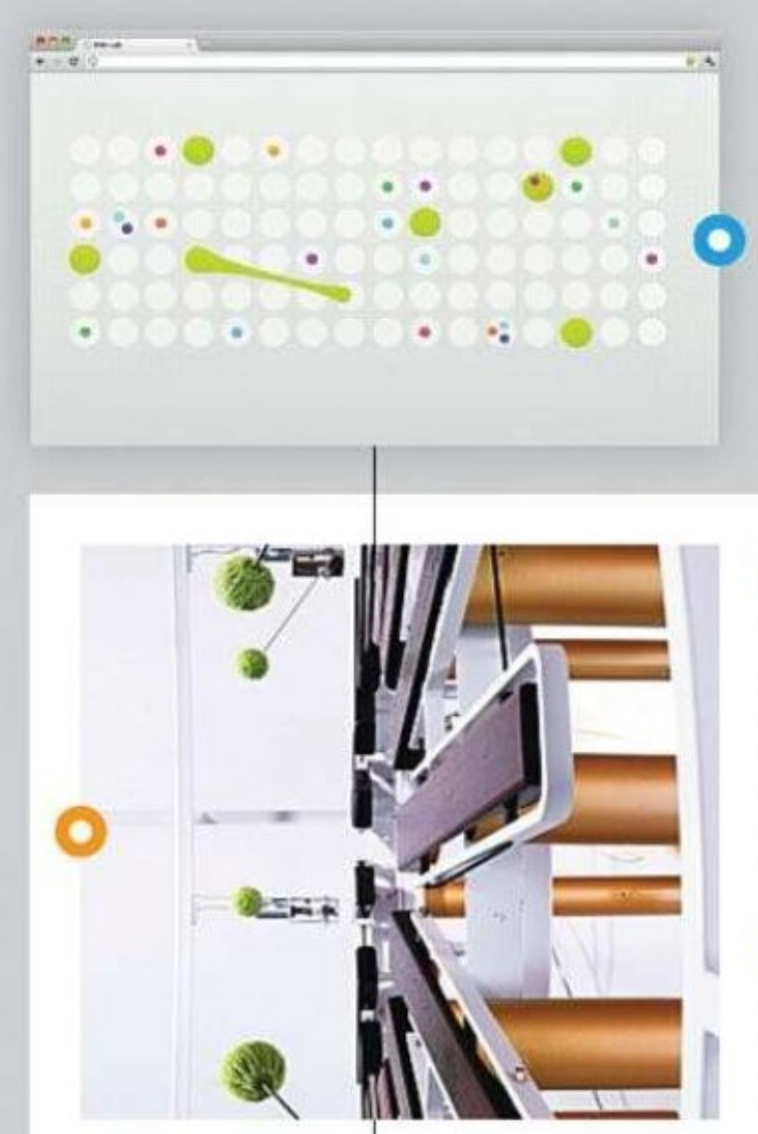
*@Kevan*, 03.12; suggested by *@vivschwarz*

# Net sounds

*Play in an online orchestra made of instruments built specially for Google's Web Lab*

**Forget Google Goggles – this is** the Google marimba, one of eight devices that make up the Universal Orchestra Experiment. Made by Google's Creative Lab, it's on display at the London Science Museum this July, but you can play it from anywhere in the world over the internet.

Four of the instruments, including a kalimba and a vibraphone, can be played at the museum by using a tablet device; the marimba is played via the website. "When the museum shuts for the day, all eight instruments can be played online," says project leader Jayme Goldstein. "We've taken the eight-hours-a-day museum and thrown it open." The orchestra is one of five experiments in the Google Web Lab exhibition. Others include the Data Tracer, which shows how information spreads over the internet, and sketchbots which draw visitors' portraits into sand. **MV** *chromeweblab.com*



An HTML5-based interface allows the instruments to be controlled in real time through a browser. The biggest challenge was overcoming the delay effect of network latency

The orchestra has been designed so that all the instruments play not only in time, but also harmoniously

PHOTOGRAPHY: DAVID ARKY

# WIRED

## TABLET EDITION


DOWNLOAD IT NOW FROM THE APPLE APP STORE

# Gotham City's worst

*Batman has been fighting the same people for almost 75 years – but they're different every time*

**Superheroes are only as good** as their villains – and that goes for superhero movies too. That's why Christopher Nolan's Batman trilogy, which concludes in July with *The Dark Knight Rises*, has been so much fun. Batman's rogues' gallery is among the best. Though to be fair, the new movie stars good villains with spotty film history – Catwoman (now played by Anne Hathaway) has had more than nine lives in her career, and one of them was Halle Berry. And remember how Bane was demoted to a grunting henchman in *Batman and Robin*? (Actually, if you remember *Batman and Robin*, you can probably sue Joel Schumacher for mental scarring.) The ups and downs of Gotham City's bad guys tell the story of how depictions of the Dark Knight have changed over the years – from comic, to tragic, to scary. Here's a look at the best of the worst. **Tim Leong**

**TWO-FACE**
*Detective Comics* #66 (1942)
A face half-full of acid turns district attorney Harvey Dent into a duality-obsessed nut.

**JOKER**
*Batman* #1 (1940)
His best murders are hilarious.

**CATWOMAN**
*Batman* #1 (1940)
Originally called The Cat, she's a whip-toting (cat) burglar and Bat-temptress.

**RIDDLER**
*Detective Comics* #140 (1948)
Leaves riddles as clues – appealing to Batman's detective skills.

**SCARECROW**
*World's Finest Comics* #3 (1941)
Turns evil after getting fired for testing fear gas on his psych students.

**PENGUIN**
*Detective Comics* #58 (1941)
A chubby thief with a penchant for umbrellas and bird-related prizes.

COMICS

**JOKER**
*Batman* (1966)
Cesar Romero played the Joker for laughs.

MOVIES

**CATWOMAN**
*Batman* (1966)
Played by Eartha Kitt and Julie Newmar. (Lee Meriwether was in the 1966 movie.)

**MR FREEZE**
*Batman* (1966)
The TV producers changed Mr Zero to Mr Freeze. The comics followed suit.

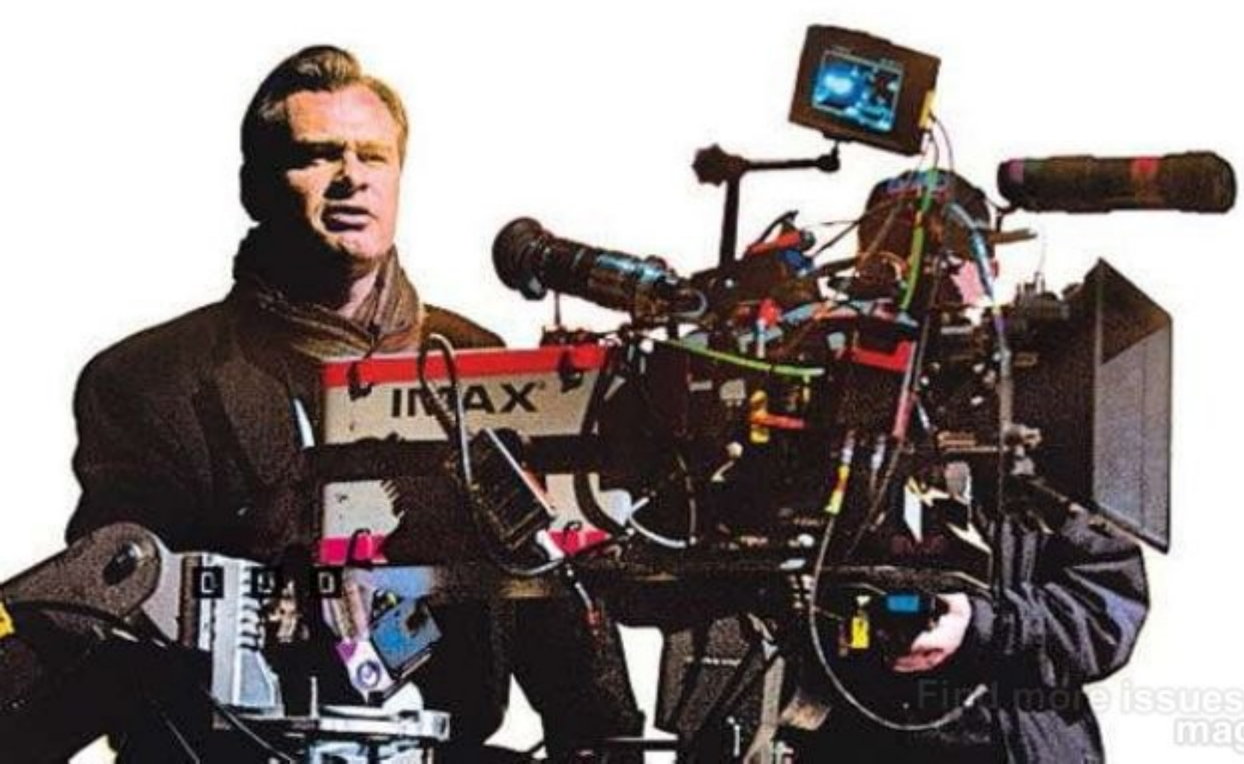
TELEVISION

**MR FREEZE**
*Batman* #121 (1959)
This cold-ray-equipped bad guy was originally called Mr Zero.

**POISON IVY**
*Batman* #181 (1966)
The original design for this eco-temptress was modelled on pin-up girl Bettie Page.

**RA'S AL GHUL**
*Batman* #232 (1971)
Immortal bioterrorist genius.

1940 1950 1960 197




## MEANWHILE... HOLY HD, BATMAN!

**He's anti-3D, still shoots on film and believes in using as little CGI as** possible – Christopher Nolan is Hollywood's traditionalist. But for his latest, *The Dark Knight Rises*, Nolan needed an epic camera to match the scale of his vision for his third Batman film.

"The IMAX cameras use 65-millimetre 15-perforation film advanced horizontally through the camera at 24 frames per second," explains

PHOTOGRAPHY: WARNER BROS; PHOTOFEST

**CATWOMAN**
*Batman Returns* (1992)

**BANE**
*Batman and Robin* (1997)
Bane plays hulking second fiddle to Ivy and Mr Freeze.

**CATWOMAN**
*Catwoman* (2004)
Halle Berry gets powers from an Egyptian god. This movie really happened.

**RA'S AL GHUL**
*Batman Begins* (2005)
This Ra's is part of a cult of assassins.

**CATWOMAN**
*Dark Knight Rises* (2012)
Ears. Thief. Voice of the 99 per cent.

**JOKER**
*Batman* (1989)
Jack Nicholson makes one scary clown.

**TWO-FACE**
*Batman Forever* (1995) Tommy Lee Jones plays the mercurial murderer as Riddler's maniacal buddy.

**SCARECROW**
*Batman Begins* (2005)
Still with the fear gas, eh, Professor?

**JOKER**
*Dark Knight* (2008)

**BANE**
*Dark Knight Rises* (2012)
Now he's an international terrorist who wants to destroy Gotham.

**RIDDLER**
*Super Friends* (1978)

**PENGUIN**
*The Super Powers Team: Galactic Guardians* (1985)

**CATWOMAN**
*Batman: The Animated Series* (1992)
For this show, she's more of an antihero.

**MR FREEZE**
*Batman: The Animated Series* (1992)
Writer Paul Dini created a tragic backstory that the comics adopted.

**RA'S AL GHUL**
*Batman: The Animated Series* (1992)

**BANE**
*Batman: The Animated Series* (1994)

**BANE**
*Batman: Vengeance of Bane* #1 (1993)
A towering fighter addicted to a strength-increasing serum, Bane snaps Batman's spine.

**TWO-FACE**
*Dark Knight* (2008)
The crazy suits are gone, and his death plays a role in *The Dark Knight Rises*.

**CATWOMAN**
*Batman: The Brave and the Bold* (2009)
Still has the ears. Still a thief. Still a love interest.

**CATWOMAN**
*Catwoman* #1 (2011)
The cat-burgling antiheroine has become Batman's friend-with-benefits.

**POISON IVY**
*Birds of Prey* #1 (2011)
Ivy goes good and joins the all-female superhero team.

70 1980 1990 2000 2010

David Keighley, IMAX's chief quality officer. "The frames are nine times bigger than a traditional 35mm movie frame. For Chris [Nolan] it's the closest you can get to zooming down the road in the Batmobile."

Keighley started collaborating with Nolan after *Batman Begins* in 2005, when they worked to convert its standard 2.40:1 aspect ratio in order to fill huge screens. The IMAX cameras piqued Nolan's attention – an interest that would eventually lead to him shooting 25 minutes of 2008's *The Dark Knight* using the format. For *The Dark Knight Rises*, billed as more like a war movie than *The Dark Knight*'s brooding psychological thriller, almost an hour of the completed film has been shot in IMAX, with scenes such as the Wall Street showdown between Batman and Bane boosted in resolution to the point where the faces of over 1,000 extras are clearly visible in frame.

Converting formats also went both ways: for shots Nolan chose not to capture in IMAX, the 2.40:1 format had to be converted in terms of contrast and colour using IMAX's DMR (Digital Media Remastering) software to match the rest of the footage. Some shots taken in IMAX had a 2.40:1 frame extracted from them, depending on whether Nolan felt a shot should be subtle or grand. "He's the story-teller," says Keighley. "He decides when he needs that extra height." Stephen Kelly

Director Christopher Nolan (*left*) on the set of *The Dark Knight Rises*, with an IMAX camera and its operator

# Genetic gastronomy

*How artists are bringing scientific debate to the dinner table*

**On the menu at the Planetary** Sculpture Supper Club: to start, the "disappearing genome", a cocktail made from the rare pomelo fruit from Karnataka, India. Next up, "glowing sushi" – a genetically modified species of zebrafish usually sold in the US as a glow-in-the-dark pet. And, for dessert, a refreshing mutagenic grapefruit sorbet.

The Planetary Sculpture Supper Club is what results when you invite artists, scientists, chefs and policymakers to dinner. "The name comes from how we sculpt the planet unconsciously, through our food choices," says artist and cofounder Cat Kramer (*far right*). She and her partner Zack Denfeld (*right*), both 29, organise the meals in cities across the world, encouraging diners to imagine and debate the future of food.

"Everybody has a relationship with food, whether they like it or not," says Kramer. "Scientists and farmers can share a meal at a table and discuss their unique perspectives on food." The nomadic research duo travel widely – Oregon, Bangalore, Dublin, Amsterdam and Singapore in the last year – working with chefs, researchers and legislators. The goal is to explain the biological, historical and ecological aspects of food through a cultural lens. The "disappearing genome", for example, owes its name to the fact that all the agricultural land where it grows is being developed. "It is a soon-to-be-gone genome," explains Denfeld.

So, do Kramer and Denfeld have a favourite food? "I really like mashups of different cuisines," says Kramer. "Such as khimchi quesadilla." **MV** *genomicgastronomy.com*

Food oddities such as "glowing sushi" (*below*) are on the menu


**KNOW YOUR FOOD**

"The first step is to learn the names and cultural history of the genomes that compose our food system," says Denfeld. Here he labels the basics found in most supermarkets.

**1. CHICORY** *(Cichorium intybus)*
**2. WHITE ONION** *(Allium cepa)*
**3. GRANNY SMITH APPLE** *(Malus domestica)*
**4. CAULIFLOWER** *(Brassica oleracea Botrytis group)*
**5. AVOCADO** *(Persea americana)*
**6. COURGETTE** *(Cucurbita pepo)*
**7. FENNEL** *(Foeniculum vulgare)*
**8. BROCCOLI** *(Brassica oleracea Italica group)*
**9. ROUND COURGETTE** *(Cucurbita pepo)*
**10. LETTUCE** *(Lactuca sativa)*
**11. GREEN CHILLI PEPPER** *(Capsicum annuum)*
**12. PEAR** *(Pyrus communis)*
**13. CUSTARD APPLE** *(Annona reticulata)*
**14. MUSTARD CRESS** *(Lepidium sativum)*
**15. PINEAPPLE** *(Ananas comosus)*
**16. MANGO** *(Mangifera indica)*
**17. PRICKLY PEAR** *(Opuntia ficus-indica)*
**18. PIEL DE SAPO** *(Cucumis melo)*
**19. BUTTERNUT SQUASH** *(Cucurbita moschata)*
**20. RED KURI SQUASH** *(Cucurbita spp)*

## MAGIC GETS AN UPGRADE

**A-list illusionists such as Derren Brown and David Blaine may draw large crowds and command high television ratings, but the most innovative work is to be found in the underground magic world. Alex Stone, author of *Fooling Houdini: Adventures in the World of Magic*, out on July 5, says, "There are highly secretive magicians who perform their signature tricks right under your nose, using regular, everyday objects. No gaffs. No gimmicks. No camera trickery. Just pure magic." Stone picks three heroes of the underground and explains their signature tricks.**

### LENNART GREEN'S LASER DEAL

Swedish close-up magician Lennart Green deals cards into the beam of a laser: as they pass through it, they vanish. It's an auditory illusion too – you hear the cards hitting the table as they disappear. Green then reproduces the cards from nothingness. To do this, he devised new sleights that shattered assumptions about what was possible with a deck of cards. *tinyurl.com/75a9po*

### ARMANDO LUCERO'S COIN MENAGERIE

A classic trick reinvented by Armando Lucero, four coins are placed at the corners of a mat and each is covered with a card. Lucero mimes placing three coins on one card. He turns over the other cards to reveal all four coins in one corner. He ends with one coin and two cards, placing the coin half-under the right-hand card. He lifts it to reveal... nothing. The coin is under the left card. *armandolucero.com*

PHOTOGRAPHY: LEON CSERNOHLAVEK


**21. POMEGRANATE**
*(Punica granatum)*
**22. TOMATO**
*(Solanum lycopersicum)*
**23. BABY PLUM**
*(Prunus cerasifera)*
**24. NECTARINE**
*(Prunus persica)*
**25. CARROT**
*(Daucus carota subsp. sativus)*
**26. PEACH**
*(Prunus persica)*
**27. CHICORY**
*(Cichorium intybus)*
**28. GOLDEN DELICIOUS APPLE**
*(Malus domestica)*
**29. CANARY MELON**
*(Cucurbitaceae melo Inodorus group)*
**30. RED CHILLI PEPPER**
*(Capsicum annuum)*

**GARRETT THOMAS'S THE RING THING**

Garrett Thomas showcased an effect that fried some of the world's top conjurors. Standing before the audience, Thomas removes a ring from his first finger and tosses it back toward his hand. Before anyone has time to blink, the ring materialises back on his finger. An entire ring-based magic routine has the ring jump between his fingers, dance as though possessed, vanish and reappear on command, and even turn into a coin. *gtmagic.com*



## HOTELS THAT ARRIVE PREBUILT

CitizenM doesn't build hotels: it manufactures them. Each of the 192 rooms at its new London hotel, open in July, was prefabricated in a factory near Luton, transported on trucks down to the Bankside site, then stacked on top of each other. "The rooms are 99 per cent finished at the factory," says Rob Wageman, principal at Concrete Architectural Associates, which designs the hotels. "The sheets are not on the beds, but everything else is in. All we do is clean them, make the beds and connect them to electricity and water."

The modular design means CitizenM is applying lean manufacturing to the hospitality business: "We have way less waste, and we know the number of hotels we're planning to open so can build rooms in huge numbers," says Wageman. "That allows us to keep the price of production low."

CitizenM started in 2007 with a simple philosophy. "We did not set out to create a hotel. If you do that there are all kinds of rules. So we started with the room." The company assembled two hotels in Amsterdam in 2008 "to experiment", then applied the lessons learned to create a new iteration in Glasgow (*shown below*) in 2010.

CitizenM has stockpiled enough rooms for three new hotels in the UK, including Bankside. Each requires a traditionally built foundation and first floor, but once a site is prepared, construction takes only eight months. Next, CitizenM is targeting New York. Wageman isn't fazed by the maze of local regulations: "We are the boss of our own boxes." TC *citizenm.com concreteamsterdam.nl*

Each window is one room – you can see the head of the bed against the glass

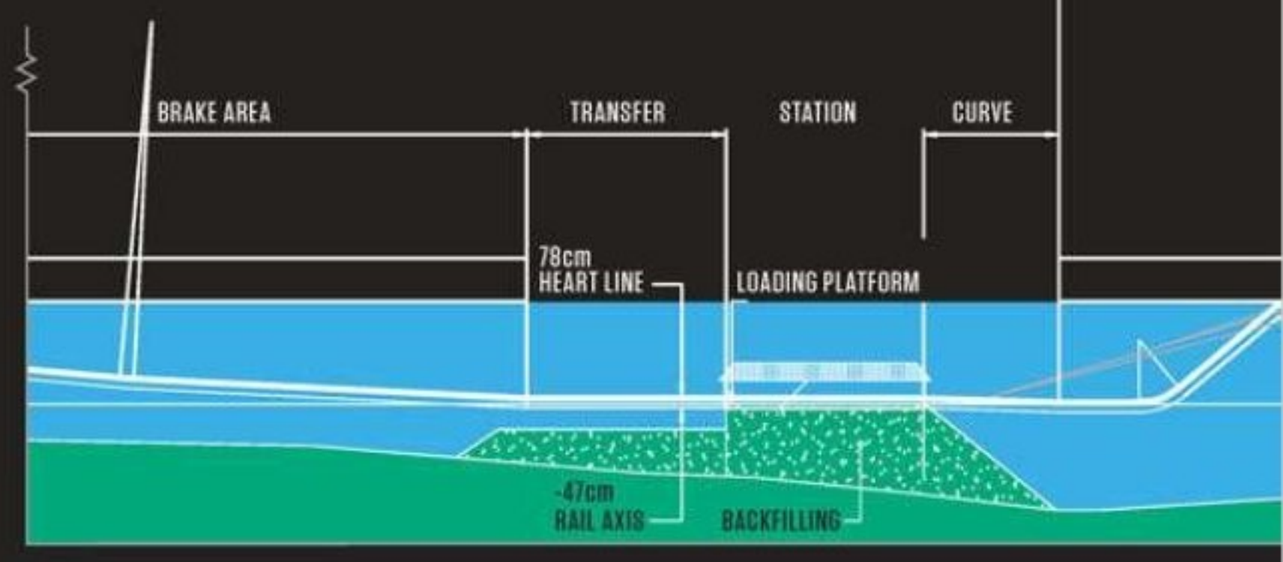
Shambhala cost €25 million to build and takes 1,680 riders every hour. The top speed of 134kph is reached during the first descent

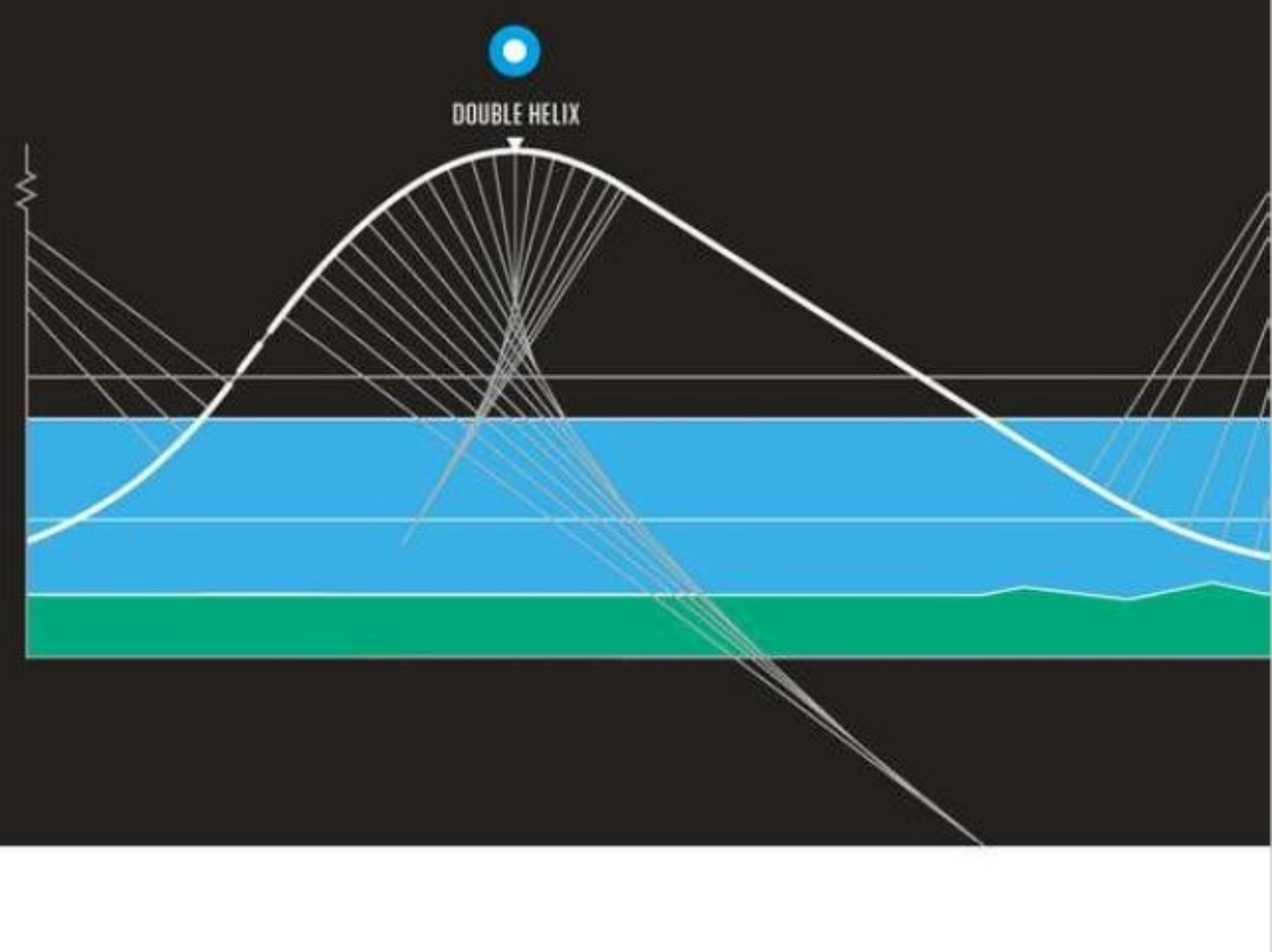
PLAY DESIGN

# Bigger dipper

*Europe's fastest roller coaster combines a double helix with water cannons*

**The tallest and fastest roller coaster in Europe,** Shambhala, opened in May in PortAventura in Salou, Spain. So how do you design a speedy hypercoaster? Luis Valencia, director of development at the theme park, takes WIRED through two of the most technically demanding sections of the 1,650-metre track. Hold tight, here it comes... **TC** *portaventura.co.uk*




## HOLLYWOOD ARCHAEOLOGY

Cecil B DeMille's 1923 silent film *The Ten Commandments* was renowned for the massive set constructed in California's Guadalupe-Nipomo Dunes – some pieces stood over 30 metres tall. Worried that rival film studios might use the facsimiles of an ancient palace, massive Pharaoh statues and sphinxes, DeMille ordered the crew to dynamite and bury them all in the sand after filming. These discarded simulacra have become buried treasure and permits for excavation require lots of cash and confusing paperwork. The site doesn't look much, either: "You think you've found an amazing hidden story," says Andres Burbano, 40, a PhD student at University of California Santa Barbara, "but then people near the dunes say, 'We don't know why you pay attention to that pile of trash.'"

Along with fellow students Danny Bazo, and Solen Kiratli DiCicco, both 33, he has virtually excavated the land using non-invasive ground-penetrating radar. Custom software that Burbano built himself processes the 3D data to create visualisations of the buried objects.

The researchers needed aerial photographs of the land to guide the exploration, so they built and launched a helium balloon-kite made of Mylar and fishing line with a digital camera attached. The high-resolution-image panoramas were then stitched together using Hugin open-source software. The UCSB team plans to explore a nearby section of the dunes that was a mystical art colony in the 1930s. Joanne McNeil

PHOTOGRAPHY: PA NEWS

### LIFT AND FIRST FALL

The coaster is 78 metres tall. "Deciding the specific height of this first fall was the main design challenge because I had to maintain a consistent balance," says Valencia.

### DOUBLE HELIX

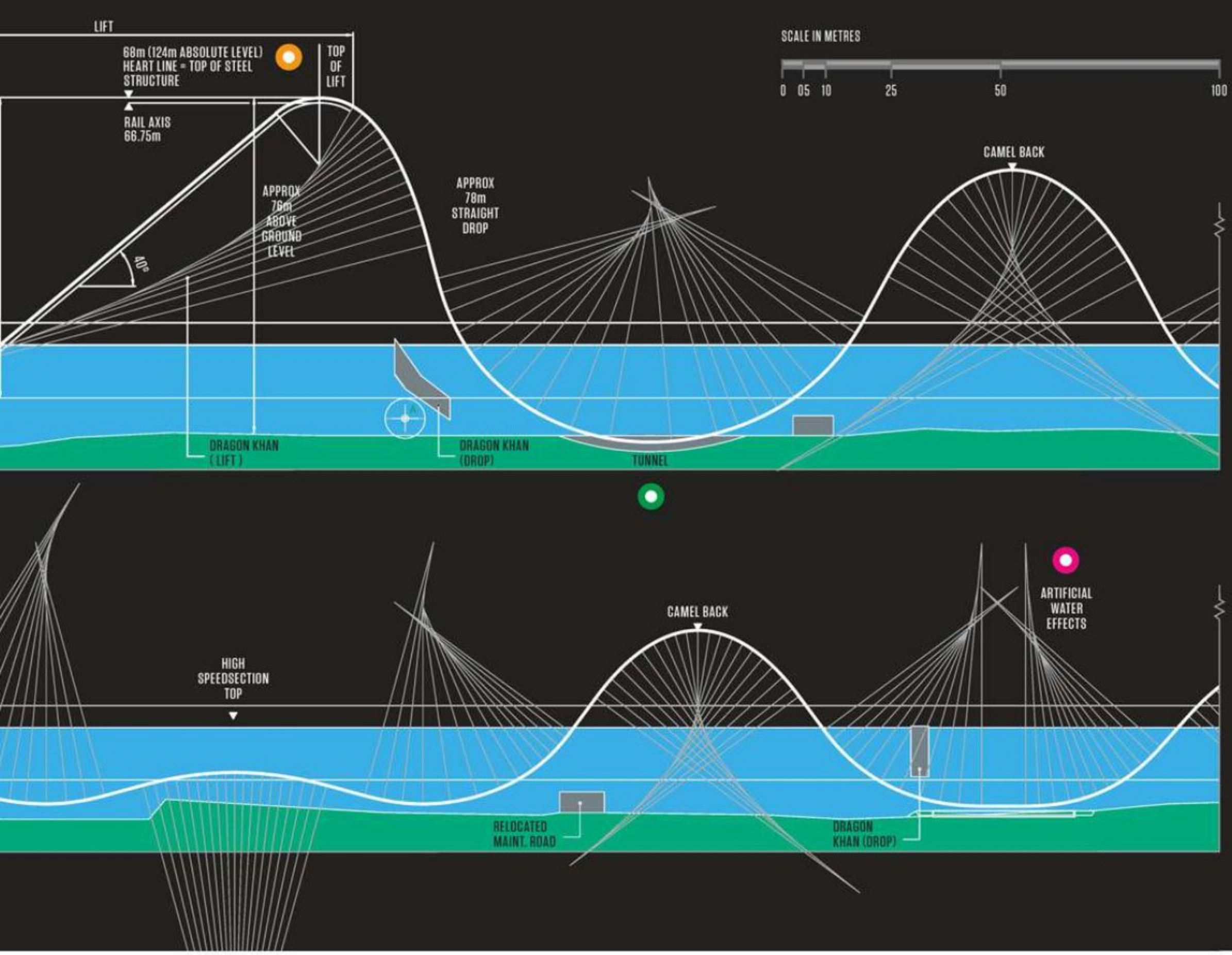
"The most complex point is the double helix, a key point that accelerates the train. Its unique design involves the installation of many more piles than any other part of the ride."

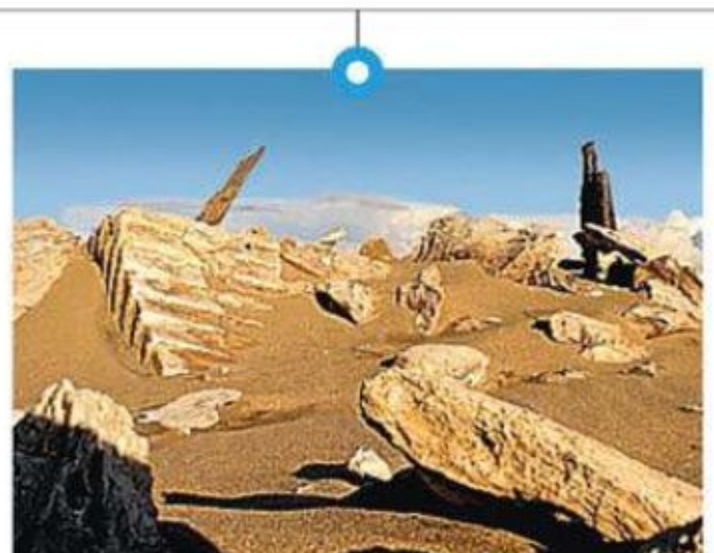
### LAKE AND SPLASH EFFECT

"One of the most dramatic effects of the journey is the big splash effect when the train crosses the lake. The effect is simulated, assisted by water cannons, to keep the speed of the train."

### TUNNEL

"One of the many difficulties we encountered in the field was the excavation of the tunnel, because the area we chose was pure rock. This has forced us to make the excavation at two levels."



- A ten-storey palace created by Cecil B DeMille in 1923 and blown up after filming had finished
- The burial ground of DeMille's set: Guadalupe-Nipomo Dunes in California as they are today
- Using data from ground-penetrating radar, Burbano's custom software renders 3D images


# Playlist

CULTURAL PICKS OF THE MONTH 08.12



## 1 *CPU WARS* VOLUME 1.0

Regular *Top Trumps* not techy enough for you? *CPU Wars* lets you do battle with 30 computer processors from the last 40 years, listing stats such as maximum clock-speed and transistor count. *£7.99 shop.cpuwarsthegame.com*

## 2 DIY NIXIE TUBE DESK CLOCK

Before we had LED displays, there were nixie tubes. The neon-filled cylinders, used to display information, are difficult to find these days – but this DIY kit lets you and your soldering iron build a fully functioning clock. *$150 thinkgeek.com*

## 3 AN AXE TO GRIND

Guns N' Roses' (post-Slash) guitarist Buckethead's Signature Les Paul is designed for rock, metal and shredding. It comes in Alpine white and features arcade-style kill switches to mute output. Bucket not included. *$4,311 gibson.com*

## 4 ROBOTIC ROONEYS

The Federation of International Robot-soccer Association's RoboWorld Cup is coming to the UK for the first time since it kicked off in 1995. It's hosted at Bristol's Robotics Lab in August. Injury worries won't be an issue. *fira.net*

## 5 THE MONARCH OF MOOMBAHTON

Moombahton is not even two years old, but DJ Sarah Young has crowned herself its queen. Expect her midtempo mixture of reggaeton, Dutch house and dancehall to ignite clubland soon. Her second EP is out in July. *iamsarahyoung.com*

PHOTOGRAPHY: SCOTT GRUMMETT; DAVE LIDWELL. WORDS: TOM CHESHIRE


# The future will be here.
# October 25-26, London.

WIRED 2012

Together with Telefónica

wiredevent.co.uk


# A COSTUME DRAMA

## JESSICA BROWN FINDLAY

BY MERT ALAS AND MARCUS PIGGOTT

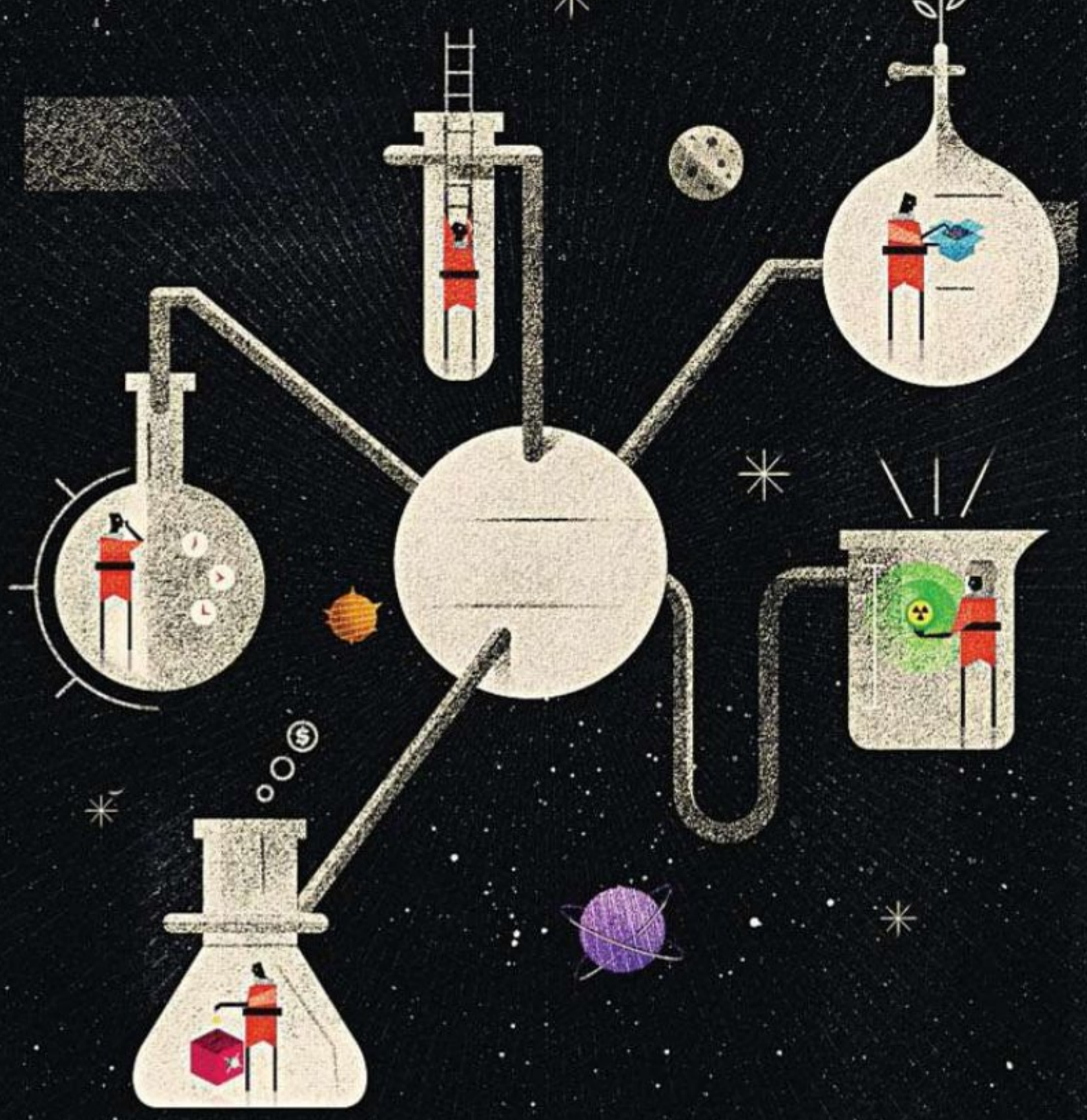
ON SALE 30TH JULY 2012 — WWW.THELOVEMAGAZINE.CO.UK

# HOW TO

LIFE ENHANCEMENT

**THIS MONTH: 08.12**

- EXPERIMENT IN SPACE
- COMMENT ON GOOGLE+
- RESCUE LOST FILES
- PEN A NORDIC THRILLER
- MAKE AN HDD CLOCK
- COMPOSE CHIPTUNES
- FORTIFY A SANDCASTLE



HOW TO...

## RUN AN EXPERIMENT IN SPACE

**Need to perform a lab test in microgravity? Jeffrey Manber, managing director of NanoRacks, a US company that allows anyone to buy a slot on the International Space Station, explains how to get your test tubes off the ground.** Duncan Geere *nanoracks.com*

### 1. EXERCISE SOME PATIENCE

Space science takes time. "We are very proud of the fact that we are averaging less than a year from contract signing to launch," Manber says. Also, be prepared to wait a year or so for your results to come back. It *is* space, after all.

### 2. ASK YOUR PEERS FOR ADVICE

Organisations that have already run space experiments could offer tips. For example, the Fisher Institute in Israel did stem cell and cancer work, and the Valley Christian High School of San Jose is working on processes in zero gravity.

### 3. KEEP YOUR PROJECT COMPACT

NanoRacks gives you a 10cm³ cube to work with, so space is tight. "Inside can be a circuit board or a video camera," says Manber. "Then the experiment itself: plant or crystal growth, materials – anything you want to test in zero gravity."

### 4. CHECK THE CHECKLIST

Some objects you just can't send. "Nothing radioactive," says Manber. "Nothing that might harm the astronauts. Fluids must be triple contained. Batteries must be approved by Nasa, and sometimes there are issues with magnets."

### 5. START SAVING UP

If you're an educational institution, getting an experiment into orbit will cost $30,000 (£18,500). For a commercial programme, it's double that. That's not cheap, but then neither is shooting rockets into space.

ILLUSTRATION: DAN MATUTINA

HOW TO...

# COMMENT ON GOOGLE+

An online comments section is a dangerous place, but Guy Kawasaki, author of *What the Plus! Google+ for the Rest of Us*, has some advice for posting your views. TC

### EMBRACE THE +1

You don't have to comment to comment. Kawasaki compares the +1 button to tipping, "so you should throw them around liberally". Or share: "This shows that you're willing to bet your reputation by providing it to others."

### MAKE THE COMMENT COUNT...

Some people just want to join the commenting party without having much to say. "LOL", "Cool!" and "Wow" are fine, says Kawasaki, "but why not let rip and show a little more emotion?" If that's not for you, just stick with a +1.

### ...BUT KEEP LONG COMMENTS POLITE

"A good model for long-form comments is that you are talking to people who have invited you into their homes for dinner," says Kawasaki. Don't get drunk and throw up on their rug. "Show a high level of civility and class."

### STICK TO THE SUBJECT

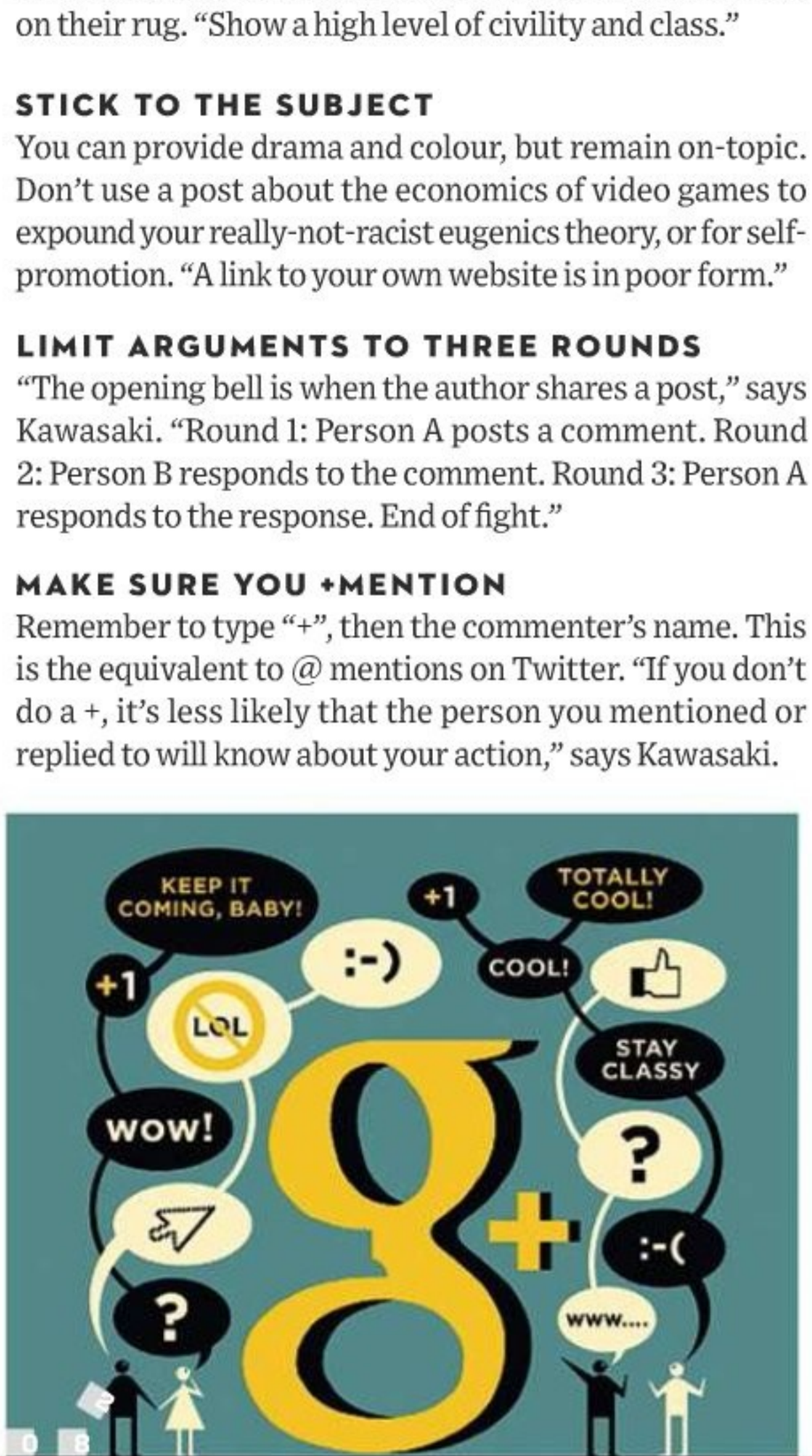
You can provide drama and colour, but remain on-topic. Don't use a post about the economics of video games to expound your really-not-racist eugenics theory, or for self-promotion. "A link to your own website is in poor form."

### LIMIT ARGUMENTS TO THREE ROUNDS

"The opening bell is when the author shares a post," says Kawasaki. "Round 1: Person A posts a comment. Round 2: Person B responds to the comment. Round 3: Person A responds to the response. End of fight."

### MAKE SURE YOU +MENTION

Remember to type "+", then the commenter's name. This is the equivalent to @ mentions on Twitter. "If you don't do a +, it's less likely that the person you mentioned or replied to will know about your action," says Kawasaki.





HOW TO...

## SALVAGE LOST EMAIL ATTACHMENTS IN WINDOWS

**There are few things more soul-destroying than closing an updated email attachment – then losing it. Oded Ran, CEO of Touchnote, is here to help.** TC

### 1. CLICK WISELY

In Hotmail and Outlook Web Access, there are two options: Open and Save. Click Save. With Open, says Ran, "you're entering zombieland". The file will be saved to a folder dedicated to files downloaded from the web and will disappear when you shut down Word.

ILLUSTRATION: RYAN INZANA; BEN NEWMAN; MATTHEW BILLINGTON


HOW TO...

# WRITE YOUR OWN NORDIC THRILLER

**A chilly north European wind has swept over the TV, film and book world recently. Barry Forshaw, author of *Death in a Cold Climate: A Guide to Scandinavian Crime Fiction*, reveals the bare necessities when penning an ice-cold thriller.** Matt Hussey

### GIVE YOUR HERO A BUNCH OF PROBLEMS

Detectives in Scandinavian novels tend to be damaged goods, so don't be afraid to pile on the neuroses. "Kurt Wallander is one of crime fiction's crucial creations," says Forshaw. "His spiralling weight and diabetes don't help, and his private life is a mess. Make the relationships with their parents and/or kids as fraught as possible."

### DON'T SHY AWAY FROM A BIT OF BLOODSHED

This is, after all, crime fiction. "Jo Nesbø's *The Redeemer* is a cocktail of urban decay and gruesome violence," explains Forshaw. "This can also be found in Yrsa Sigurðardóttir's *Last Ritual,* but the yardstick is the violence surrounding Lisbeth Salander in Stieg Larsson's *The Girl with the Dragon Tattoo*."

### MATCH THE SETTING WITH YOUR STORY

The setting of a Scandinavian thriller is as crucial as the characters and the plot – and locations are arguably also characters. "*Miss Smilla's Feeling for Snow* by Peter Høeg gets it just right, transfixing the reader with its stunning use of Copenhagen locales and whiteout weather, so traumatic for the damaged, snow-sensitive heroine."

### READ UP ON YOUR PEERS' WORK

Do your research and be willing to learn from the best. "Don't miss ex-criminal and criminologist duo Roslund and Hellström, the cosier Camilla Läckberg and Anne Holt, king of the Nordic private-dick saga Gunnar Staalesen, the atmospheric Johan Theorin and the darker Jussi Adler-Olsen and Karin Fossum. All are essential."

### BLUR THE BOUNDARIES OF GOOD AND EVIL

Arnaldur Indriðason's *Silence of the Grave* contains a good example of a character flitting between both sides of the law. "A murdered man's computer is found to contain pornography, and it transpires that he has been accused of rape," says Forshaw. "The moral boundaries are unclear." This kind of uncertainty makes for engaging reading.

### THINK ABOUT THE BIG (AND SMALL) SCREENS

Swedish TV and film production company Yellow Bird's tagline is: "We turn best-sellers into blockbusters." Or set your sights higher and go to Hollywood: David Fincher has remade *The Girl with the Dragon Tattoo* and Martin Scorsese has signed up to film Nesbø's *The Snowman*. And why write one book, when you can pen a whole series?

---

**2. ACT QUICKLY**
You can rescue a file if a short time has passed. On Windows 7 or Vista, open Start and type "%userprofile%\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5" into the search bar. Windows won't show you the file unless you type it.

**3. UNHIDE FILES**
Type alt+T to show the Tools menu and go to Folder Options. At the top of this box, choose View/Advanced Settings. Under Hidden Files and Folders, choose to show Hidden Files, Folders and Drives. Uncheck the box that says "Hide protected operating system files".

**4. FIND YOUR FILE**
There should be more transparent-looking files here. The easiest way to find your one is by sorting folders in date order. Bring up the View menu, and select Sort By. Open each folder, ignoring any warning messages. Check each file by the Date Modified.

**5. BREATHE AGAIN**
When you're done, return Windows to its normal state by hiding the hidden folders again. In Explorer, click alt+T/Folder Options/View, check the box "Hide protected operation system files" and choose the option "Don't show hidden files, folders or drives".

HOW TO...

## MAKE A HARD-DRIVE CLOCK

Do you have an old hard drive that's either broken or hopelessly outdated? Why not recycle its internal platter into a stunningly nerdy hard-drive platter clock? **Jeremy Cook**

### 1. COLLECT YOUR PARTS AND TOOLS

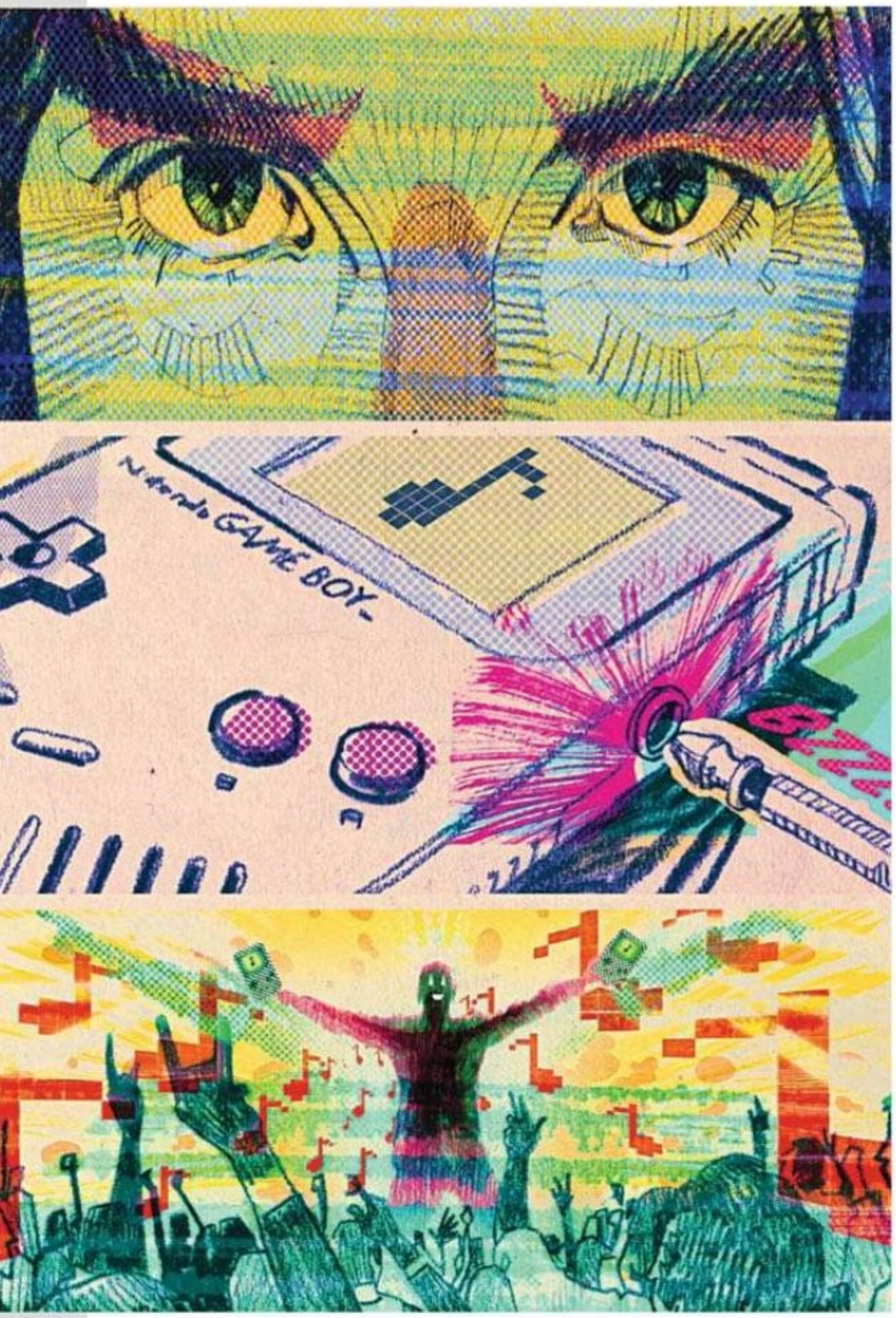
You will need: a three-inch hard-drive that is either broken or that you don't mind being destroyed; a clock kit bought from a hobby shop; a small Torx-bit screwdriver (or more destructive means) to get the cover off the hard drive.

### 2. PREPARE YOUR COMPONENTS

Unscrew the drive's case. (Some hard drives have screws hidden under a piece of foil that is easily cut and circumvented.) Once the cover is off, unscrew the platter from the central spindle. Make sure you move the read head out of the way.

### 3. ASSEMBLE THE CLOCK

The clock kit should easily screw on to the inside of the platter. The middle hole may be too big, so a large washer, or the spindle attachment piece, may be needed for a snug fit. Centre the clock and align the hands so they come together at 12:00.



HOW TO...

## MAKE 8-BIT CHIPTUNES

**The retro bleeps from our old Game Boys and C64s are back. Chiptune artist Daniel Davis, aka an0va, is on hand to give us a music lesson.** Brian Benchoff

### 1. BROADEN YOUR AURAL HORIZONS

"Familiarise yourself with the medium," Davis suggests. "There is an active community of chiptune musicians out there; everyone involved in the scene is very friendly and would love to talk shop."

### 2. SOURCE YOUR SOFTWARE

Chiptunes are written using trackers – spreadsheet-like apps where notes are edited line by line. "*FamiTracker* and *MilkyTracker* are good ones to start on," Davis suggests, "and many are freeware."

### 3. LEARN A COVER VERSION

Chiptune versions of well-known songs are popular for a reason: "They are a great way of familiarising yourself with the workflow. You have a tangible piece of audio so you have a building block to work with."

### 4. MASTER MORE EQUIPMENT

"I write with Little Sound DJ [a music editor that runs on a Game Boy]," Davis says. But not every chiptune artist uses the same kit: "There's a huge difference in the sound generated from a Commodore 64 and a Sega Mega Drive."

### 5. GET OUT THERE AND PERFORM

"It's like playing guitar," says Davis. "If you're alone in your bedroom, there's little reason to improve your craft. Getting up in front of a crowd and playing your music gives you a reason for improvement."

ILLUSTRATION: THE TREE HOUSE PRESS; MICHELLE THOMPSON; DWAYNE BELL

# MAKE AN ARMOUR-PLATED SANDCASTLE

**Frustrated that castles made from sand fall into the sea, eventually? Then strengthen your silicon fortress using gas. Neil Downie, author of *The Ultimate Book of Saturday Science* (Princeton University Press), offers these tips.**

### 1. GATHER YOUR EQUIPMENT

You'll need: clean, dry sand; sodium silicate (AKA water glass – you can buy it from a potter's supplier, it's used in casting-slips); water; a pair of rubber gloves; a thin rubber tube; sand moulds and buckets; a mixing tray; a carbonating tray; a large clear plastic bag; carbon dioxide ($CO_2$) from a SodaStream machine.

### 2. MIX THE INGREDIENTS

Dry out the sand as much as possible by spreading it across stone slabs. Dilute the sodium silicate with water to create a 50/50 solution. Put on your gloves and mix the sand with the sodium silicate/water mix to make a mouldable building material. You are now ready to play sandcastles.

### 3. FORTIFY YOUR STRUCTURE

Make your sandcastles and place them on the tray. Fit the rubber tube on to the carbonating lance inside the SodaStream and run the other end into the tray. Put the tray and castles inside the bag and seal it. Fill the bag with $CO_2$ until it is twice the size of the volume of the tray, remove the tube and seal the bag.

### 4. HEAD FOR THE BEACH

You should notice a slight off-white deposit on the surface of the sand – this means that its crust has begun to harden. The longer you expose your structure to the gas, the tougher it will end up, but ten minutes should be sufficient. Now take your castle to the seaside and turn the tables on the beach bullies.

# WIRED

NEXT ISSUE

楽天株式会社

# SAYONARA AMAZON!

HIROSHI MIKITANI CREATED JAPAN'S BIGGEST INTERNET COMPANY. HE'S NOW TAKING IT INTO 27 COUNTRIES, BUYING PLAY.COM, BUY.COM AND A CHUNK OF PINTEREST ON THE WAY. COULD RAKUTEN BE SILICON VALLEY'S BIGGEST THREAT ?

+ SPECIAL SUPPLEMENT: EUROPE'S 100 HOTTEST STARTUPS

ON SALE AUGUST 2

ILLUSTRATION: GRANT GILBERT. 0812 LOGO WAS CREATED BY DRILLING INTO A PIECE OF BLACK PERSPEX, THROUGH WHICH FIBRE-OPTIC CABLES WERE THREADED. SHOT USING A CANON 5D MOUNTED ON A GLIDE TRACK

# FEATURES/08.12

# WHEN JACK DORSEY INVENTED TWITTER, HE CHANGED HOW WE COMMUNICATE. NOW HE'S TRANSFORMING HOW WE SPEND MONEY.

BY
STEVEN LEVY

DORSEY'S SECRET:
MAKE PAYING EFFORTLESS

PHOTOGRAPHY:
ART STREIBER

Jack Dorsey wants to make commerce "beautiful" with the Square dongle

# CONVERSATIONS

**with Jack Dorsey often veer into the obscure. Job interviews** pivot into 30-minute disquisitions on the New York Yankees. Press briefings transform into critiques of Virginia Woolf novels. A comment about Dorsey's game-changing startup, Square – which lets anyone accept credit cards – triggers a lecture on the history of money. And Dorsey can be downright verbose when talking about one of his seemingly limitless obsessions – maps, journal-keeping, perambulation, CB radio.

This tendency can become a problem for the 35-year-old, whose packed schedule would seem to afford little time for such digressions. In addition to his full-time job as CEO and unofficial chief design officer of Square – one of Silicon Valley's hottest startups, which recently sought a valuation of $4 billion (£2.6 billion) – he also serves as executive chair of Twitter, which launched in 2006 by springboarding off his idea that brief sneezes of communication could deepen human interaction. As the driving force behind the two startup darlings – and as a man often mentioned as the spiritual successor to Steve Jobs – Dorsey is in major demand.

Today, he has blocked off a slot on his calendar to talk about Square and how the company hopes to infuse financial transactions with a dose of human intimacy. We are sitting in the Taste tea shop in the Hayes Valley neighbourhood of San Francisco. It is midday and we are the only customers. Dorsey has selected this teahouse because its customers pay with Square; instead of a register there is an iPad with a white plastic cube that accepts credit-card swipes.

But our discussion is sidetracked when the proprietor, Vincent Fung, starts a long and complicated explanation of the various tea options. A few minutes later, Fung appears at the booth with a deep wooden tray and begins a carefully choreographed ceremony. Dorsey watches the ritual and appreciatively touches his finger to a worn corner of the tray.

"That's *wabi-sabi*," he says.

Dorsey has lots to say about *wabi-sabi*, a Japanese concept that beauty can be found in imperfection and impermanence. It's a complicated idea, involving not just art but philosophy as well. Dorsey claims that this mysterious aesthetic is at the core of his design philosophy, a simple yet lived-in quality that pleases and engages users on a profound level.

Dorsey's PR man – who has been sitting uncomfortably while tea was offered, madeleines served and not a word uttered about payment technology – finally speaks. "I love that you guys have been talking about tea for 40 minutes," he says unconvincingly.

But Dorsey is just getting started. In the spirit of *wabi-sabi*, I tell him that Jobs once compared the way the iPod ages to the weathering of blue jeans. This sends Dorsey off on another tangent, as it becomes instantly clear that he is not only an ardent admirer of Jobs but also a student of the denim arts. At one point in his career, just before starting Twitter, he took a course in apparel design, thinking he might become a jeans artisan. He leaps at the chance to educate someone.

Blue jeans, he claims, were originally made for miners and sea divers. Divers would break them in by sitting in a bath until the shrunken fabric embraced their legs like tights. The unintended side-effect was to transform each manufactured garment into a unique item that carried the imprint of the wearer's shape.

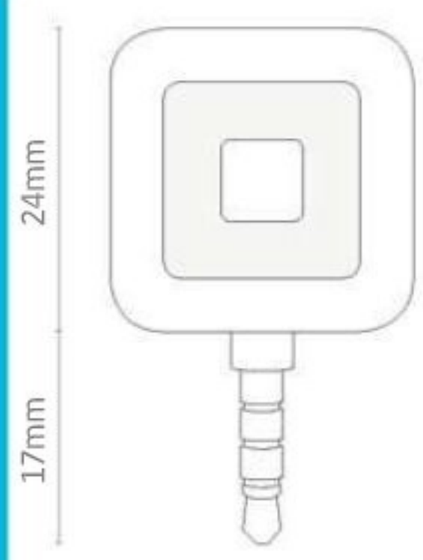
Naturally, when choosing his own jeans, Dorsey prefers ones that reflect that heritage. He is an aficionado of those made by fashion designer Scott Morrison. Once, Dorsey says with quiet awe, Morrison provided rigid, unwashed jeans to dishwashers at a New York City restaurant. They wore them constantly in the filthy, steaming kitchens, which created a bewitching pattern (known as "whiskering") that was painstakingly replicated by Morrison's jeansmiths. It's an elaborate process, all in the pursuit of *wabi-sabi*.

The conversation is beginning to sound surreal. But Dorsey has been talking about Square all along. Face-to-face commerce today, Dorsey claims, is socially impoverished. Human beings have been handling money for thousands of years, but it is still an awkward, time-consuming, uninspiring experience. What if it were beautiful?

Dorsey is trying to create magic in an industry where people have not previously sought wonder and delight. In short, he hopes to pull an Apple on the entire financial world.

PREVIOUS PAGE: (STILL LIFE) WILSON HENNESSY

## SQUARE'S DEAL




**Swiping cards through a slot lets the device read the magnetic stripe**

Square uses 2,048-bit encryption keys to keep your data secure

**It connects via the audio jack to iOS and Android devices**

*Shown actual size*

Dorsey first showed WIRED his payment app in the summer of 2009, when we met to talk about Twitter. It was bound to be a difficult conversation. Though he was listed as the chair of Twitter's board, and although the social network was his idea in the first place, he had been effectively shut out of day-to-day operations. Dorsey relinquished the CEO post just as the service was becoming a household word. Instead, cofounders Evan Williams and Biz Stone became the public faces of Twitter, and Dorsey watched from the sidelines.

Still, he shrugged off the humiliation, insisting he'd volunteered to step down: "I think I rationalise it by saying Twitter is certainly bigger than me, bigger than anyone in the company." But wasn't it tough? "It was tough," he said then. "I have honestly been working on this concept for like 15 years." (Later, in a less guarded moment, he would admit to writer David Kirkpatrick in an interview for *Vanity Fair* that the departure hit him like a punch in the stomach.)

After we finished our Twitter discussion, Dorsey asked me casually whether I wanted to see what his new company was all about. Its name – Squirrel – was not particularly descriptive. He took me to his apartment in a high-rise overlooking the bustling plaza of San Francisco's old US Mint. The half-renovated one-bedroom looked more like a construction-site–cum–make-shift-office than a home. Young engineers were tucked into dusty corners, working away at their computers. At the kitchen counter, Dorsey explained he was going to empower everyone to accept cashless payments.

He took a piece of plastic shaped roughly like a white acorn, jammed it into the ear-phone jack of his iPhone, and asked me for my credit card. When I produced it, he swiped it through a slot on the acorn. Then he had me sign the screen with my finger and enter my email. When I checked my own iPhone, I had a message noting that I'd paid Jack Dorsey $1. A Google Maps image marked the location. Dorsey was beaming like a proud parent.

Squirrel came about in a strange way. When Dorsey was growing up in St Louis, Missouri, he became fascinated with computer programming. As a teenager, he had a summer internship with an entrepreneur and glassblower named Jim McKelvey. Even at 15, Dorsey was impressive enough to be given responsibilities far beyond that of the average intern. And McKelvey and Dorsey remained friends throughout the younger man's early working endeavours.

Then, shortly after Dorsey left Twitter, McKelvey remarked during a phone conversation that he had lost a recent sale – a $2,500 blown-glass bathroom tap – because his customer could pay only with a credit card. As McKelvey recounted this tale to Dorsey – both of them with iPhones pressed to their ears – they realised that a business was literally at hand. Those smartphones had more processing power than entire banks did decades earlier. Why couldn't they process credit-card payments?

That story has attained near-legendary status, like Pierre Omidyar's Pez dispensers or Steve Jobs's visit to Xerox PARC. But the details are in some dispute. As Dorsey tells it, the customer was in the

## THE SQUARE ECONOMY

SQUARE MAY BE BEST KNOWN FOR ITS DONGLE, BUT DORSEY SAYS THAT'S JUST THE BEGINNING. HE ENVISIONS THE COMPANY AS A VAST ECOSYSTEM THAT HUMANISES EVERY ACT OF COMMERCE. ITS CURRENT PRODUCTS AND SERVICES HAVE ALREADY MADE PLENTY OF HEADWAY INTO THAT SECTOR

### SQUARE CARD-READER

**Who uses it:**
More than a million US taxi drivers, massage therapists, accountants...
**How it works:**
Vendors plug the free dongle into their iPhone, iPad or Android smart-phone's headphone jack. Customers pay by swiping their cards and signing the screen with their finger.

### THE SQUARE REGISTER

**Who uses it:**
Boutiques and shops looking for an alternative to a cash register.
**How it works:**
The iPad app, which connects to a cash drawer via Wi-Fi, lets US vendors set up buttons for each item in their store. Square provides merchants with free analytics.

### PAY WITH SQUARE

**Who uses it:**
Customers and stores that like the idea of swipe-free payments.
**How it works:**
When consumers with the app walk into a participating business, their name and photo pop up on the store's iPad. They pay by giving their name and can even add a tip later.

store and wouldn't run out to get the cash to pay for the item. McKelvey, however, says that the customer was calling from Panama, and he couldn't accept American Express.

Not long after, in February 2009, Dorsey, McKelvey, McKelvey's wife, Anna, and a friend named Greg Kidd drove north of San Francisco to a restaurant called the Pelican Inn. They spent the evening debating whether they should start a company based on the idea that the world needed an easier way to make payments in person. Eventually they decided to do it. On the way home, they stopped to buy some water. Dorsey and Anna, who stayed in the car, saw a squirrel run across the bonnet. It got Dorsey thinking. Squirrels dart around and collect acorns – it's like currency for them! And like the word twitter, squirrel can also be used as a verb – people "squirrel" away their treasures! Dorsey instantly envisioned acorn-shaped hardware.

Within ten days, Dorsey and his team had whipped up a prototype, designed to be powered by the energy generated during the actual swipe. As a bonus, the sound it made when the card zipped through the slot resembled the squeak of a squirrel.

But the most outrageous part was how easy it suddenly became for anyone to accept credit cards. The process through which businesses are authorised to accept credit-card payments is arduous and slow. In fact, it took Square longer to get approval from Visa and Mastercard to accept a swipe than it did to create a prototype for the entire payment system. "Our sign-up process takes two minutes," Dorsey says. "You download an app, put in your name and address, answer three security questions, link your bank account and you're done." Just as Twitter democratised broadcasting, Dorsey's new company would democratise the credit-card industry.

Small problem: there was already a payment system named Squirrel. The team repaired to the dictionary and found a new name. A square is a fundamental shape that suggests heft. A square deal is a fair one. And when two parties settle a deal, they square up.

Square was positioned to disrupt the payments industry, but it wasn't out to topple the credit-card companies. Indeed, it could be a boon to them; payments that were once made with cash could now be made with credit cards. (Square, currently only available in the US, charges 2.75 per cent per swipe and gives the vast majority of that fee to the card issuers.) So Dorsey met with some of the biggest names in finance, such as JPMorgan Chase CEO Jamie Dimon and Visa head Joe Saunders. The demo won over the bankers, and Visa became an investor.

Since then, Square has signed up more than a million merchants; it expects to process more than $5 billion in US transactions over the next 12 months. Square has announced that it intends to be in several other countries by the end of the year. (It won't say which ones, and won't comment at all whether the UK is one of those nations.) The difficulties of going abroad aren't so much regulatory but those involving partnerships: Square has to have a banking entity that channels its transactions (in the US it's Chase) and also has to cement relationships with the major credit-card firms in each jurisdiction it wants to enter. But high-level discussions are underway.

## OUTSIDE

another artisanal beverage shop – this time Café Grumpy in New York City's Lower East Side – a few days after our tea ceremony, Dorsey is sadly acknowledging he never met Steve Jobs. "We were setting up a time to meet – that was my last email to him – but then he got really sick," Dorsey says. "I learned a lot from him from afar."

When people talk about who might fill the vacuum left by Jobs's death, Dorsey's name keeps coming up. Talented geeks once dreamed of working with Jobs; now they want to work with Dorsey. Keith Rabois, an early PayPal executive and a hot prospect, says he took the COO job at Square in large part because of Dorsey. "There are three things you need to do as a CEO-founder," Rabois says. "Drive design, drive technology and think strategically. Some people who are really good at one can build a pretty foundational company. Most people who are very successful are good at two. But Jack is the only person in the Valley I've met who's all three."

Like Jobs, Dorsey has proclivities that have helped him build something of a cult of personality. Every Friday he indoctrinates new employees with a forced march through the streets of San Francisco, beginning at the statue of Mahatma Gandhi at the Ferry Building, heading into the canyons of the Financial District, and emerging in the startup haven south of Market Street where Square resides. During the walk, Dorsey outlines what he calls the Four Corners of Square. "It's something that codifies our ethic," he says. But he is mum on the details of this vaguely Masonic concept. "If I told you, you'd have to work here," he says with a tight smile.

Dorsey also boasts a Jobs-like obsession with design and detail. In early 2011 he became captivated by the idea of using a wallet metaphor in a Square app. William Henderson, a former Apple operating-system specialist who now works at Square, says, "Jack came to work one day with a stack of ten leather wallets." For hours, Dorsey and his team deconstructed every detail. He was especially fond of the Hermès. The team designed a digital wallet that faithfully replicated it. It even carried a monogram, extracting initials from the user's registration information and dropping the trailing dot after the second initial, just as Hermès does. The credit cards, which fit into their slots at slightly asymmetrical angles, were stamped with holograms that changed colour when the screen was tilted.

> 'THERE ARE THREE THINGS YOU NEED TO DO AS A CEO-FOUNDER: DRIVE DESIGN, DRIVE TECHNOLOGY AND THINK STRATEGICALLY. JACK IS THE ONLY PERSON I'VE MET WHO CAN DO ALL THREE'

But, perhaps Dorsey's most Jobsian trait is his knack for disrupting entire industries and forcing them to follow his lead. The established companies that process merchant transactions – such as PayPal and VeriFone – were caught off guard. Now they've launched competing offerings. PayPal has created PayPal Here, with a stylish triangle-shaped card reader the company says is more structurally sound than Square's. PayPal president David Marcus thinks all of PayPal's 110 million users will eventually adopt it. VeriFone, the leader in credit-card-swiping machines, built a Square knockoff called Sail, which has a flap that extends down the back of the smartphone. (Intuit has offered its own mobile credit-card system, called GoPayment, since 2009.)

The message from those giants seems to be, thanks, kid, we'll take it from here. "There's no question they've innovated," PayPal's Marcus says. "It's been good for the ecosystem. And Jack is a good guy. But people need a multichannel solution." Jennifer Miles, an executive vice president at VeriFone, adopts a similar tack: "Square took a sleepy industry that was doing things the same way for years and innovated. But that process is replicable."

Dorsey is unimpressed. First of all, he thinks it's wrongheaded to build those flaps on readers that plug into smartphones: "We don't want to add things – we take things away to make them more simple," he says, once again sounding like Jobs. More broadly, Dorsey takes issue with the implication that Square is too naïve to compete with the ultra-sophisticated finance industry. "Yes, we're naïve," Dorsey says. "But that's a strength, not a weakness. We have fewer than five people in a company of 250 who have worked in the financial industry. So our approach is to engineer and create and build what we want to see." In any case, should Dorsey get stumped on some intricate issue of high finance, he can seek enlightenment from Larry Summers, a former US Treasury secretary under Bill Clinton, who sits on Square's board.

If VeriFone and PayPal spent as much time studying Jobs's legacy as Dorsey did, they'd understand the risk in mimicking another company's products. Indeed, in the same way that Apple introduced new versions of its devices just as competitors caught up to its previous model, Dorsey has already released the next iteration of Square – a swipe-free version. It began at an all-hands meeting in late 2010, when Dorsey issued a challenge to his staff: "I want to have a payment experience that's so smooth that when I walk out I won't be able to remember if I even paid." Imagine if customers were checked in automatically via Wi-Fi any time they walked into a participating store. When they wanted to buy something, they could just give the merchant their name. They'd never even need to reach into their pocket!

The vision – swipeless pay, if you will – was a logical extension of Square's mission of turning payment into an intimate experience. But instead of merchants doing all the work, this required customers to download an app too. They dubbed it *Card Case*. The first version – which featured the passionately designed digital wallet, including virtual credit cards for each participating merchant – launched in the spring of 2011. A few months later, while being interviewed by Dorsey for a job at Square, an Apple iPhone product manager named Shuvo Chatterjee pointed out that, while he loved the service, the wallet metaphor didn't really work. "I'm collecting those cards, but it's not really scaling," he said. "In my real wallet, I don't have one card for every merchant I buy from." Dorsey hired Chatterjee and made him the *Card Case* product lead. In March 2012, they released an update. The beloved Hermès wallet was gone, replaced by a cleaner interface that more effectively promotes discovery of new places. (Once you establish a relationship with a merchant, it's like opening a bottomless ledger, one that can easily handle things like loyalty programmes.) The app also acquired a new name, *Pay With Square*, an indication that it was no longer a side project but had become crucial to the company's mission. No dongle required.

Dorsey says that he learned a lot during the early days of Twitter – including what not to do. "I wrote down everything that happened at Twitter, and we corrected all the mistakes," he says. Twitter's rise was hampered by managerial whiplash and frequent outages. So with Square, Dorsey says, "We immediately focused on the culture – reliability and uptime. We focused on having a design team. Pretty much everything was a reaction to those early years."

In March 2011, Twitter CEO Dick Costolo hired Dorsey back, both for his design savvy and, as he puts it, a "sincere appreciation for the vision of the founder". Today Dorsey splits his time between the two companies. "It's unusual, but the companies have a lot of parallels," he says. "They're both utilities. They both can be used by a dynamic range – from individuals to the largest organisations in the world. They both have social aspects; payments are just another form of communication. Both are exchanges of value."

However, some have criticised Dorsey's dual role, arguing that he is spreading himself too thinly. "I will do whatever it takes to make sure both succeed," Dorsey insists. "It's like two family members you care for and love deeply."

> 'I WROTE DOWN EVERYTHING THAT HAPPENED AT TWITTER, AND WE CORRECTED ALL THE MISTAKES. WE IMMEDIATELY FOCUSED ON THE CULTURE – RELIABILITY AND UPTIME, AND ON A DESIGN TEAM'

## EARLIER

this year, Square leveraged the popularity of the iPad into an opportunity to expand its business beyond individuals to boutique-level merchants. It released *Square Register*, an app that makes it easy to use an iPad as a full-featured cash register. Vendors can set up buttons for each item they sell, much as McDonald's lets cashiers simply press "Shake" instead of entering the price. It can also connect wirelessly to a cash drawer.

But *Register*'s real value is it offers sophisticated analytics for free. Its users get data that allows them to identify which products are selling and when, and future versions will be even more powerful. "As a customer enters the vicinity of the establishment, a notification will spring open on the merchant's screen," says Megan Quinn, Square's director of products (who has since left the company). "It will show the customer's name and suggest their most likely order, based on an algorithm that knows past purchases and things that sell well at the store."

Henderson, the engineering lead on *Pay With Square*, points out that the company collects all kinds of information about its users, data that might be invaluable to merchants and customers alike. "First of all, we know your location," he says. "Second, we have a decent sense of your history. We know the kinds of places you've been and what you like. But we also know lots of other things – like if there's a whole bunch of food trucks that pull up nearby, we'll see the spike in activity and can point you to those trucks. I think you'll see us getting really good at this."

Analytics and data-mining might provide Square's real business model. So far, the company has charged a very small fee for each transaction, and merchants aren't likely to pay much more. And although Square has been giving participating merchants access to analytics about their businesses for free, it is also aggregating that data, real-time information about what people are buying in every region of the US. It's reasonable to think that might be very valuable in the near future.

Square is currently focused on smaller merchants, but its executives believe that even tier-one retailers will use Square before long. "The Neiman Marcuses and the Walmarts will want an emotional attachment to their buyers, where anybody can walk in and pay with their name and have an electronic receipt," Rabois says. "That's what we're going to deliver."

In other words, Square aims to provide shoppers with an emotionally satisfying experience – and it is using the Apple playbook as its guide. "My challenge to our product team is to build the app they themselves want," Henderson says. "That's something I learned at Apple. That's the reason it's able to consistently surprise consumers." Working the Apple way isn't too hard for Henderson, because "almost every one of my team from Apple is now at Square".

And just as Jobs did, Dorsey works hand in hand with his designers. "It's almost as if the whole of Square is a manifestation of Jack's mind," says Twitter's Stone, who has remained close to Dorsey and is an investor and an adviser to Square. "He was always that way, but now he has the gravitas and authority to make it happen."

Recently, Dorsey oversaw a rejigging of the icons for Square's iPhone apps. He took special care with the one for the *Card Reader* app. The design he settled on was a version of the company logo, set atop a blue background. There's something evocative about it – it isn't an antiseptic patch of blue. It's a bit weathered, textured, striated. It is, in fact, a photograph of a swatch of denim from Scott Morrison's high-end jeans, shot directly from Jack Dorsey's leg.

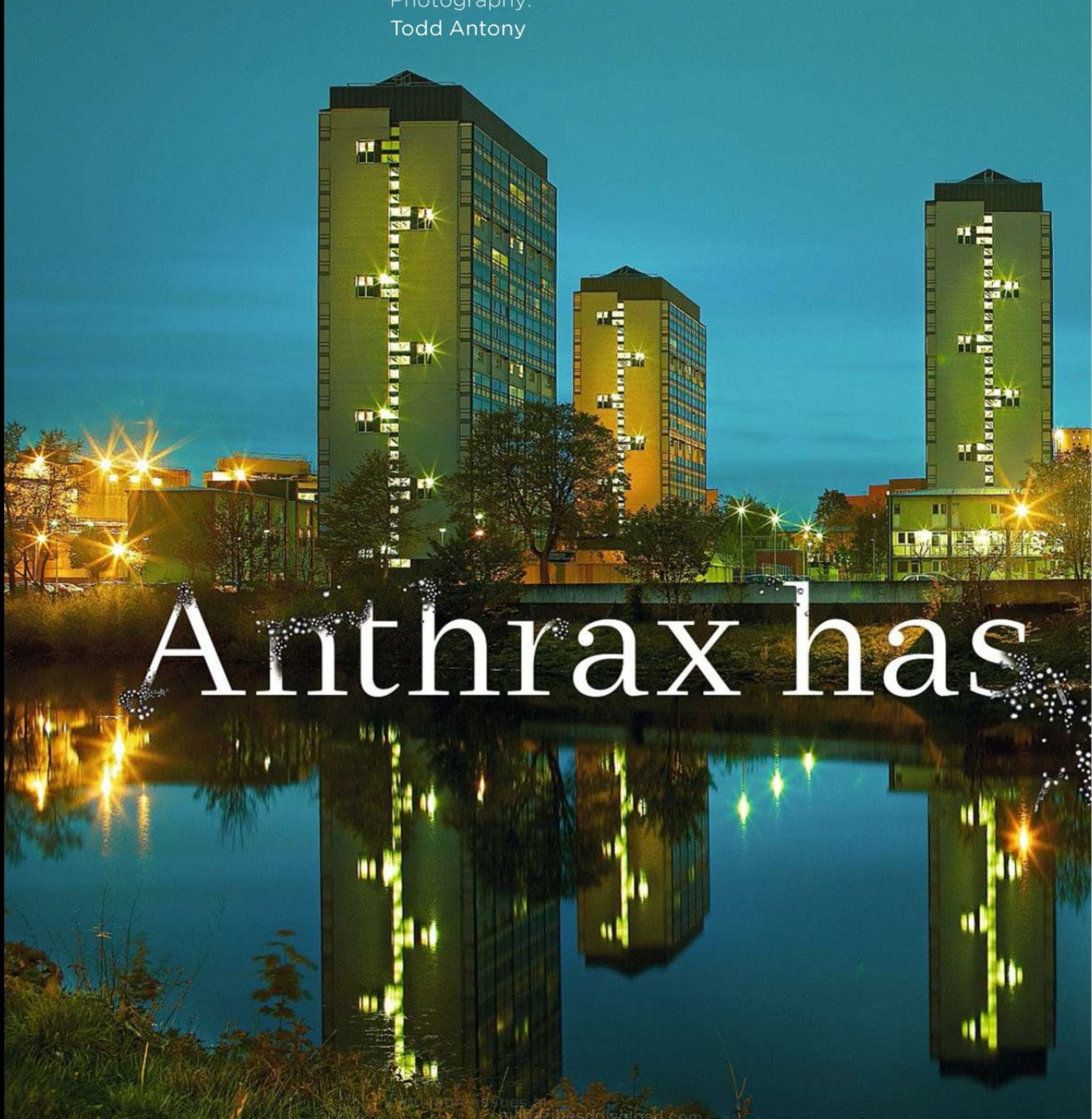
*Wabi-sabi* heaven.

*Steven Levy is senior writer at* WIRED US

Dorsey in the Square office in San Francisco, which houses the startup's 250 staff

By
Yudhijit Bhattacharjee

Photography:
Todd Antony



# Anthrax has

When heroin users in Scotland began dying from a powerful infection, public health officials were alarmed to discover the culprit was anthrax. The deaths provoked a desperate hunt for the source, involving the police, microbiologists and bioweaponeers

# hit Glasgow

## Now you have to find the source. Urgently

The Gorbals Estate, Glasgow, initial site of the anthrax outbreak

Hope House (*above*), where "Donny" discovered that he had symptoms of anthrax. "Nobody tags heroin with a barcode," says epidemiologist Colin Ramsay (*opposite*)

**cotland has an estimated 50,000 heroin users, many of whom can** be found on the streets of Glasgow. Today, the signs of the city's drug problem are visible even in the city centre where addicts can be seen sitting on the pavement, leaning against walls and staring listlessly into the distance. Hope House, a hostel for the homeless on the edge of the Clyde, provides a refuge for many of them.

It was at this shelter that a 35-year-old heroin addict called Donny (not his real name) woke up on a December morning in 2009 with an unbearable pain in his thigh. On most days, Donny followed a familiar routine that had been engraved upon his life by his drug habit. He would walk over a bridge across the river to a neighbourhood on the opposite bank that was once a leper colony, and is now home to council housing. There, Donny would buy heroin from a dealer and visit his partner and two children. After taking a hit in their flat, he would wander back to his hostel. But on this day, Donny could barely walk. His thigh, right where he injected himself, was so inflamed that he had trouble dragging himself out of bed. Donny's partner called an ambulance for him – he would never have gone to the hospital by himself – and he was taken to the nearby Victoria Infirmary.

The doctors at Victoria – as at other Glasgow hospitals – were used to seeing heroin addicts show up with lesions in the arms, legs and other parts of the body where the users had been plunging a needle into their flesh. Such infections, the doctors knew, are typically caused by a bacterium called *Bacillus cereus* that is often behind food poisoning. But, when pathologists examined some of Donny's blood under a microscope, they saw a far more deadly germ. It was anthrax.

Donny died on December 16, eight days after being admitted. By then, doctors at Victoria had already encountered another case like his – a young female heroin user from the same part of town, with a festering lesion at her injecting site that was confirmed as an anthrax infection. The woman was responding to antibiotics, and doctors were confident that she would survive. But the two cases set alarm bells ringing among public-health officials who began calling other hospitals around town to find out if any other similar cases had been detected. By the end of the day, they had learned of three other patients who had been possibly infected: blood cultures would subsequently confirm them to be anthrax. All the patients were heroin users.

Colin Ramsay, an epidemiologist at Health Protection Scotland in Glasgow, was about to leave work that evening when he got a phone call about the outbreak. Scottish authorities wanted him to lead a team to halt its spread and trace its origin. At a meeting of public-health officials, doctors and police officers the following day, Ramsay – who is short and balding, with a silver-blond beard – made a mental list of the questions that would have to be answered. It wasn't hard to guess that the infections were being caused by heroin contaminated with anthrax spores – the oval-shaped vegetative form of the microbe that can survive extreme temperatures and lie dormant in the environment for decades, waiting for a host in which to germinate. But where did the contamination come from? Would the outbreak spread beyond Glasgow? And how could it be contained? The same questions were on the mind of others in the room, including a burly, moustachioed detective named Derek Robertson.

Ramsay has an even tone that conveys a sense of certainty and assuredness. When he began looking into the outbreak, his first reaction was one of wishful thinking, the opposite of paranoia. "Well, it could be just these few cases, you know," Ramsay remarked to John Hood, a microbiologist at Glasgow Royal Infirmary. "I don't think so," Hood responded. "I think this is going to roll on."

It wasn't the first time that Ramsay had been called in to conduct a public-health investigation into anthrax. In 2006, he spent months trying to unravel the cause of death of a 50-year-old drum-maker

in a village on the English border. A Buddhist who loved gardening, Christopher Pascal Norris suffered a brief flu-like illness before dying in an Edinburgh hospital. The cause of his death wasn't known until a month later, when blood samples were finally cultured at a lab in London, revealing the presence of *Bacillus anthracis*. The retrospective diagnosis left public-health officials worrying not just about the source of the infection but also about the likelihood that Norris's body may have exposed other people, such as postmortem technicians, to anthrax spores. Ramsay learned that Norris had been cremated. His remains had been scattered at his home, where a gust of wind had blown the ashes over everybody attending the wake, including a group of motorcyclists from Belgium. "We didn't know if the cremation was enough to get rid of the anthrax," Ramsay says. It took Interpol's help to track down the motorcyclists, and everybody exposed to the ash was put on antibiotics just to be safe.

Norris used imported goatskins to make African *djembe* drums. Ramsay knew of a few rare cases in the medical literature in which drummakers contracted anthrax infections from shaving animal hides embedded with spores of *Bacillus anthracis*. Investigators searched Norris's house for spores, but "it was clean as a whistle", Ramsay says. Then, after learning that Norris had joined a local drumming class a few months before his death, investigators had the three drums being used in the class sent to the UK's top infectious-diseases lab in Porton Down. The hides on all of them tested positive for anthrax: each drum carried a different strain, one of which matched the strain that had killed Norris. Ramsay and his colleagues found anthrax spores at all the venues where the drums had been played, including the village hall. "It turns out that when you bang the drums, it liberates the spores from the surface of the skin," Ramsay says. Norris contracted his illness from inhaling those spores.

Although Norris's death was a single, isolated incident that health officials analysed post-facto, the outbreak Ramsay was investigating was a tragedy still in the making. The first priority was to identify and treat victims as quickly as possible. Heroin users who showed up at hospitals with dark lesions and tell-tale signs of internal bleeding were taken to the operating theatre where surgeons cut away the infected tissue, in some cases removing kilograms of muscle and sinew from the patient's injection site. These so-called debridement procedures were not complicated, but the risk of infected blood drying in the operating room or anywhere else – leading to the formation

**What is anthrax?**

Anthrax is a fatal disease caused by a family of tiny rod-shaped bacteria, *Bacillus anthracis*, that kill by producing two lethal toxins. The danger of anthrax lies in its resilience: it forms tiny, tough spores that can survive extreme temperatures, lack of nutrients and harsh chemical treatment, remaining dormant for decades. The first toxin triggers tissues to swell and leak body fluids. The second over-activates the immune system, and the body destroys its own defences. **MV**

of spores – put the outbreak-control team on edge. In one case, a surgeon forgot to put a tourniquet on a patient who was later confirmed as an anthrax case. The surgeon's overalls were splattered with blood. "By the time we found out about it, the blues that the surgeon had been wearing had gone through the hospital laundry along with other clothes," Hood says. "You know that the spores are not going to be destroyed by the hot water in the washing machine because it's not an incinerator or an autoclave." There was no way to trace those blues, and the control team ultimately decided that the risk was too remote for the hospital staff to have to track down the entire laundry batch and burn it.

To warn heroin users, Ramsay's team had leaflets distributed at homeless hostels such as Hope House and other venues frequented by addicts. The leaflets emphasised that there was no safe way to take the drug: users could end up being infected with spores even if they smoked contaminated heroin instead of injecting it. Addiction experts scoffed at the warnings. "The attitude was – you're telling people who are addicted to a substance to stop using the substance they are addicted to," Ramsay says. "But what else do you do?"

As expected, the warnings did not help. By January 7, another 12 cases had been confirmed and the death toll had climbed to six. Like an eddying oil spill, the outbreak was spreading beyond Glasgow, with cases reported from the neighbouring regions of Lanarkshire and Tayside, and from as far as Stirling, 59 kilometres to the northeast of the city. The emerging pattern of cases was similar to an outbreak of *Clostridium novyi* – another spore-forming microbe – that occurred among Scottish heroin users in the year 2000. In that outbreak, just as in this one, there were almost no cases reported from Edinburgh, which is known to get its heroin through supply networks distinct from those that feed Glasgow.

**Heroin users typically buy their** drugs from neighbourhood dealers. The spread of the infections suggested a contamination in the region's entire heroin supply. "You couldn't get this [spread] of cases unless the contamination had occurred further up the distribution chain," Ramsay says.

The anthrax may have come from the poppy fields of Afghanistan, where the raw material for 90 per cent of the world's heroin supply is grown. Alternatively, the contamination may have occurred after the poppy harvesting, at some stage in the manufacturing process, typically carried out at labs in Afghanistan and elsewhere. It may also have happened after the heroin entered Scotland: a trafficker may have stored it on a farm, burying it in soil contaminated with spores. Or the spores may have come from bonemeal, which dealers use to dilute heroin and increase their profits.

The Strathclyde police headquarters on Pitt Street is an imposing building located at the top of a hilly street. Inside, from his office on the fourth floor, Inspector Derek Robertson has a view of the city's south side. He is a big, friendly man with a beefy handshake. He points across the Clyde to the tower blocks of the Gorbals, where the first victims obtained their heroin. "It's got poverty, it's got violence, it's got heroin dealers," Robertson says. "If your dealer on the tenth floor doesn't have heroin, the dealer on the twelfth floor does."

Soon after officials became aware of the outbreak, Robertson was put in charge of the police investigation. Right away, he and fellow

**"If your dealer on the tenth floor doesn't have heroin, the one on the twelfth does"** Inspector Derek Robertson, Strathclyde Police

officers raided the residence of a dealer in Gorbals who had sold heroin to the first female victim, the one who got treatment the same week Donny died. Nervous about contracting anthrax, the police entered the premises wearing heavy-duty breathing gear and suits meant to protect against chemical, biological and radiation threats. Later, when Robertson consulted the UK's top anthrax expert, microbiologist Tim Brooks, about the risk of officers becoming infected during such a raid, he realised that the protective outfits were overkill. "Tim said you'd have to have a big pile of heroin sitting on the table, and you'd have to puff it up and put your face in it. A standard face mask and gloves were all we needed," says Robertson.

Police searched the homes of several more dealers in Glasgow and other towns where cases were popping up. "We were going undercover in these areas to buy heroin," Robertson says. By the first week of February, a case had been detected in London. The Metropolitan Police hunted down the dealer, who had hidden the batch in a cereal box. They were confident that they had confiscated a tainted sample.

The police sent the seized and purchased heroin to the Centre for Emergency Preparedness and Response in Porton Down, where Tim Brooks runs a biosafety lab studying anthrax and other deadly pathogens. The spores could have been hiding anywhere in all of this material. To make sure they didn't miss any spores – no matter how few there might be – microbiologists at the lab divided the heroin into thousands of tiny samples to be tested individually. They dissolved each sample in citric acid, adding the solution to a broth used to culture microbes. The process was meant to free up any spores lurking in the sample, and encourage them to germinate. The Petri dishes were examined under a microscope the next day to see if any had grown *Bacillus anthracis*. It was a tedious task that occupied half a dozen people in the lab full-time for several weeks, Brooks says.

**The lab tested what amounted** to about 70,000 samples of heroin. Not one bit grew anthrax, not even the stash from the cereal box. The result was disappointing to the police, but not surprising. The number of cases was still very small compared to the population of heroin users in Scotland, which implied the contaminated heroin was likely to be a tiny fraction of the overall supply. To find any trace, the investigators would have had to round up a much bigger volume of the drug. "We could not afford to buy that much heroin," Brooks jokes, darkly.

In mid January, Ramsay and his colleagues learned of a heroin user in Aachen in Germany – a few kilometres from the Dutch border – who had contracted anthrax the previous December. "Up until this point, we were still considering the possibility that the adulteration had occurred somewhere in Scotland," Ramsay says. "After finding the German case, it was plausible that the contamination may have occurred well before the supply was split between Germany and Scotland." On February 5, Ramsay's office issued a press release laying out what they knew so far: "The anthrax contamination in both countries, thought to originate in the heroin supply, could share a source."

Days later, Ramsay recieved an email from a man who claimed to be a former prison inmate. "When I was in prison," the person wrote, "I met a Pakistani serving a sentence for heroin importation. One of the methods used was concealing drug shipments in containers transporting animal skins. Apparently Customs left these shipments alone because of the awful smell! I think that's where your anthrax contamination is coming from, in my humble opinion."

The most important clue to the origin of the contamination lay hidden within the pathogen itself. There are dozens of strains of *Bacillus anthracis* that exist naturally in the world, with certain types being endemic to specific geographic regions. Scientists have also developed a variety of laboratory strains of the organism, some of which were created in decades past for use as bioweapons. All of these different strains are distinguishable by their DNA.

Ramsay and his colleagues turned to Paul Keim, a tall, silver-haired microbiologist at Northern Arizona University in Flagstaff. Biologists and bioweaponeers used to think that anthrax DNA varied only a little from strain to strain. But in the late 90s, Keim and his colleagues identified more than 50 sites on the genome of *Bacillus anthracis* with variations. The work helped Keim to develop a DNA-fingerprinting test sensitive enough to distinguish between, for instance, a strain endemic to Kazakhstan and one found on livestock in Kenya. Keim's lab maintains a repository of more than 1,000 samples; he was the researcher who identified the strain of anthrax used in the deadly 2001 attacks on US politicians and media outlets.

About a month after the outbreak began, scientists shipped samples of *Bacillus anthracis* cultured from the first victims to Keim. After extracting DNA, Keim's group began running assays. The researchers were quickly able to rule out all the known bioweapon strains, including one that the British military spread on Gruinard Island off the Scottish coast as part of a biowarfare experiment during the second world war. The researchers then screened the disease sample against strains from Afghanistan. No match there, either.

Their work continued into March, when Keim travelled to Porton Down to attend an unrelated meeting and to update the outbreak-

**Heroin's journey from Afghanistan to Scotland**

1) Afghanistan; 2) Pakistan; 3) Iran; 4) Turkey;
5) Greece; 6) Albania; 7) Bulgaria; 8) Macedonia;
9) The Netherlands; 10) Bradford; 11) Kirkcaldy

investigation team. While he was there, he received an email from an undergraduate in his lab doing some of the DNA fingerprinting. She had found a match. The Glasgow strain was virtually indistinguishable from two anthrax isolates that had been sent to the repository a few years earlier by veterinarians in Turkey, collected from a couple of goats. "My heart rate went up," Keim says.

In a closed-door session with Brooks, Ramsay and law-enforcement officials, Keim started by drawing a diagram on the blackboard, a multipronged tree that showed the relationships among different anthrax strains. "I told them all the things that it wasn't," Keim says. The sense of relief in the room was palpable as he checked off bioweapons strains. A homegrown bioterror attack was effectively ruled out. Then, Keim revealed the match with the Turkish strains. The discovery of the Turkish connection led Ramsay's team to form a hypothesis. Drug users in Scotland, England and Germany were being infected by heroin that was contaminated while being smuggled through Turkey in an infected goat-hide.

Microbiologist Tim Brooks, of the Health Protection Agency, is the UK's top anthrax expert

The Turkish link fitted what is known about the movement of heroin into Europe: traffickers move the drug from Afghanistan and Pakistan into Iran, a major consumer of heroin, and into Turkey, before transportation into Europe. Much of the heroin destined for the streets of western and southern Europe is smuggled along the Balkan route, starting in Turkey and going through Greece and Albania, or through Bulgaria, Macedonia and a string of Balkan states. Travelling northwest, large quantities of the drug arrive in the Netherlands, from where it is distributed to the UK and elsewhere.

The police inquiry into the outbreak suggested that the tainted heroin had come in via this smuggling route, strengthening the hypothesis based on the genotyping work. In January 2010, police had arrested a dealer in Kirkcaldy, near Edinburgh, who had sold heroin to a victim. That dealer led the police to a supplier one step up the supply chain who was being investigated for importing heroin from a group in Bradford. "This was the first tangible link where we thought we knew the route the drugs were coming in," Robertson says.

Meanwhile, police had infiltrated the Bradford syndicate, which was linked to a trafficking ring in the Netherlands. Four men were arrested in Bradford, and the Dutch police nabbed seven suspects. Through interrogations and available intelligence, investigators in Holland, England and Scotland confirmed that the heroin sourced by the Dutch ring had indeed travelled through Turkey.

In late March, a wave of new cases was reported in Dumfries, 85km southeast of Glasgow. Then the outbreak slowed down. Scottish authorities detected the final case in July, but the outbreak lasted longer in England, where the last case was in November 2010. By the end, the anthrax killed 13 out of 47 victims in Scotland, and claimed four out of five victims in England, in addition to a victim in Germany.

"The most likely scenario is we were dealing with a single batch of heroin, and the contamination was the result of contact with a single infected goat, and that occurred in Turkey," Ramsay says. If there had been multiple batches wrapped in different goatskins, the cases would probably have involved more than one strain. Even though a batch would typically get distributed and used within weeks, the outbreak was drawn out over a year because the police inquiry after the first cases in Glasgow may have prompted dealers to shelve what they suspected to be contaminated and bring it out later, or to disperse it – hence the spread across several cities. "We think all of the contaminated heroin has been used up or disposed of," Ramsay says.

In December 2011, Ramsay's team published a 134-page report on the outbreak. "I think it's highly unlikely we would get any more definitive evidence," Ramsay says. "Nobody tags heroin with a barcode."

**On a rainy October night in 2011, WIRED travelled two hours** southeast from Glasgow to meet a woman who contracted anthrax after injecting heroin in March 2009. "Susan", now 32, had smoked heroin since the age of 23. She kicked the habit for a long period, returning some time in 2008. She was then on methadone – a prescription opiate substitute – but that wasn't enough. She said heroin helped her fight depression while she raised two children as a single mother, and it lessened the boredom of long-term unemployment.

A friend told Susan that injecting heroin would give a better high, and so Susan began injecting. "It just gave me the energy to go on," she explained. "To do the housework, to make the tea, to be in the proper frame of mind when the kids came back from school."

In March this year, after she had been injecting heroin into the muscle around her shins, she noticed angry red lesions. She'd heard about the outbreak in the news, but was too afraid to go to the doctor. One morning two weeks later, she was getting her younger son dressed for school when he swung his leg and accidentally brushed her shin with his shoe, making her whimper in pain and finally muster the courage to call her doctor. She was admitted to a local infirmary where doctors removed two tennis-ball-sized chunks of tissue from her legs.

Two weeks after surgery, Susan felt a familiar craving. A dealer phoned. She went out and bought a bag for £10, returned home and filled up a syringe. Then, suddenly, she came to her senses. "I was sitting thinking, 'Oh my God, I nearly lost my life, this could be the same stuff that had the anthrax in it'," she tells WIRED. "I squirted the syringe into a fag packet and threw everything away." Susan shows the deep hollows left in her shins by the surgery that saved her. "That's a constant reminder," she says, tears welling into her eyes. She is becoming used to not being able to wear either skirts or shorts, because her children were oblivious.

Her scars had become an unfortunate symbol of the world's interconnectedness. A goat dies of anthrax in Turkey. A young woman in a small Scottish town must always wear trousers.

*Yudhijit Bhattacharjee is a staff writer at* Science *and a contributor to* The New York Times, The Atlantic, Discover *and other publications*

WHERE DOES AN OVER-CRAMMED SCIENCE MUSEUM STORE ITS SURPLUS NUCLEAR MISSILES AND JET PLANES? IN A QUIET WILTSHIRE FIELD...

# OVER MATTER

PHOTOGRAPHY / BENEDICT REDGROVE
BY / MADHUMITA VENKATARAMANAN

IF YOU THINK YOU'VE GOT CLUTTER AT HOME, BRITAIN'S science museums have it worse. In a yawning 220-hectare airfield near Swindon, the Science Museum at Wroughton uses six aeroplane hangars, each the size of a football field, as warehouses. They are piled high with around 16,000 "large objects" that the Science Museum in London, the Museum of Science and Industry at Manchester, the National Railway Museum at York, the National Media Museum at Bradford and the National Railway Museum at Shildon can't quite squeeze in. "It's like the shed every bloke dreams of having," says Matt Moore, Wroughton's site manager.

Stored there is everything from a Russian supercomputer obtained after the Cold War (it's not known how it reached the UK) to the Lockheed Constellation airliner in which the Rolling Stones toured in 1973. There is no public access to the relics, but researchers can request to view specific objects. "We don't collect beautiful things," Moore says. "We collect objects that represent a significant shift in the way engineers and scientists thought." WIRED went exploring.

*ABOVE*

**POLARIS MISSILE**

The submarine-launched Polaris missile carried nuclear payloads for the UK between 1968 and 1996. With a range of 4,630km it could deliver six targeted warheads, each of which possessed 40 kilotonnes of explosive force. Originally built by the Lockheed Corporation of California for the US Navy, it was sold to the British government in 1963 by the Kennedy administration. This particular missile was used for training purposes at the Royal Navy's Coulport submarine base. It is stored opposite another type of British nuclear deterrent – the Blue Steel missile developed by Avro in the 1960s for use in the V bombers, such as the Vulcan.

*PREVIOUS SPREAD*

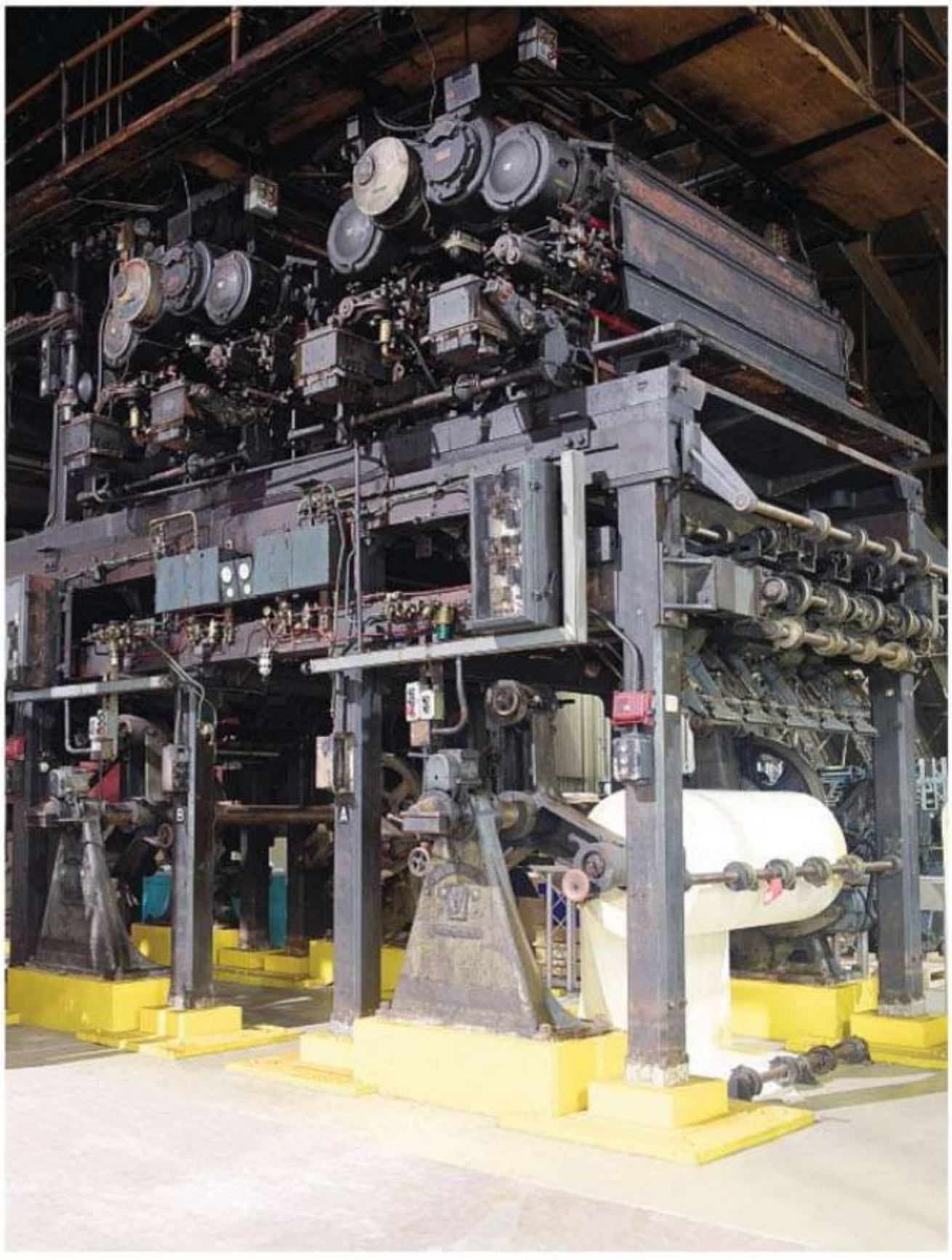
**TRIDENT AND COMET AIRCRAFT**

This is a 1971 Trident 3 aircraft, of which only 117 were made, and a 1960 Comet 4B jet airliner, both built at the Hatfield aircraft factory.

*RIGHT*

**SR.N1 HOVERCRAFT**

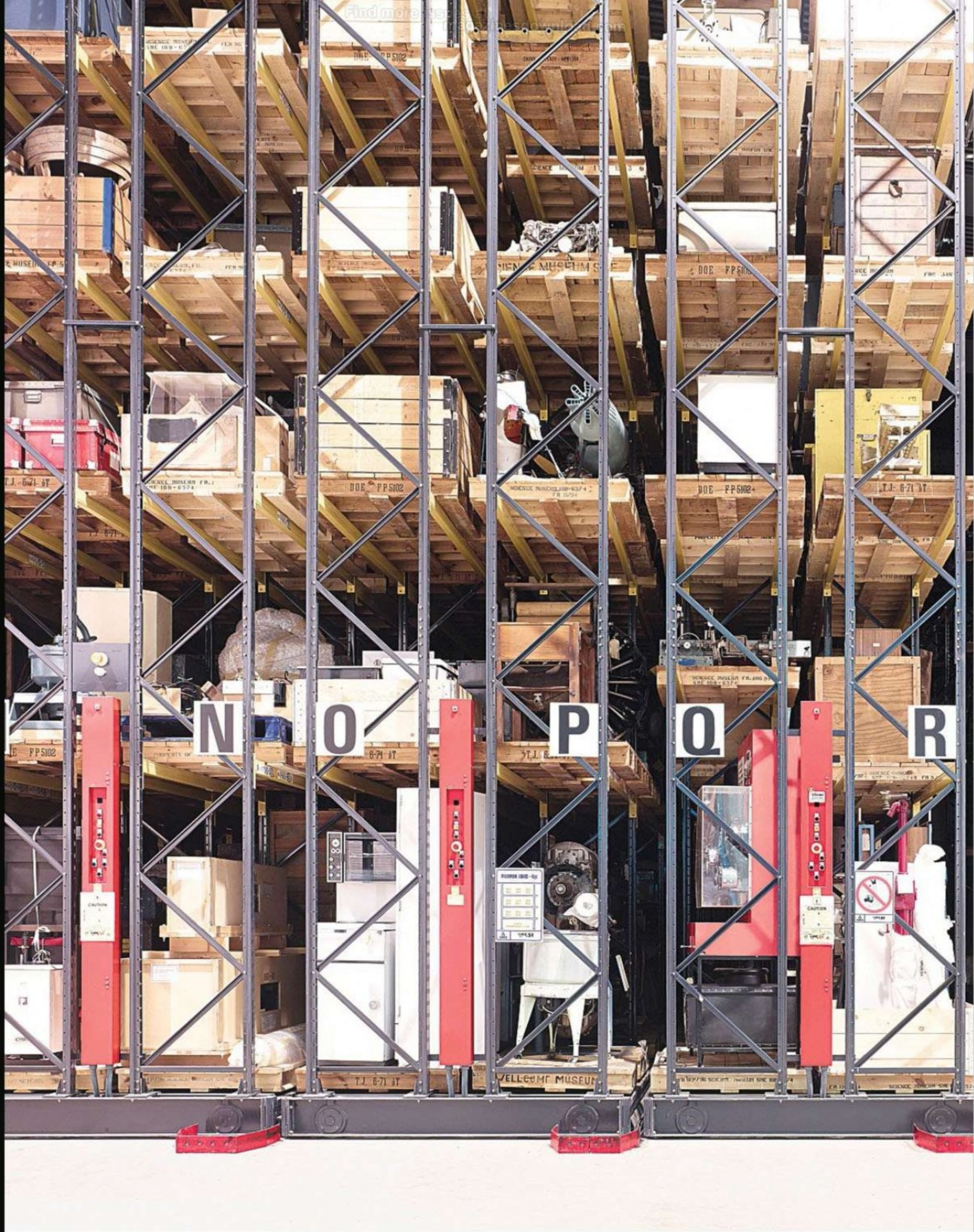
Inventor Christopher Cockerell designed this hovercraft in 1958. When the concept proved viable, the Saunders-Roe company on the Isle of Wight was commissioned to build the one pictured, which made its maiden journey in June 1959. A month later, the SR.N1 crossed the English Channel from Calais to Dover in just over two hours – the first international passage for what was an entirely new form of transport.



*LEFT*

**FLEET STREET'S LAST WOOD PRESS**

For nearly 150 years, newspapers around the world were printed on massive batteries of rotary presses. The advent of digital technology meant that they were all eventually scrapped, except for this one – the last surviving hot-metal printing press. This portion of the Wood Press (named after its American inventor Henry Wood, who built it in New York in 1934) was in operation at Northcliffe House, which was home to the *Daily Mail* and *Evening Standard* from 1827 until 1987. The press is the heaviest object in Wroughton's archive: nine metres tall by 9.5 metres wide, it weighs 140 tonnes.


N
O
P
Q
R

*LEFT*
**A1 STORE**

Stored in eight-metre-high mobile racks are close to 9,000 cooker-sized objects, ranging from agricultural devices to X-ray apparatus. Among them are 50 actual cookers. Other objects include a 1950s tea-vending machine; a section of a particle accelerator; a British street-lamp; a diorama of Blackfriars Bridge; sectioned engines showing serpentine belt configurations; and railway-worker uniforms. The dedicated store provides a stable environment for the more vulnerable items in the collections. Museum Information Management SYstem software – called Mimsy – helps digitally organise large collections and enables the museum to locate and manage the objects easily.

*BELOW*
**THE GNAT**

This light, agile fighter-jet, which first flew in 1955, was made by British aircraft designer Teddy Petter, who wanted to reverse the trend towards heavier and more expensive interceptors in the 1940s by developing an aircraft design that could also be built easily in developing countries. Although the RAF never used it in combat, the Gnat became famous as the aircraft of choice for the Red Arrows aerobatic team. It was also flown extensively by the Indian Air Force and was exported to Finland and Yugoslavia. The example pictured was built in 1962 and used by the Royal Aircraft Establishment in Bedford to investigate air turbulence from 1970 to 1983.


*LEFT*

**RUSSIAN SUPERCOMPUTER**

The BESM-6 Russian supercomputer was designed in the 1960s by leading Soviet computer scientist Sergei Lebedev at the Institute of Precision Mechanics and Computer Engineering. It was the last Soviet computer with an entirely homegrown architecture, and was reputedly on a par with its Western counterpart, the Control Data Corporation (CDC) 6600. The 48-bit processor ran at a speed of 1M flops (the current fastest supercomputer runs at 8 petaflops). Reportedly, 355 BESM-6s were built, the last of which were in service until the early 1990s. During the Cold War they were a part of the USSR's military, space, engineering, meteorological and computer-science programmes.

*ABOVE LEFT*

**REINFORCED CONCRETE**

This chunk of reinforced concrete, poured in 1899, is one of the first pieces of its kind in the world. It was part of a concrete jetty built at Woolston Quay, Southampton, which was designed by British engineer LG Mouchel. He used the principles established by François Hennebique in France, who patented his concrete reinforcing technique in 1892. Hennebique's system was one of the earliest construction methods to employ reinforced concrete and, based on his work, the Woolston Quay was the first reinforced concrete jetty in the UK. This chunk was an early and significant application of a radical new type of construction, a method that survives until today.

*ABOVE*

**MANTIS MINISUB**

The Osel Mantis atmospheric submersible craft was invented by London-born marine engineer Graham Hawkes in 1978 and manufactured by HMB Subwork, Great Yarmouth. Designed to inspect pipelines and undersea installations, it can be piloted manually or remotely operated. Hawkes controlled a sister vessel in a tank at Pinewood Studios for the 1981 James Bond film, *For Your Eyes Only*. Other submersibles in the Science Museum at Wroughton's collection include a Vickers Oceanic submarine, used to hunt for a supposed monster in Loch Ness, Scotland. As for the monster: best check the Natural History Museum.

> By >
Neal Pollack

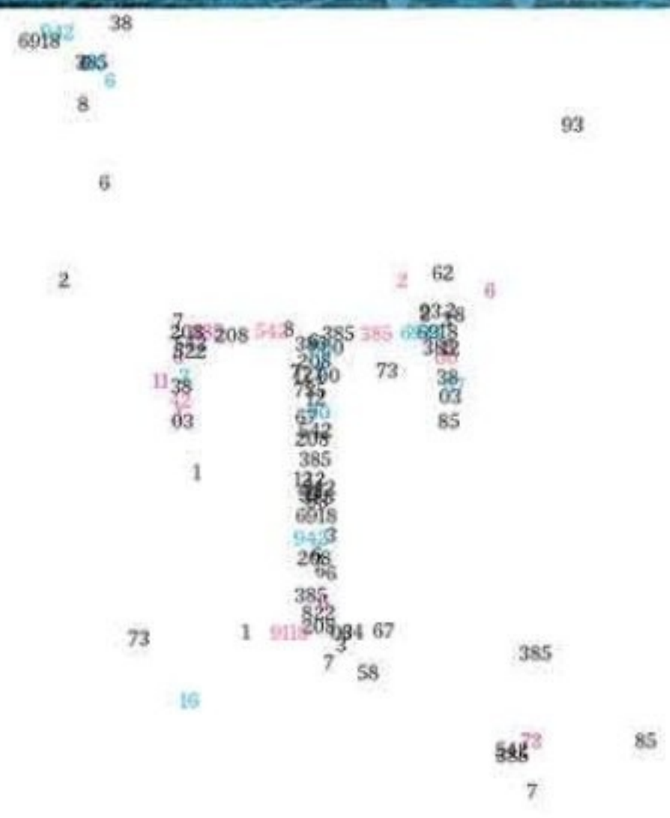
> Illustration: >
Tatiana Plakhova

> Photography: >
Gregg Segal

# THE EXABYTE

> IN SILICON VALLEY, IT'S NO LONGER THE SOFTWARE ENGINEER WHO'S THE ROCK STAR – IT'S THE DATA SCIENTIST. FOR STARTUPS SUCH AS KAGGLE, WHICH AIMS TO SOLVE BIG-DATA PROBLEMS, THAT MEANS A GOLDEN OPPORTUNITY

# EVOLUTION



**he 2012 Strata Data Science Conference,** held in February in Santa Clara, California, is the kind of place where conversations start with, "What's your index time?" Cocktail hour features custom-made drinks called Hadoopery Hooch, Alcohol-Stat and Numbers Numb-er. The conference's hottest swag is a black button with white letters that reads, "My, what big data you have." Those attending are glad to be among their own kind. "There's only so long you can talk to your spouse about data before you end up on the couch," one of them says.

"It reminds me of the 90s," says Mike Bowles, a former MIT professor of aeronautical engineering who, under the rubric Hacker Dojo, now teaches courses in data mining to working professionals. "That was an exciting time for the internet, and this is an exciting time for big data. The enthusiasm [here] is palpable."

The second annual Strata – known to many attendees as "Datastock" – marks the moment when data scientists are emerging into the sunlight as members of tech's hottest profession; pioneers in what's being described as "the age of big data".

**BIG DATA AT WORK:** *1*

COMPANY/ORGANISATION:

**Global Viral Forecasting Initiative**

AIM:

**Preventing global disease pandemics**

SOLUTION:

**GVFI gathers data from multiple sources, including viral discovery in the field, anthropological research, over-the-counter drug sales and social-media trends, to predict and prevent outbreaks. The data also helps track animal viruses.**

A 2011 study called *Extracting Value From Chaos* by John Gantz and David Reinsel reported that the volume of the world's information more than doubles every two years. Parsing meaning from these vast mountains of data has become tech's new obsession: business now views data as a raw material – an economic input on a par with capital and labour. International Data Corporation estimates that a billion connected devices will ship this year, with that number set to double by 2016 – but all the data flowing from them, rich with indications of users' preferences, location and behaviour, is worthless unless it can be interpreted. What's really valuable isn't the data, of course: it's the ability to extract meaning from it.

"The notion of a professional data wrangler or data manipulator, the other half of a machine-learning system as a full-time job, has emerged very recently," says Max Levchin, a Silicon Valley investor and entrepreneur, and the cofounder of PayPal, on the phone from his office in San Francisco. "In the past, if you were a good coder, you delved into machine learning a little bit, or you were a good modeller; it was enough. Now it's not any more, and the entire driver of that has been the availability of data."

Six years ago, Clive Humby, creator of Tesco's Clubcard, was quoted as saying: "Data is the new oil" – implying that its value lies in refining the crude source. At Strata, the phrase is almost a cliché. Futurist and Silicon Valley stalwart Tim O'Reilly, whose O'Reilly Media puts on Strata, buzzes about the exhibition floor dipping in and out of conversations. He says the data universe continues to surprise him. "When I first saw data starting to dominate," he says, "I didn't think about the companies that could emerge. Or how mobile was going to explode. All these data subsystems are starting to coalesce into this operating system that we all work with. There's more data than I thought would ever be possible."

"Last year, I theorised that data would be the foundation for Web 3.0," Reid Hoffman, the founder of LinkedIn and an investor in many high-profile tech companies (issue 04.12), tells WIRED. "Essentially, new services will build [systems] for navigating our lives through aggregate data: from explicit data we input to social networks, from implicit data from mobile phones and activity, and from analytic data created from explicit and implicit data. These services will help us navigate our lives better: from the physical world (examples: driving and walking), to the entertainment world (examples: which books and movies), to the career world (examples: which information and which opportunities). New Web 3.0 products will come both from existing companies such as LinkedIn and Twitter and form new companies."

*Jeremy Howard, president and chief scientist of Kaggle, at its San Francisco HQ*

**On the morning of March 1, dozens of data** scientists, most under 40, gather in the Strata speakers' lounge at the conference centre, finalising talks on topics such as "Democratisation of Data Platforms", "Decoding the Great American ZIP myth" and "Embrace the Chaos".

Jeremy Howard, when not working on the presentation he is to give that morning ("From Predictive Modelling to Optimisation: The Next Frontier"), walks about in his orange Vans and a hoodie that reads "Data Science" on the back. He grins impishly, engaging everyone, introducing people and enjoying the world he's helped create. Howard is the president and chief scientist of Kaggle, the "leading platform for predictive modelling competitions", where users compete to solve data problems.

"Data scientists are people who have been hacking away for years," he says. "Now we're coming together under a banner. It hasn't grown much. We've just found one another."

Howard and his fellow data scientists sit around a table. Hal Varian approaches with his breakfast plate. A respectful hush falls. Varian, professor emeritus at Berkeley and chief economist at Google, has been working with large data sets since before many of this crop of data scientists were born. Howard doesn't seem intimidated.

"Hey, Hal," he asks. "Can you give a demonstration of Google Correlate?"

Correlate is a relatively new public feature from Google that, in the company's words, "finds search patterns which


NaN
NA
" "
Model
prediction
PMML?
Private Public
Public Ignored
Ignored
Scale
End
0 or 1 results in a
Scale. if so, we
replace each prediction
above 1.5e
moved to 1.5e
and

correspond with real-world trends". Search terms vary in popularity over time, and also match up with other search terms that display similar patterns. Data scientists are delighted by such pattern tracking; it helped Google build its popular and useful *Google Flu Trends* app, which lets doctors and researchers search trends to track influenza outbreaks quickly and accurately.

Varian seems glad to have a receptive audience that understands how Correlate works. Some of the top minds in the industry gather around. He opens his laptop, and types "Eric Schmidt" into the Google Correlate search bar.

The first result, with a correlation of more than 0.89, is "Schmidt Google". Not surprising, since Schmidt is Google's executive chairman. The next terms are equally mundane: "Eric Schmidt Google", "Google CEO", "Google CEO Eric Schmidt" and so on. Then, towards the bottom, with a 0.61 correlation, is "Starbucks size", followed by "male yeast infection". The table explodes in laughter. "I don't know what that could mean," Varian says.

The group starts speculating. As it turns out, there's a Dr Eric Schmidt – no relation – in California who specialises in treating male yeast infections. But Google Correlate didn't know that. It could only track trends in the data.

At the bottom of the stack, with a 0.60 correlation number, is "disco fries". How in the world does it relate to Eric Schmidt? It's up to data science to determine.

Howard beams with pleasure. He loves this sort of question. To him, data science contains a multitude of possibilities. It's continually revealing things about the world that we didn't know before. "It's at the heart of so much that we do today," he says. The US insurance company Allstate, for instance, used a Kaggle competition to improve its actuarial model by 340 per cent, and Google used data science to help to develop its self-driving car, which, Howard says, "is just a whole bunch of predictive models working in parallel".

Kaggle is running the Heritage Health Prize, sponsored by California healthcare company Heritage Provider Network. It wants to be able to identify the US patients most likely to be admitted to a hospital within the next year and the length of their stay, and is offering $3 million (£1.86 million) to the winning entrant. The healthcare industry in the US wastes up to $30 billion dollars a year in unnecessary hospitalisations. Data analysis, says Jonathan Gluck, senior executive and counsel at the Heritage, will help to tease out certain factors that may previously have been overlooked. "Doctors' intuition is great, but there's too much information," he says. "We're trying to take those people who are helping Google to figure out which restaurants are good in your area, or those people who are helping Netflix to recommend which movies you should be watching, and doing something that will benefit society."

Another Kaggle user is Pete Warden. He started a company called Jetpac, which allows people to share their travel photos. Yet many users were finding that its discovery process led them down useless rabbit-holes. So Warden deployed a $5,000 Kaggle competition to try to data-determine, through analysing words in captions, which photos were "inspiring" people to travel. He received more than 400 entries. "The reason we know it's working is that no one asks us about bad photos any more," Warden says. "It's amazing just how far this tool kit can take us."

Data, Howard says, "doesn't leave any room for bullshit. Most of the data is telling us stuff that we already know. But once in a while, it'll reveal something new to us. People will argue, but you can show them the data. It doesn't lie."

**In the beginning, there was data, but it** was hard to understand. A statistician named John Tukey – who, among other things, is credited with coming up with the term "bit" while working with John von Neumann on early computer designs in the late 40s – promoted a system called Exploratory Data Analysis. This argued that large, complex data sets should be simply summarised using explanatory charts and graphs. In other words, statistics weren't just numbers games that existed for their own sake. They had potential real-world applications and should be evaluated based on the stories they could tell. In 1972, Tukey developed a computer program called PRIM-9 (an acronym for picturing, rotation, isolation and masking of data in "up to nine dimensions"). It was well ahead of its time, and allowed users to see data displayed from nine separate graphical angles.

For decades, that was all data scientists had to go on as they wandered in the numbers wilderness. Howard got his start more than 20 years ago, first as an analytical specialist at management consultant McKinsey, and later at big retail banks and insurance companies in his native Australia. "There was big data going on," he says. "They had tens of millions of customers, filled warehouses with data and spent shitloads of money." But he found the profession lonely: "When I started at McKinsey, I was it. I invented the position."

Gradually, the industry began to shift. When Howard started, he needed a room full of machines to analyse data. As the price of computing dropped, programmers began to develop open-source data-storage software. The arrival of the internet meant that companies had more and more data that they needed to store and analyse. Big financial institutions were no longer alone in their need to crunch numbers – from retail corporations to public-health nonprofits, data belonged to and mattered to everyone.

**BIG DATA AT WORK:** *2*

COMPANY/ORGANISATION:

**Santa Clara Police Department, California**

AIM:

**To reduce crime, including burglaries, car-jackings and vehicle theft.**

SOLUTION:

**A predictive algorithm based on data from thousands of crimes. The algorithm generates daily maps, indicating hotspots and high-risk time windows and has reduced crime by 27 per cent since 2010.**

**BIG DATA AT WORK:** *3*

COMPANY/ORGANISATION:

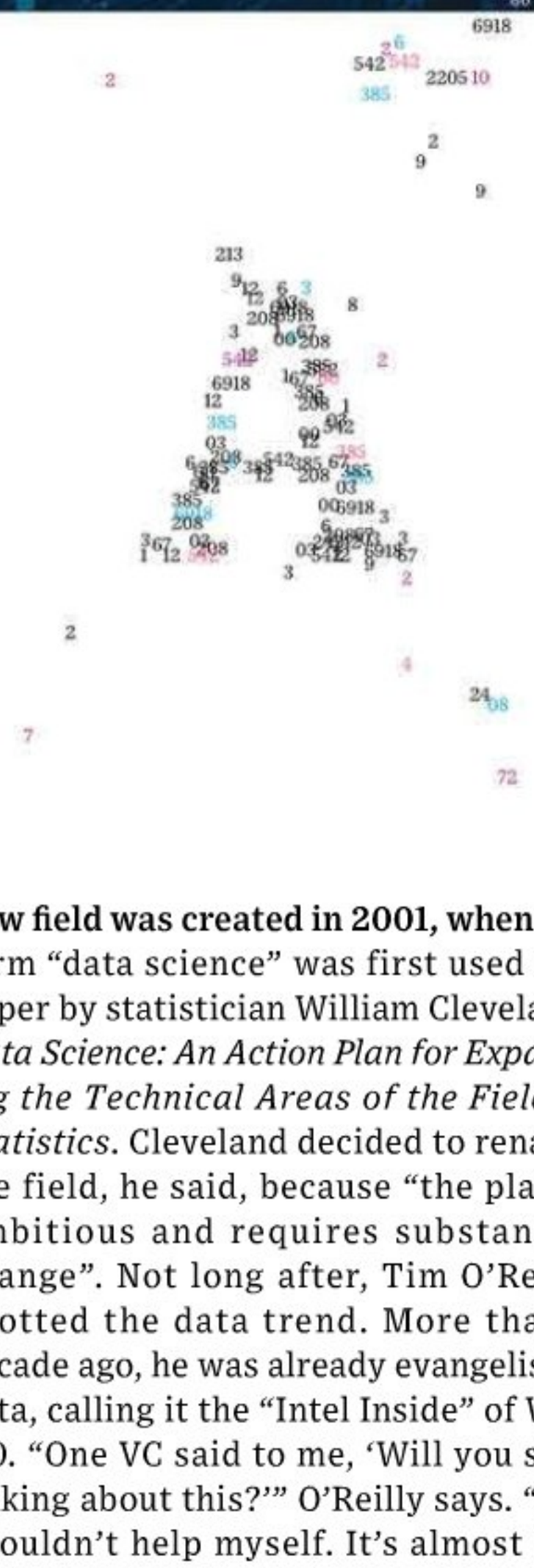
**Netflix**

AIM:

**Improving efficiency of the movie-recommendation system**

SOLUTION:

**Netflix released 100 million customer ratings and offered a $1 million prize for the team that could improve prediction of user ratings by ten per cent. BellKor, a group of scientists from AT&T labs, won.**



**new field was created in 2001, when the** term "data science" was first used in a paper by statistician William Cleveland, *Data Science: An Action Plan for Expanding the Technical Areas of the Field of Statistics*. Cleveland decided to rename the field, he said, because "the plan is ambitious and requires substantial change". Not long after, Tim O'Reilly spotted the data trend. More than a decade ago, he was already evangelising data, calling it the "Intel Inside" of Web 2.0. "One VC said to me, 'Will you stop talking about this?'" O'Reilly says. "But I couldn't help myself. It's almost like talking about your kids. I was doing it by pattern recognition. You just saw more and more people playing with data."

Data science, O'Reilly realised, was becoming the essential new field in every industry. "It's really the currency of the future," he says. "We're just at the beginning of what the data economy will look like."

O'Reilly wanted to get his media company into the data business as soon as he could. He hired Roger Magoulas as his director of research. Magoulas had designed and implemented data-warehouse projects in the 90s, long before they were popular. When he started at O'Reilly, he was handed a database of hundreds of millions of jobs, ranging from Best Buy salesperson to barista. His task was to mine the data to tease technology trends out of these job descriptions. O'Reilly Media had all the data stored on two standard CPUs ("the kind that look like a pizza box," Magoulas says) using the MySQL database-management system. "It was slow," he adds.

Companies had begun to spring up that allowed people to crunch data more quickly, but they were too expensive for small companies such as O'Reilly Media to use. To fill the gap, free open-source systems such as Hadoop emerged, in Magoulas's words, to "democratise" the data world. O'Reilly switched to open-source company Greenplum, which loaded the data on to 12 servers working simultaneously and rapidly. Queries that had taken Magoulas and his team ten hours were suddenly being processed within six minutes.

Reality shifted almost overnight. Magoulas and his colleagues started calling this their "big data" project. "The feedback we've received suggests that we were the first people that used that term extensively," he says. "But I doubt we were the people who actually coined it." They published a paper in 2009 called *Big Data: Technologies and Techniques for Large-Scale Data* and the term entered the public sphere.

As part of his research, Magoulas visited LinkedIn, where a young chief scientist called DJ Patil was working. At the time, he was an eccentric chaos theoretician running a data-research team at a company still establishing itself. Three years later, in January 2012, Patil would appear on the cover of *Fast Company* as part of "Generation Flux" – industry leaders best equipped to survive a business environment that's "pure chaos".

But data was starting to mean more than it once had. "The data guy [used to be] relegated to the back," Patil says. "He wasn't allowed in on the real conversation. It's like having Spock on the bridge – nobody would have thought that made sense. Now it's like, 'Oh, why isn't Spock in on the conversation?'"

Web 2.0 companies were generating data in petabytes, and they needed specialists to process and understand it. Terms were getting thrown around: "analyst", "business intelligence", "research technician", but none of them made much sense. The lack of clarity was driving personnel departments crazy when it came to hiring people.

Patil says he came up with the term "data scientist" over lunch one day with Jeff Hammerbacher, who was running Facebook's data team. "It was the least offending term," he says. "It's more of a broad thing rather than a niche thing, and it's the term that people would most like when they were looking for jobs. People looked at 'data scientist' and said, 'These guys are on to something. That describes me.'"

But it didn't describe enough people. The ability of the digital universe to produce data far outpaced the ability of experts to mine, analyse and explain it. Essentially, the universe suffered from a shortage of data scientists. Studies begun to appear, warning

**BIG DATA AT WORK:** *4*

COMPANY/ORGANISATION:

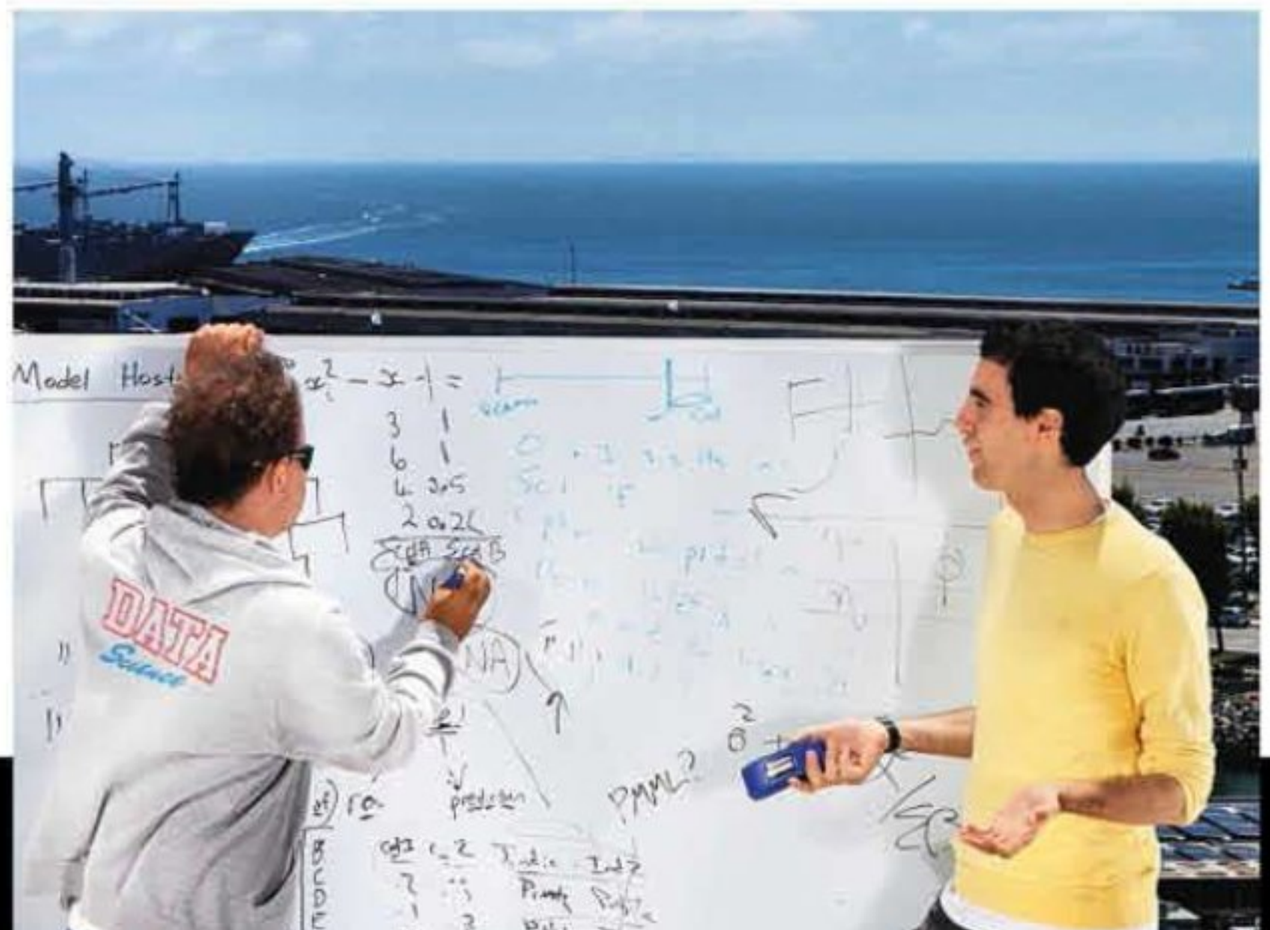
**Google Books**

AIM:

**Analysing words published since 1500**

SOLUTION:

**Having digitally copied more than 5.2 million books into a database, Google built the Ngram Viewer, a tool that facilitates analysis of the usage and evolution of single words and phrases throughout the centuries.**




*Rooftop maths with Jeremy Howard and Kaggle CEO Anthony Goldbloom*

of the "looming data-science talent shortage", and that great volumes of essential data stood to be lost forever.

Kaggle stepped into the void.

**Anthony Goldbloom is a mild-mannered** young econometrician who built models for the Australian treasury and the Reserve Bank of Australia. In 2008, he entered an essay contest sponsored by *The Economist*, writing about how the subprime-mortgage crisis wasn't as big a deal as people thought. That was the winning entry, and it gained him an internship at the magazine. As no one else was interested, he chose the big-data beat.

"I started interviewing people who were doing the same things I was at the treasury and the bank, but they were using more real-world applications," he says. "I called up and said I was from *The Economist*. Everybody likes to speak to a journalist."

The executives that Goldbloom talked to told him that data science was one of their top priorities, "but it was clear their application didn't match their ambition," he says. There was a shortage of available talent, and it was hard to know whom to hire. Goldbloom suddenly had his big idea: "To join companies that have data to people who want to muck around with data."

He drew inspiration from the Netflix Prize, a million-dollar competition run by Netflix from 2006 to 2009 that sought an algorithm to improve its movie-recommendation software's accuracy by ten per cent. Everyone came away a winner: data junkies got to work on a tough problem in a lively, competitive environment with the possibility of a huge payout, and Netflix got nearly unlimited R&D from some of the world's top minds at a cost of less than £6 an hour. Goldbloom bet that if it worked for Netflix, it would work for everyone.

Goldbloom launched Kaggle in April 2010 with a $1,000 contest for the algorithm that could best predict the winner of the *Eurovision Song Contest*, a test run that was more accurate than betting markets, proving Kaggle's software worked. The first serious Kaggle competition, to predict how genetic markers might affect the viral load of HIV-infected people, followed. Dozens of people and teams from around the world, none of whom had experience with HIV research, wrote algorithms.

"In a week and a half," Goldbloom says, "the best scientific research had been blown out of the water."

Goldbloom was overwhelmed with work, so, in November 2010, Jeremy Howard – one of the first Kaggle users and who'd won competitions – joined the firm.

"The people who win Kaggle competitions have this amazing mix of tenacity, creativity, open-mindedness, coding skills, software-engineering skills and data-analytical skills," Howard says. "They're these amazing Renaissance people. You can imagine that working with people like that is a real pleasure. When we talk at work together we have a deep respect for one another, because we know that what we do is based on actual results."

Howard had found his people at last.

**Here's an example of how data science** actually works: dark matter comprises 83 per cent of the known universe. We have no idea what it actually is; it could be an undiscovered type of particle or something else entirely. Regardless, the mystery of dark matter represents the greatest puzzle in cosmology.

One of the ways cosmologists map dark matter is through "gravitational lensing", or measuring the change of elasticity in a galaxy because of dark matter's effects. For years, researchers at the University of Edinburgh had been trying to use elasticity numbers to map dark matter, but none of their algorithms worked. They had access to a huge data set. They opened a terabyte of data to a public contest, asking for help. They got a lot of press, but only 20 entries, none successful.

Then Kaggle gave them a call. According to Thomas Kitching, a cosmologist and postdoc doctoral research fellow at the University of Edinburgh, "they said, 'What you're doing is good, but the challenge is too big. It's too hard.'"

Goldbloom and Howard told him that they could make the dark-matter-mapping competition more straightforward and human-scaled, turning it into a forum where people would churn ideas around. "They said they could make it into a sport," Kitching says. He got the British Royal Astronomical Society, Nasa and the European Space Agency on board. Kitching, Howard and Goldbloom then spent months boiling down the huge data set into something more digestible. Competitors would be given 100,000 images of galaxies and then asked to measure the elasticity of 40,000. "In retrospect, it all sounds kind of obvious," Kitching says. "But because it was the first time, we took months."

More than 1,000 people or teams signed up for Kaggle's dark-matter competition.

Martin O'Leary, a PhD candidate in glaciology at Cambridge, was one of the first competitors. The fact that he had no experience in astronomy, nor even in data, didn't intimidate him. He'd been examining amorphous satellite images for years, so he felt like a plausible candidate. "I took a mathematically simple form and just deconvolved them with a bit of algebra," he says. "Science is science. If it doesn't have data in it, it's not science."

*Kaggle CEO Anthony Goldbloom with a t-distribution-shaped pillow*

**BIG DATA AT WORK:** *5*

COMPANY/ORGANISATION:
**1000 Genomes**

AIM:
**Understanding the entirety of human genetic variation, to help scientists to cure diseases.**

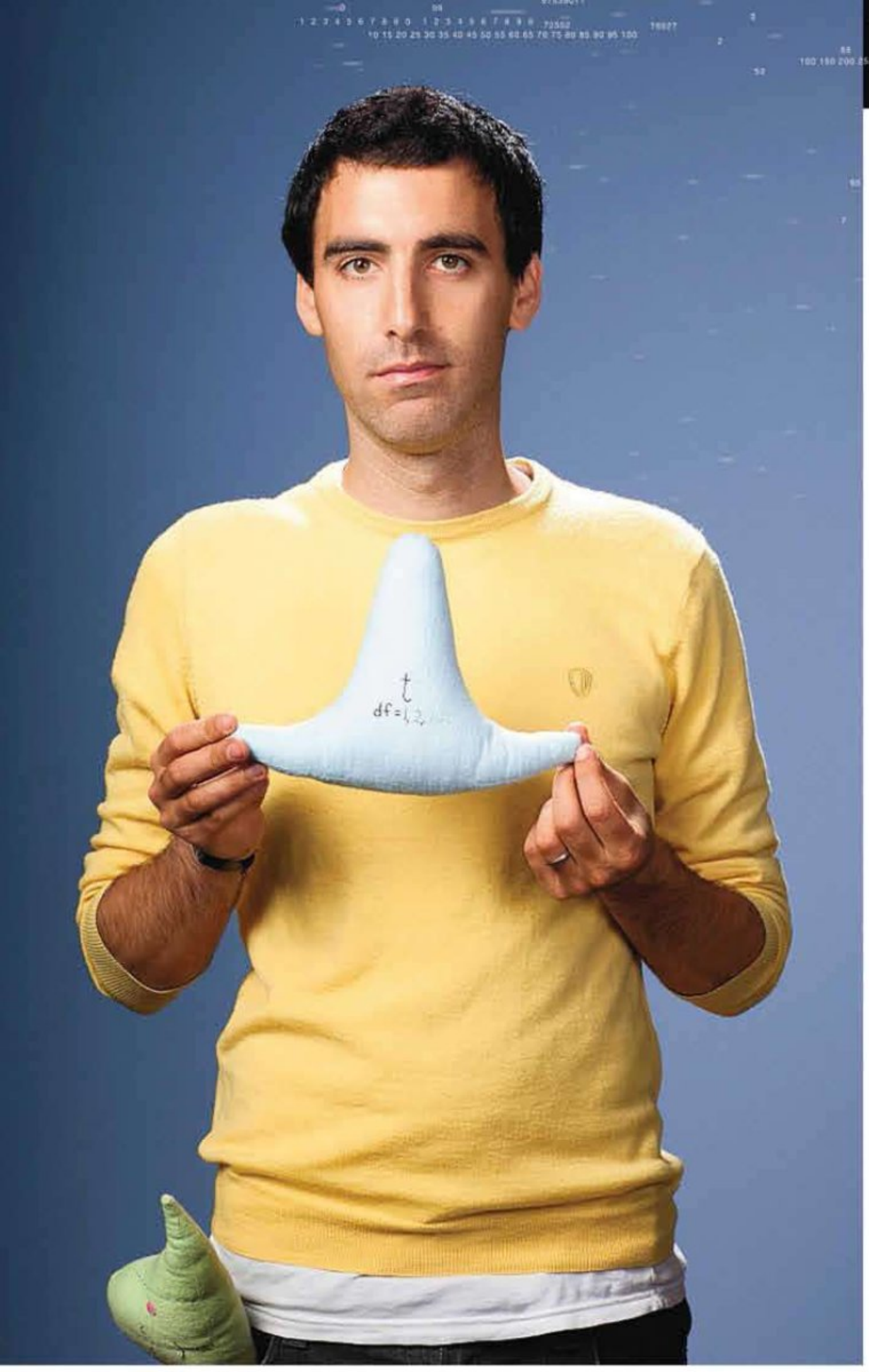
SOLUTION:
**An international network of scientists created a 130-terabyte open database. It will eventually contain the genetic information of 2,500 humans.**

**BIG DATA AT WORK:** *6*

COMPANY/ORGANISATION:
**data.gov.uk**

AIM:
**Increasing government transparency and civic information.**

SOLUTION:
**The UK government has made more than 8,400 raw data sets available to the public, plus 210 apps based on the data built by citizens, startups and government departments.**



**BIG DATA AT WORK: *7***

COMPANY/ORGANISATION:

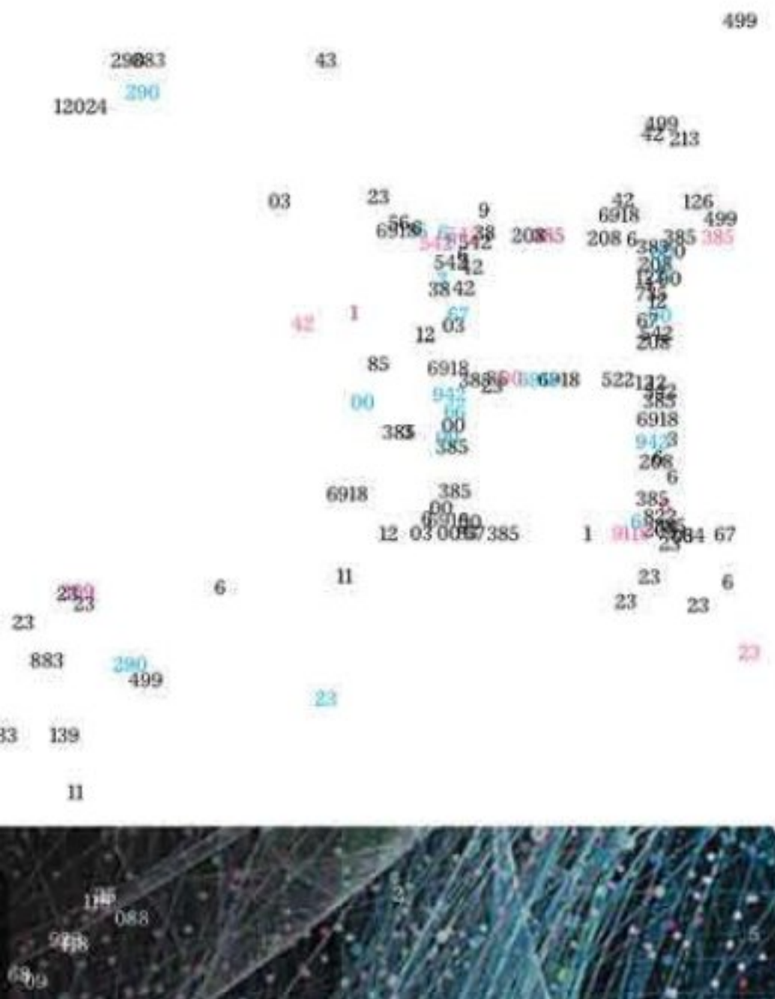
**Wal-Mart**

AIM:

**Managing stock efficiently in all of its 8,400 stores.**

SOLUTION:

**In 2004, Wal-Mart (now Walmart) created an inventory-management system, Retail Link, that analysed point-of-sale data. The system spots sales trends, allowing suppliers to better manage stocks.**



is algorithm shot to the top of the Kaggle leaderboard. Two days later, someone surpassed him. He tweaked his equation and moved back to the top. But coming up on the rail was David Kirkby, a professor of physics at the University of California at Irvine. "I had to turn it into a data-science problem rather than an obscure astrophysics problem," says Kirkby, "because the essence of the problem really is data science."

Using brain-mapping software as a basis, Kirkby and his research assistant Daniel Margala designed a program that pushed them to the top of the leaderboard with three weeks left. They were overtaken a few times, but they kept tweaking. "You get to the point where you can figure out what time zone people are in, and when you expect them to try and overtake you," Kirkby says. They spent the last nine days at the top.

The competitors had increased the accuracy in mapping dark matter by a factor of three. The top three won a trip to Nasa's Jet Propulsion Laboratories in Pasadena. Martin O'Leary was fourth, but had the thrill of seeing his accomplishments being written up on the White House website. He tweeted: "Not braggin' or nothin' but the White House just compared me to Newton and Einstein."

**At the first Strata conference, the Kaggle** team was essentially just part of the crowd. But by the second year, they'd raised £6.8 million in series A funding, and were among the biggest stars at the convention centre.

Over drinks in the hotel bar at Strata, Goldbloom says that the real work in data science is going on in the academic hinterlands. "These are the cool kids doing data here," he says. "But our guys are the ones doing [it] not for Silicon Valley reasons, but for the love of the game. Our people go to work, come home, have dinner with their family and then from 10pm to 2am compete in competitions before going to bed."

Howard, who enjoys the spotlight more than his partner, walks around the convention centre, basking in his good fortune.

"What was it Arthur C Clarke said, that advanced technology is indistinguishable from magic?" he says. "I feel like that's what we do as data scientists." A guy stops him. "Oh Jeremy Howard!" he says. "Hi!" says Howard. "I've been following your career on Kaggle for some time." "Oh, wow. Really?"

It's Howard's first fan. Later he says, "It's so strange. That's something someone would say to a tennis star. Not a data scientist." W

*Neal Pollack wrote about Troy Carter in 06.12*

AFRICA RISING

# IN SEARCH OF AFRICA'S EINSTEIN


There are a BILLION Africans – most are young, and among them are undiscovered geniuses. Neil Turok is determined to find and help these people – by rethinking what a university is

BY

PETE GUEST

PHOTOGRAPHY:

ANDREW B MYERS

**The city is largely low-rise, although there are patches of new construction;** buildings in the faded yellows and pinks that represent new west African modernism. Roadsides bristle with billboards advertising mobile phones, televisions, beer and real estate. Traffic has grown along with the economy. Cars spill out on to the Cape Coast Road, which snakes from Nigeria's commercial hub of Lagos in the east to the battered but recovering Ivorian city of Abidjan in the west. Roughly at the midpoint – about 50 kilometres west of Accra – is Saltpond. Once the site of the earliest European military structures on the continent, the area is about to become home to the latest outpost of AIMS – the African Institute for Mathematical Sciences.

The brainchild of South African cosmologist Neil Turok, one of Africa's most decorated scientists, AIMS is a bold initiative that seeks to create a new scientific class in Africa. More than that, Turok hopes to advance science through the rest of the world by teasing from Africa's intelligentsia an individual who can re-imagine how we see the world. Turok intends to create a mathematical community by establishing mathematical bootcamps. He plans to build 15, with versions already in Nigeria, Senegal and South Africa.

Neil Turok, photographed at the Perimeter Institute for Theoretical Physics in Ontario, Canada

Turok, 54, sees conditions in Africa today as comparative to those of eastern Europe 100 years ago: then, ambitious young Jews were suddenly granted access to education, and went on to make significant discoveries and advances in science. Now it is the turn of Africans. "Einstein came from a very disadvantaged community, which had been completely excluded from university until the second half of the 19th century," he says in his office in

Students focus intently during a maths lesson at the Institute of Muizenberg, South Africa

Ontario, Canada, where he runs the Perimeter Institute for Theoretical Physics. "But once they got into university, that first generation, you start having Jacobi, Einstein, Bohr, Pauli. This group completely revolutionised physics."

Turok talks with the long, measured tones of an experienced lecturer. His work involves looking at the largest structures of the universe and then, by examining the fundamental constructs of matter, seeking to explain how they are possible. It draws lines between the infinitely small and the infinitely large, which in some parts explains his journey from a modest attempt to bring some of his experience home to a continent-wide programme that he hopes could transform individuals – and the continent. Africa's population is thought to have passed a billion in 2011 and, south of the Sahara, around 40 per cent are under the age of 15.

"You're talking about a huge body of people, and that includes brilliant individuals," Turok says. "And yet they have almost no opportunity to develop their minds further or to connect with the global science community... I don't think it's stretching things to say that when a continent with the diversity of Africa enters basic science in a big way, they're going to bring a whole lot of creativity and originality to bear."

**A decade ago, Turok took a four-month sabbatical to travel with his daughter** to Cape Town to be with her grandparents, the anti-apartheid activists Ben and Mary Turok. Ben, now an 85-year-old member of Parliament in South Africa representing the African National Congress, served three years in prison after a 1962 conviction under the Explosives Act. Mary, too, was jailed for helping the banned ANC. The family spent 25 years in exile.

Having grown up in such a politicised home, Neil gained a PhD in mathematical physics at Imperial College, London. He then worked at the US Department of Energy's national laboratory Fermilab, the second-largest particle accelerator in the world. In 1992 he won the Institute of Physics' Maxwell Medal, awarded to a physicist early in his or her career who has made an outstanding contribution to theoretical, mathematical or computational physics. After a professorship at Princeton, Turok took the chair of mathematical physics at Cambridge in 1997, working with Stephen Hawking to derive new solutions to the theory of an expansionary universe. "As an excuse to Cambridge, I said that I'd be spending the term trying to build partnerships with universities in South Africa," he says.

What he found, however, was that despite the economic resurgence that accompanied its reintegration with the international community, South Africa was lacking in mathematically skilled graduates. Every industry, from finance to telecoms and the government itself, was struggling to find technically trained people. The country – in fact, the continent south of the Sahara – lacked any institute that produced high-quality graduates in mathematical sciences. So Turok decided to build one – AIMS. "It kind of seemed an obvious thing to do," he says. "To bring Africa's brightest students to South Africa and bring the best lecturers in the world to teach them."

AIMS now has a self-contained residential facility in Muizenberg, a suburb to the east of Cape Town. "I thought we could do it on the campus of a university, but very quickly came to the conclusion that that wasn't going to work... we more or less had to reinvent many aspects of graduate education," Turok says.

AIMS is not, however, just another university. Students do not sit endless exams; they are not led down predetermined paths of learning; and it is routine for those who enter in one discipline to leave on a totally different path. In the campus's main building, students and lecturers live together. "Africa [is] the ideal place to be completely innovative in advanced education, because the need is huge and the opportunity is huge," says Turok. That process started, in true mathematical fashion, by taking scientific education back to first principles.

Many great universities are failing to keep pace with the outside world, Turok says. They are insular and departmental, forcing students down narrow channels of learning, and academics into publishing papers and attending conferences. Real discovery, and the kind of science that exists on the frontiers between traditional disciplines, has suffered. Turok wants to change that in a continent that is accustomed to exporting many of its brightest minds to Europe and north America. It is a combination of thousands of small miracles that he believes will endow young Africans from underfunded schools with surprisingly high standards of maths.

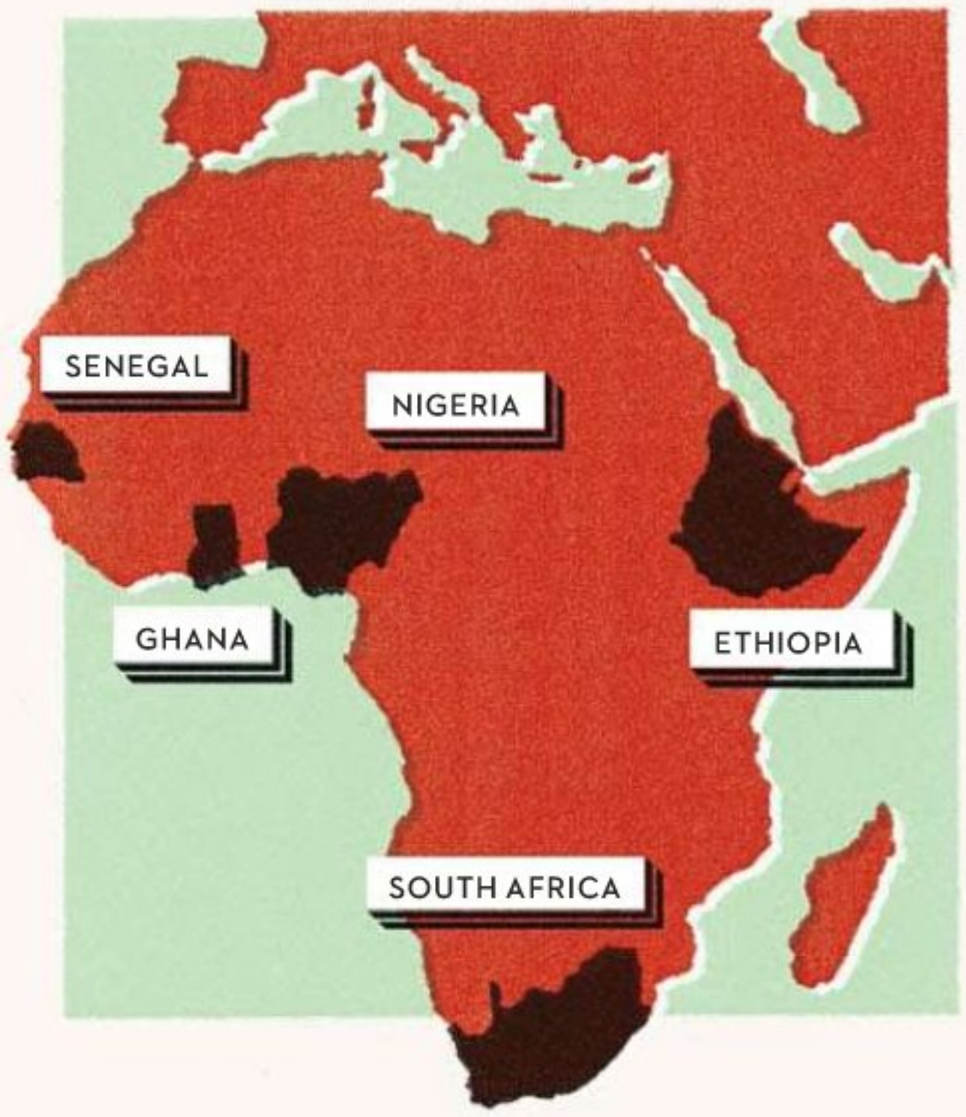
Africa does have one advantage: its people have long needed to rely on ingenuity to make up for limited resources. Whereas the developed world's economy shrank by nearly four per cent in 2009, sub-Saharan Africa steamed on, expanding by almost three per cent. That year, Ethiopia's GDP grew ten per cent, Uganda's 7.2 per cent – albeit from a low base. International devel-

opment has mostly focused on boosting primary education. But Turok believes spending on tertiary education could deliver disproportionate returns. He points out that investments in higher-level schooling are an accelerator for economic and social development, with South Korea and Singapore standing out as exemplars.

Graduates, particularly those with technical skills, are job creators and innovators and, more importantly, they are teachers. When development aid fails to build such a sustainable body of local expertise, Turok says, the recipient nation remains dependent on outside help. He was determined to change that – and had a billionaire technologist in his sights. "Bill Gates made his fortune out of clever software, good software," Turok says. "Well, I say good software, sometimes, but software. So it seemed a complete natural that AIMS should go to the Gates Foundation."

He took this up during a meeting with Gates's father, who chairs the foundation, in the early days of the institute's life. "I said, 'You're doing all this wonderful work on health in Africa, but how do you expect this to be sustainable when you're not also training the people to run and evaluate those programmes? You're not training Africans to do it. What you're doing is using Washington consultants to judge the effectiveness of your aid. How do you imagine this is going to work without a local skilled set of people to implement and evaluate and assess your programmes?'"

It is when recounting the response that Turok, who is usually calm and logical, betrays his intense irritation. He was, he says, told that the foundation "does education" in North America, and health in Africa. "I can see why the aid doesn't find it attractive to go to universities, but to neglect that is incredibly short-sighted," he says.




## THE SEARCH IS ON

**The AIMS Next Einstein Initiative has associate branches dotted across Africa; founders hope to establish 15 in all.**

**SENEGAL**
Opened: 2011

**GHANA**
Not yet open

**NIGERIA**
Opened: 2007

**ETHIOPIA**
Not yet open

**S.AFRICA**
Opened: 2003

**ote learning, interdepart**mental turf fighting and chronic underinvestment had become pronounced characteristics of African tertiary education. Turok chose to confront them head-on, in order to shake up the further education system from top to bottom. "The beauty of doing something in Africa is that you see all the systemic problems that you see in universities worldwide," he explains. "The difference here is that in Africa they're multiplied by a factor of 100, so they become absolutely blindingly obvious. Universities are extremely ivory tower. The relevance of the students' education to what they will ultimately be doing when they graduate is minimal. So these problems kind of hit us in the face when working in Africa, and we had no option but to do something radically different."

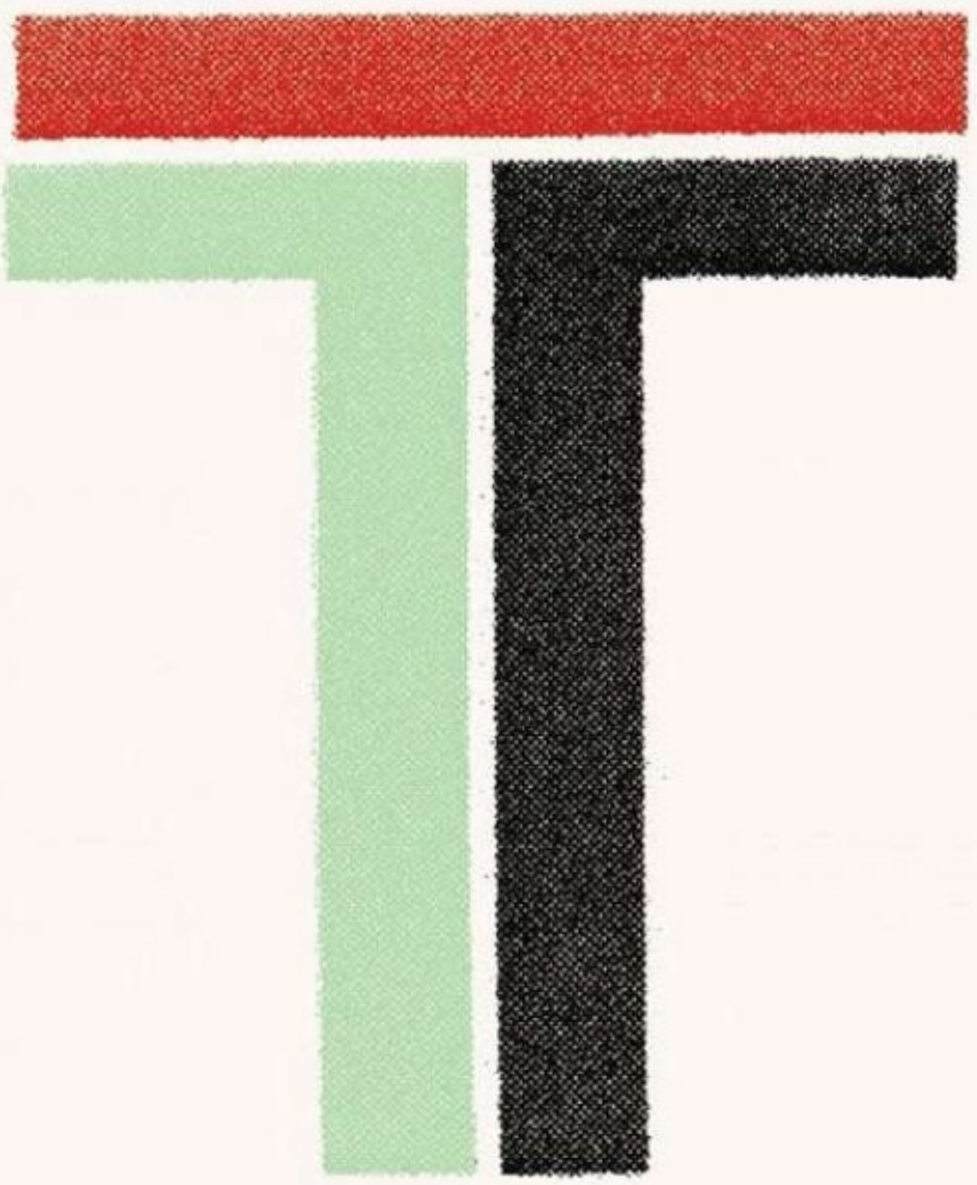
Turok and his colleagues tore up the textbook – in their case taking the classic 1960s course devised by the Russian physicists Landau and Lifshitz – and decided to throw it away in its entirety. "We scrapped the whole traditional curriculum and we said, 'Let's think about what scientists actually do now.'" The answer was build databases, play with software and use statistical models as a way of developing deep understanding of a subject. "There's a widely applicable toolkit, which is in practice what all scientists are using, but which is never taught," Turok says. One result has been that students begin the course without preconceived notions of where they want to end up. They use computers running Linux, rather than Windows, so that they can more directly influence how they work – and change it. "We designed a very novel course, which is completely interdisciplinary. The course gives students a wide skill toolbox before they decide what they're going to specialise in. It essentially opens doors across the whole of science."

Students, visiting professors and tutors eat and sleep in the same residential campus. There are no exams, and the empha-

sis is on problem-solving and discussion. According to Professor Philip Maini, a mathematical biologist at Oxford and distinguished research fellow at AIMS, the resulting culture is far more conducive to interaction. "It's like a school where the teacher walks through the desks and asks the students questions. That's something that I never do in university. But doing that with the AIMS people meant you had a really good interaction," Maini says. "Maybe it was because my office was exactly opposite where they were working, but they would come into the office and ask questions... the students were thirsty for knowledge. They would take advantage of that."

For the students, it is worlds apart from any educational programme they may have enrolled onto before. As Kidist Zeleke, who passed through the programme in 2007, says: "This is completely different. It's a 24-hour learning experience. You don't think about passing a test or something. You dive into it. We have lectures every day for two hours, but the professors stay there, they live with us. Sometimes after the professors, teachers, there is some theorem that we don't understand, after 1am we hold a workshop with the tutors, and work the whole night... AIMS is the first place that I got to call the professors by their first name." Zeleke now lives in Houston, Texas, where she is studying for a PhD in computational fluid dynamics, and writing a thesis on enantiomer separation in microfluidic flows.

Neil Turok: "We more or less had to reinvent many aspects of graduate education"

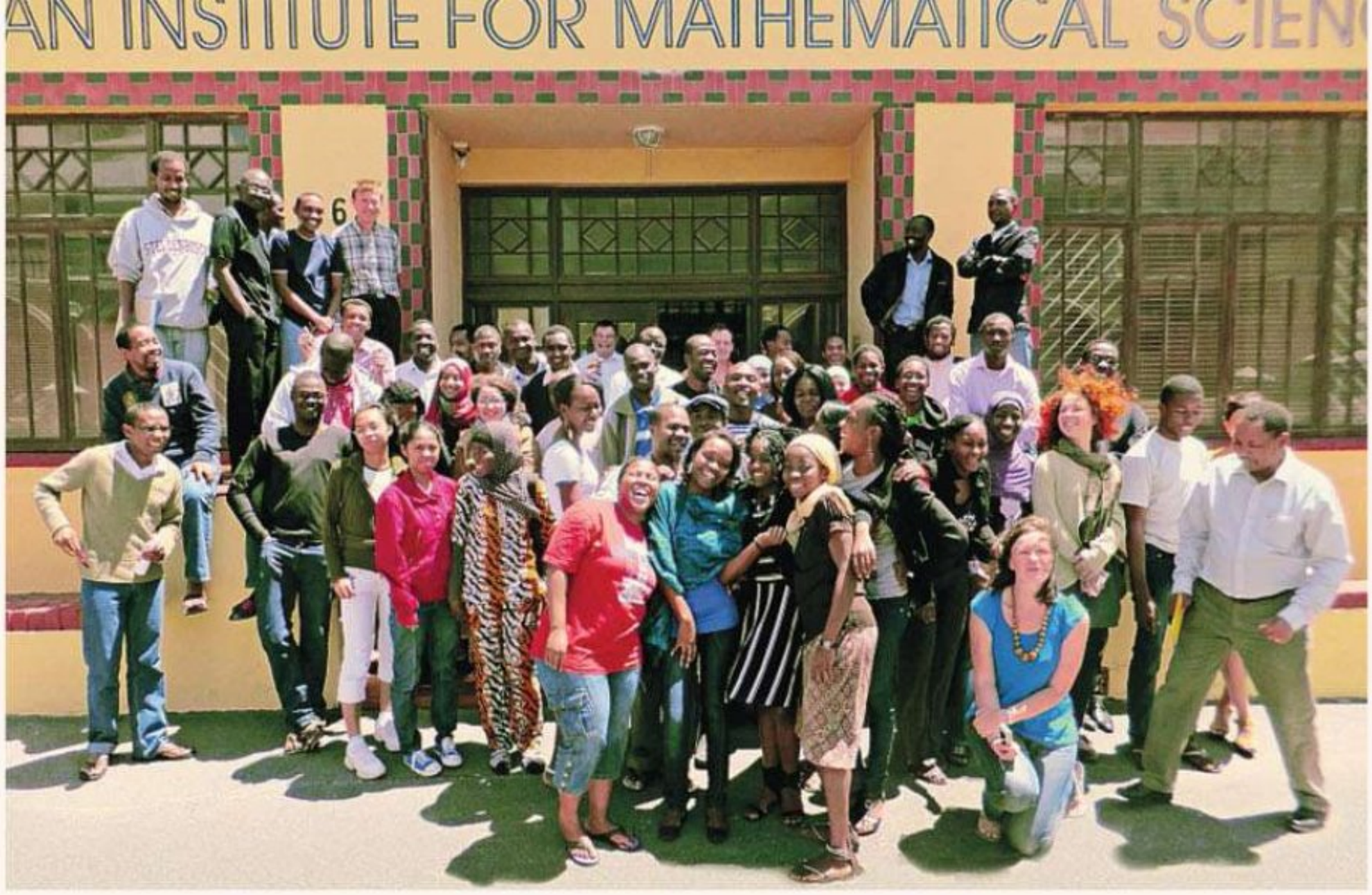


**urok was awarded a TED Prize in 2008 for** his work with AIMS. Winners are asked to make a wish. Turok had just given a lecture to the 2008 cohort in Cape Town and, the following day, one of his students gave a talk to a visiting donor. The student ended her presentation by saying: "We want the next Einstein to be an African."

"I was concerned it would sound too much like a slogan," Turok says, "so I called my most critical physics friends to ask: 'Does this sound like bullshit?'" The response was the opposite. Corporate, government and academic supporters have lined up behind the scheme. Its board includes Howard Alper, the chairman of Canada's Science, Technology and Innovation Council, Cambridge Mathematician Keith Moffatt, and Fernando Quevedo, director of the International Centre for Theoretical Physics in Trieste.

The Next Einstein Initiative, run from AIMS, is more a mindset than a competition – there is no mechanism to identify an individual genius, and no prizes for the winner. On a continent starved of academic investment, it is inspiring a small core of mathematicians.

That Zeleke even graduated is a measure of the enormous progress being made by AIMS. She was born in a small village in the east of Ethiopia, and at three she moved to Dire Dawa, the country's second city. "There was no school in my village, but my dad wanted me to be educated, so he gave me to his sister," she says. The Ethiopian system assigns students to universities, rather than allowing them to choose, but having scored highly at school, Zeleke went to the capital, Addis Ababa, to read applied mathematics, with the




Students pose after a farewell party at the institute in South Africa

intention of studying engineering. That changed in 2007, when an undergraduate algebra tutor suggested she apply to AIMS.

For 30-year-old Trust Chibawara, a mathematician who consistently topped his classes in South Africa, AIMS opened up the possibility of an academic career over a more conventional finance-industry. "When I got to AIMS I came with the mind that I was going to go into banking," he recalls. Working as a quantitative analyst in a bank was the logical step after graduation. "I had to convince people that I should do a masters degree," he says. "My peers wondered what I was doing: I was expected to be just getting a big job." Chibawara is applying for PhD positions in epidemiology and working as an academic coordinator on the Next Einstein initiative.

Three hundred and five students from more than 30 countries have graduated from AIMS. One, Zakariya Mohamed, heads the statistical department at the University of Khartoum. The institute produced Lesotho's first cosmologist. Its alumni are modelling the movement of disease vectors in East Africa, working in nuclear physics and writing financial models in London – and they are talking to each other.

Donors are coming on board. The Canadian government has stumped up to expand the programme, and Turok has had encouraging conversations with the UK's Department for International Development about supporting another five centres, with Benin – which tends to win African maths Olympiads at school level – and even newly independent South Sudan on the list of potential sites.

The programme has demonstrated a sense of momentum and mission. As Kristina Eriksson, the Swedish physical chemist who will head up AIMS Ghana, says, there have been initiatives before, but they have lacked the financial, political and academic support that AIMS has had.

Could Turok's approach challenge traditional models of dependence? "We can run away from the idea that we have to wait for people to come and help us, we can do it ourselves. By Next Einstein, this is what we mean," Chibawara says. "Let African minds get out there and make them be relevant, contribute to the scientific world. Or let it be politics, let it be economics, let it be the development of young minds. Let it be entrepreneurship. Let us give them hope that they can do it."

Zeleke, who is returning to Ethiopia to help teach a course at the Dire Dawa university, agrees. "AIMS opened my eyes to new ways of looking at Africa's problems," she says. Politics is getting in the way, so science, she hopes, will give new solutions. "There are people who think we are genetically not designed to do maths and physics," she says. "It's not only Africa that needs science. Science itself needs input from Africa."

*Pete Guest is a freelance writer and former editor of* This is Africa *magazine*

## TUROK'S STRATEGY

**01 / A HOUSE OF LEARNING**
At all AIMS locations, professors and students live together on a campus. The goal is to foster an informal community where learning extends beyond the classroom.

**02 / BEYOND BOOKS**
The programmes do not feature set texts or syllabi. Instead, students tailor the curriculum to their own interests. If they need a specific tool they are taught enough code to build it themselves.

**03 / EXAM-FREE**
All evaluation is project-based. Students take a series of seminars, culminating in problem-solving projects. The results are presented orally, as with a PhD viva. Internal and external assessors give marks.

**04 / 24-HOUR EDUCATION**
Since assistants, teachers and students are co-located, their interactions spark impromptu conversations that turn into informal classes. Students are able – and encouraged to – approach professors at any time.

**05 / INTERDISCIPLINARY**
Students take a non-linear route through AIMS. Most come in with an aptitude for one discipline, but leave with expertise in a different one. This allows them to combine scientific knowledge in multiple areas.

HERE


THE

# DRONE

WITH CHEAP SENSORS, OFF-THE-SHELF PARTS AND FREE SOFTWARE,

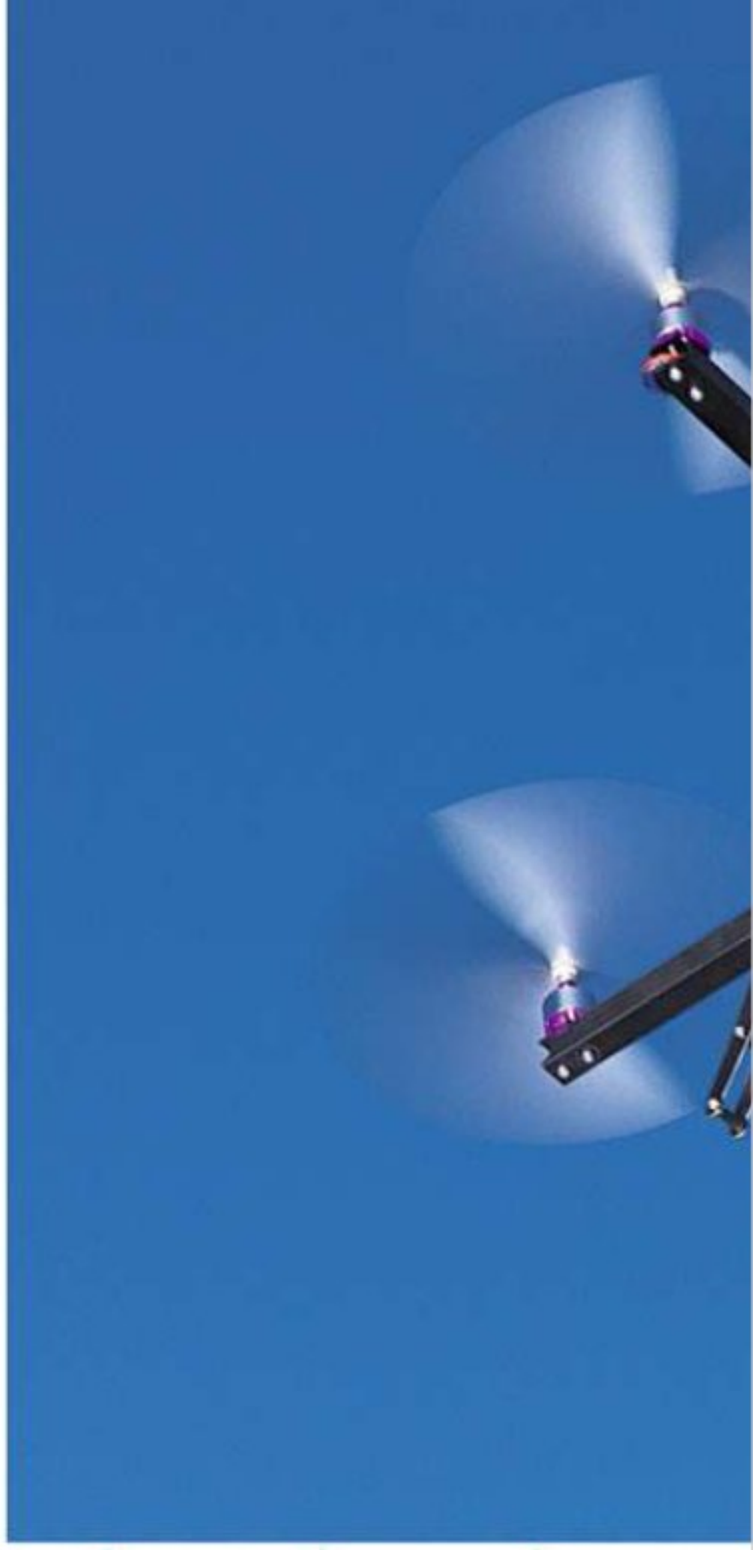
# COME

# YES!

NOW ANYONE CAN HAVE A PERSONAL FLYING ROBOT

BY CHRIS ANDERSON **Photograph: Dan Forbes**

# AT LAST YEAR'S PARIS AIR SHOW,



**some of the hottest aircraft were the autonomous unmanned** helicopters – a few of them small enough to carry in one hand – that would allow military buyers to put a camera in the sky anywhere, any time. Manufactured by major defence contractors, and ranging in design from a single-bladed camcopter to four-bladed multicopters, these drones were being sold as the future of warfare at prices in the tens to hundreds of thousands of dollars.

In May, at a different trade show, similar aircraft were once again the most buzzed-about items on display. But this wasn't another exhibition of military hardware; instead, it was the Hobby Expo China in Beijing, where Chinese manufacturers demo their newest and coolest toys. Companies such as Shenzhen-based DJI Innovations are selling drones with the same capability as the military ones, sometimes for less than $1,000 (£650). These Chinese firms, in turn, are competing with even cheaper drones created by amateurs around the world, who share their designs for free in communities online. It's safe to say that drones are the first technology in history which has the toy industry and hobbyists beating the military-industrial complex at its own game.

Look to the skies today and you might just see one of these drones: small, fully autonomous and dirt-cheap. On any given weekend someone's probably flying a real-life drone not far from your own personal airspace. (They're the ones looking at their laptops instead of their planes.) These drones can do everything the military ones can, aside from blow up stuff. In the UK, the Civil Aviation Authority (CAA) states that drones can be flown without a pilot's licence so long as they weigh less than seven kilograms, stay below 122 metres and within visual line of sight, and are flown away from populated areas and airports. Pilots must also be able to take manual control when necessary.

What are all these amateurs doing with their drones? Like the early personal computers, the main use at this point is experimentation – simple, geeky fun. But as personal drones become more sophisticated and reliable, practical applications are emerging. The film industry is already full of remotely piloted copters serving as camera platforms, with a longer reach than booms as well as cheaper and safer operations than manned helicopters. Some farmers now use drones for crop management, creating aerial maps to optimise water and fertiliser distribution. And there are countless scientific uses for drones, from watching algal blooms in the ocean to low-altitude measurement of the solar reflectivity of the Amazon rainforest. Others are using the craft for wildlife management, tracking endangered species and quietly mapping out nesting areas that are in need of protection.

To give a sense of the scale of the personal drone movement, DIY Drones – an online community that I founded in 2007 (more on that later) – has 26,000 members, who fly drones that they either assemble themselves or buy premade from dozens of companies that serve the amateur market. All told, there are probably around 1,000 new personal drones that take to the sky every month (3D Robotics, a company I cofounded, is shipping more than 100 ArduPilot Megas a week); that figure rivals the drone sales of the world's top aerospace companies (in units, of course, not dollars). And the personal-drone industry is growing much faster.

**A THOUSAND NEW PERSONAL DRONES TAKE FLIGHT EACH MONTH, RIVALLING THE PACE OF MILITARY SALES**

Why? The reason is the same as with every other digital technology: a Moore's-law-style pace where performance regularly doubles while size and price plummet. In fact, the Moore's law of drone technology is currently accelerating, thanks to the smartphone industry, which relies on the same components – sensors, optics, batteries and embedded processors – all of them growing smaller and faster each year. Just as the 1970s brought the birth and rise of the personal computer, this decade will bring the ascendance of the personal drone. We're entering the Drone Age.

**What exactly do we mean by drone? The definition has changed** over the years, but today it refers to aircraft that have the capability of autonomous flight, which means they can follow a mission from point to point (typically guided by GPS, but soon this will also be possible through vision and other sensors). This differentiates them, on the one hand, from radio-controlled aircraft, which need to be manually piloted, and on the other from uncontrolled vehicles such as balloons or ballistic rockets. Usually, drones – also known as unmanned aerial vehicles (UAV) or unmanned aerial systems (UAS), to include the ground-station components – also carry some sort of payload, which at a bare minimum includes cameras or other sensors, as well as some method to transmit data wirelessly back to a base station.

That definition fits a $140 million Global Hawk drone, circling over Afghanistan and transmitting video to US Air Force intelligence analysts in California. But it also describes the $500 foam plane that my children fly at weekends. Both have sophisticated computer autopilots, high-resolution cameras (we're partial to GoPros), wireless data connections for video and telemetry, ground stations with heads-up displays and real-time video (my children were disappointed at a recent tour of the Oshkosh air show to see that today's military drone pilots have worse ground stations than

PHOTOGRPAPHY: MISHA GRAVENOR. ILLUSTRATIONS: +ISM

they do), step-by-step mission scripting, and the capability to play back footage of the mission in full. The main difference between the two drones is that the Global Hawk can fly at 18,300 metres for 32 hours and our craft can fly at 122 metres for 30 minutes. (What we lack in high-altitude optics we make up in proximity: we can easily read licence plates from the air.)

The key ingredient in a drone is the autopilot, a technology that first came into use as a flying aid in the 1930s. Initially, all that autopilots did was keep the aircraft level. A combination of a barometric-pressure meter, a compass and mechanical gyroscopes (motorised flywheels with analogue electrical outputs) allowed a pilot to set

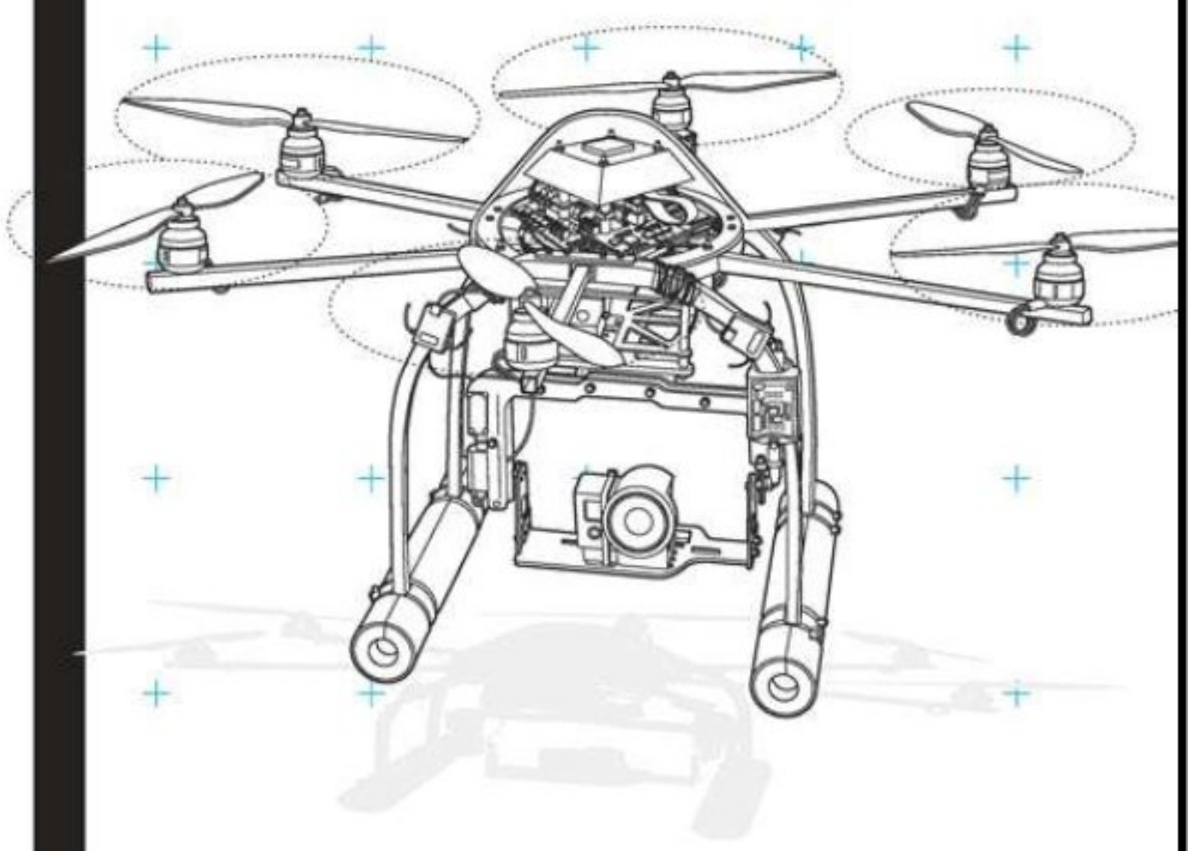
# 5 DRONES AT WORK

*by Noah Shachtman*

**1** USE
**INSPECTING OIL EQUIPMENT**

| DRONE | PILOT |
| --- | --- |
| Drone Aeryon scout quad-rotor minidrone | Greg Walker |

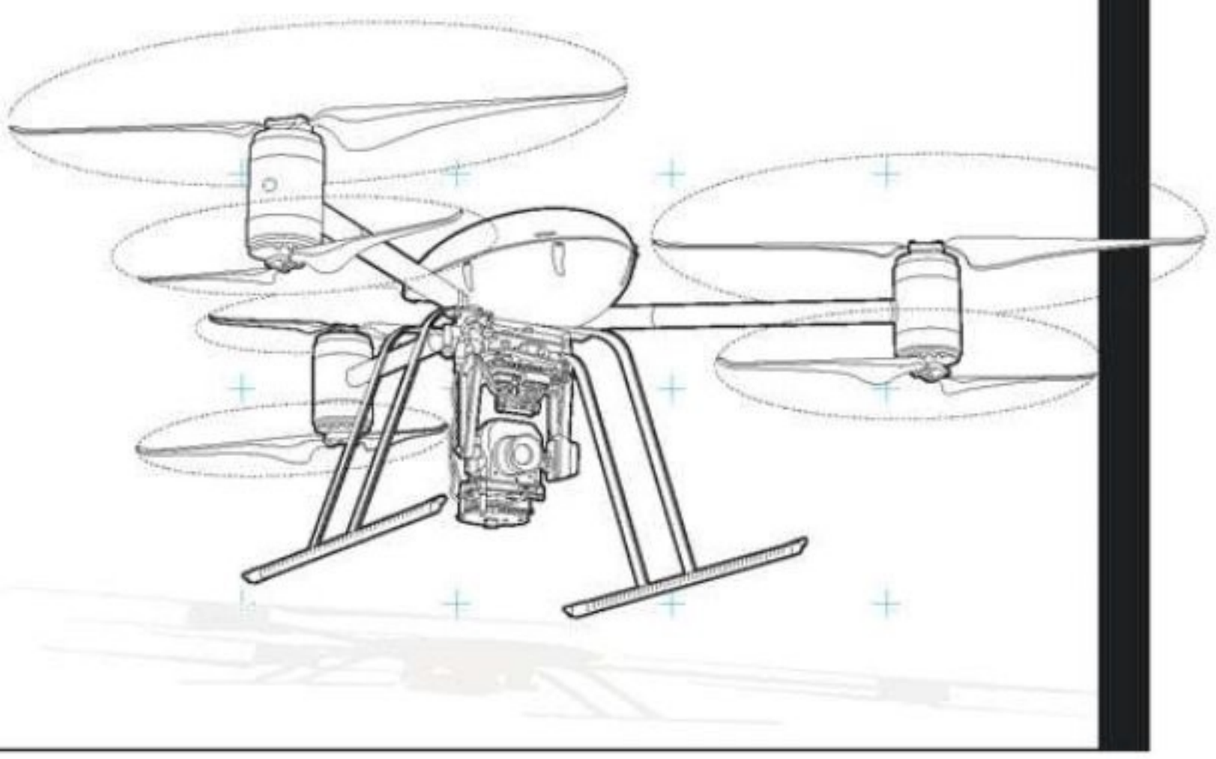
**In the oil-rich fields of Alaska's North Slope, gas flares burn constantly, occasionally bursting into fireballs two storeys high. It's a safety feature of BP's operation: burning off excess gas from drilling. Unless the facility is shut down – which costs BP millions – carrying out a detailed examination of those nozzles is impossible, which is why the operation is inspected once a year at most. At least, that was true until November 2011. As an experiment, BP brought in Greg Walker to fly a one-kilogram Aeryon Scout quadrotor drone to examine the flares between inspections. With the Scout, Walker – manager of the Poker Flat Research Range for the University of Alaska Fairbanks – was able to spot a crack in one of the nozzles while it was still burning. Doing the repair required a shutdown, but BP was able to speed up the process and save money by ordering the parts ahead of time.**



**2** USE
**POLICE RECONNAISSANCE**

| DRONE | PILOT |
| --- | --- |
| Draganfly robotic rotorcraft | Ben Miller |

**The New York Police Department already has manned surveillance helicopters that can see clear across the city, but drones are better suited to rural terrain. The town of Mesa, Colorado, for example, has a fleet of two self-flying craft. One is a miniature plane made by Falcon, the other an even smaller quadrotor drone made by Draganfly. "There's nothing they do that manned aircraft couldn't," says Ben Miller, the sheriff's department civilian who oversees the programme. "We just can't afford manned aircraft." Miller's most notable mission came in June 2011, when the quadcopter helped search through dense woodland for a stabbing suspect; it turned out the man was in hospital. Since then things have been pretty slow. Layoffs have led to the remaining officers being so overworked they haven't had time to break out the surveillance drones. It's hard to be Big Brother on a small budget.**



a heading and altitude and have a nap, knowing that the aircraft would continue to fly straight ahead until told otherwise. Starting with commercial planes, pilots could set waypoints and the autopilot would fly an entire route. By the early 90s, the whole flight could be automated, including takeoff and landing.

Today, all the sensors required to make a functioning autopilot have become radically smaller and cheaper. Gyroscopes, which measure rates of rotation; magnetometers, which function as digital compasses; pressure sensors, which measure atmospheric pressure to calculate altitude; accelerometers, to measure the force of gravity – all the capabilities of these technologies are now embedded in tiny chips that you can buy at Maplin. Indeed, some of the newest sensors combine three-axis accelerometers, gyros and magnetometers (nine sensors in all), plus a temperature gauge and a processor, into one little package that costs about £11.

Meanwhile, the brain of an autopilot – the "embedded computer", or single-chip microprocessor, that steers the plane based on input from all the sensors – has undergone an even more impressive transformation, thanks to the rise of the smartphone. Once Apple's iPhone showed that fluid and fast visual interfaces on touchscreens were what people wanted, the same demand for computational power that kicked in with the graphical user interface of desktop computers came to phones. But unlike the desktop, these mini supercomputers also needed to use as little power as possible. The result was a shift to the hyper-efficient "reduced instruction set computing" architectures – led by British chip designer ARM, which now dominates the single-chip industry – driving the performance gains of our smartphones and tablets. As it turns out, these chips are also perfect for drones: fast and power-efficient processors mean that they can go beyond simply following a preprogrammed mission and start to think for themselves.

The smartphone-drone connection goes far beyond the processors. These days, a standard smartphone has a full suite of sophisticated inertial sensors to detect its position, a feature that's integrated into everything from games to maps and augmented reality. The demand for higher-quality cameras in phones has launched a similar revolution in image-capture chips, which have also found use in drones. The need for smaller, better GPS in phones has brought the same technology to drones, too, such that GPS performance that cost tens of thousands of pounds in the 1990s can be had for as little as £6 in a thumbnail-sized device. The same goes for components such as wireless radio modules, memory and batteries.

In short, this new generation of cheap, small drones is essentially a fleet of flying smartphones. More and more, autopilot electronics look just like smartphone electronics, simply running different software. The technical and economic advantages of coat-tailing on the economies of scale of the trillion-dollar mobile-phone industry are astounding. If you want to understand why the personal-drone revolution is happening now, look no further than your pocket.

**Every industry has its garage-creation** myth. Here's mine, on the start of the personal-drone movement. One sunny Friday afternoon in March 2007, I started to plan what would hopefully be a deliciously geeky weekend with the children. In the usual stack of products that had come into the WIRED offices that day to be reviewed, there were two that seemed especially promising: a robotics kit and a ready-to-fly radio-control airplane. The schedule was settled: we would build robots on Saturday and fly planes on Sunday. Awesomeness would surely ensue. By mid-morning on Saturday, things were already going wrong. The children were happy enough to open the robotics kit (from Lego's Mindstorms line) and assemble the starter bot, a three-wheeled rover. But once we powered it up, they could barely hide their disappointment. Hollywood, it turns out, has ruined robotics for kids, who now expect laser-armed humanoid machines that also transform into trucks. Back in the real world, after an hour of assembly and programming, the rover could only roll forward and bounce feebly off a wall. Online, we could see that hobbyists were doing amaz-

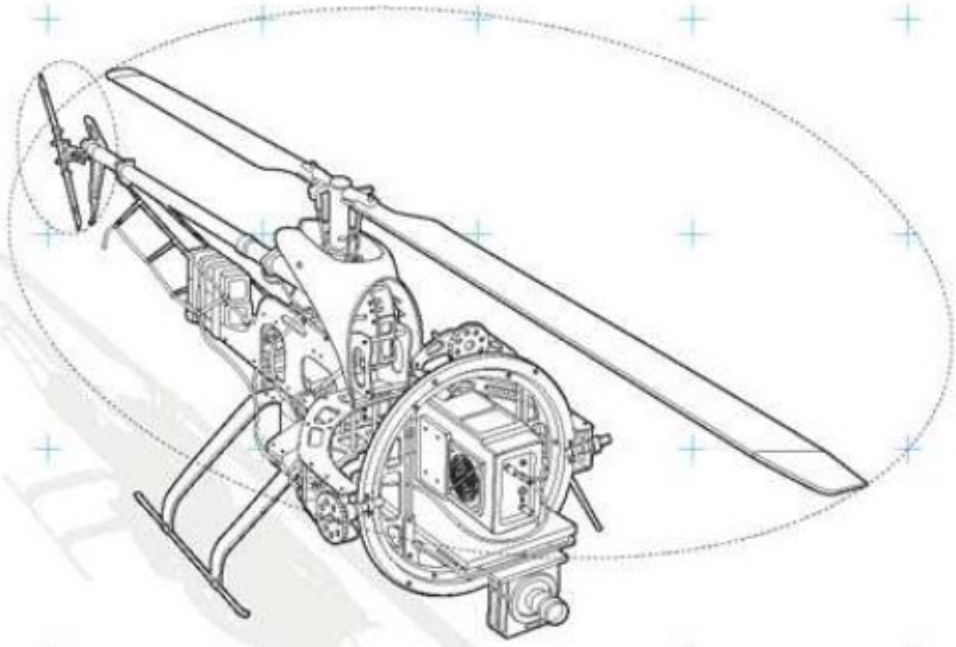
Employees assemble drones at 3D Robotics's San Diego plant

## THE SENSORS NEEDED TO MAKE AN AUTOPILOT ARE NOW RADICALLY SMALLER AND CHEAPER

ing things with Mindstorms: robotic Rubik's Cube solvers, working photocopiers and more. We wanted to invent something like that, but it was impossible to see how. The children lost interest after lunch.

OK, but at least we still had the plane. On Sunday, we took it to a park, where I promptly piloted it into a tree. The children just looked at me, appalled not merely by my lack of ability but also by the yawning gap between the promised coolness of the plane itself and the actual experience of flying it. I threw sticks at the plane to try to dislodge it from the tree as my mortified children pretended not to know me. My geekdad weekend was an utter failure. I was annoyed with myself for getting it so wrong and annoyed with my family for being so unappreciative.

Later, I started thinking about the Mindstorms' impressive range of sensors. There were accelerometers ("tilt sensors"),



**3** **USE**
**AERIAL FILMING**

**DRONE**
Custom-built helicams

**PILOT**
David Quinones

**David Quinones runs the aerial photography company SkyCamUSA, which specialises in helicopter and plane shoots for commercials and Hollywood films. For several years he also used drones. They could fly inside tunnels or close to structures that no chopper could manage. For a Johnny Walker advert, Quinones used a 1.2-metre custom-built helicopter to take the viewer from the centre-field stands of Yankee stadium all the way down to home plate. Then, in May 2011, the California Film Commission, citing US federal regulations, stopped issuing permits for drones. For a time, estate agents hired his drones to highlight luxury estates. "The best way to see these properties is from the air," Quinones says. "But the aerial views suck from a regular aeroplane. You can only get so low and slow down so much." Drones provided a solution, until that business too was grounded by authorities.**

electronic gyroscopes, a compass and a Bluetooth link that could connect to a wireless GPS sensor. Those were exactly the same sensors you'd need to make an aeroplane autopilot. We could solve both problems at once: build something cool with Mindstorms that had never been done before and get the robot to fly the plane! It was sure to be a better pilot than me. Back at home I prototyped a Lego autopilot on the dining-room table, and my nine-year-old helped write the software. We took some pictures, posted them, and the project was on the front page of Slashdot by that evening. We put it in a plane – the world's first Lego drone, I think – and took it out a few weekends later. It almost-kinda worked, staying aloft and steering on its own, albeit not always to the places we told it to go.

With a few weeks more of tinkering, I developed a Lego autopilot that had most of the functionality of a professional device, if not the performance. But it became clear that Mindstorms, for all its charms, was too big and expensive to serve as the ideal platform for creating homemade drones. Looking for a better way took my search for answers online and in public, sharing what I'd done and found. Instead of setting up a blog, I registered DIYDrones.com and established a social network for people who were experimenting with autonomous aircraft.

That distinction – a site created as a community, not a one-man news site like a blog – turned out to make all the difference. Like all good social networks, every participant – not just the creator – has access to the full range of authoring tools. Along with the usual commenting, they can compose their own blog posts, start discussions, upload videos and pictures, create profile pages and send messages. Community members can be made moderators, encouraging good behaviour and discouraging bad. Open to anyone who chose to participate, the site was soon full of people trading ideas and reports of their own projects and research.

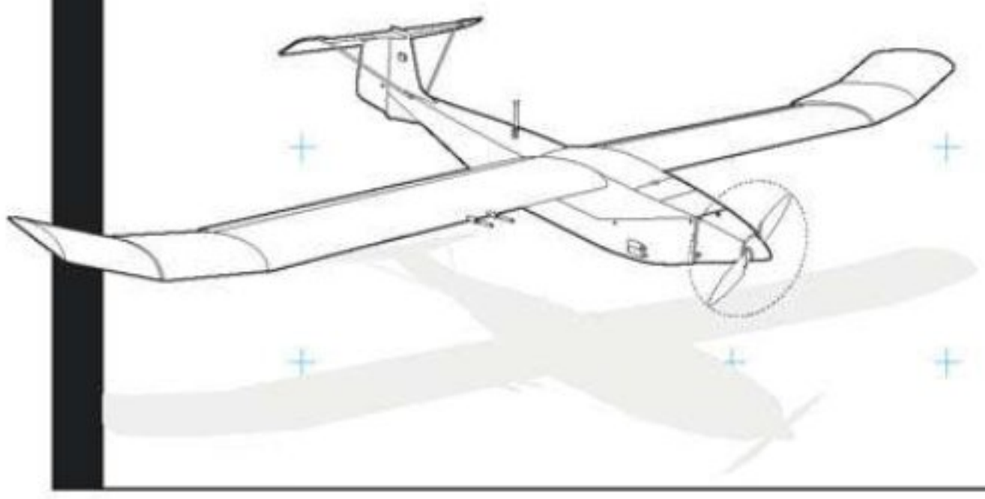
Initially, members would just post code and design files for their own projects, showing off for each other in a form of nerd

**4** USE
**CHECKING CROPS**

**DRONE**
Hand-built miniplane

**PILOT**
Robert Blair

**In 2004, Idaho farmer Robert Blair wanted to see his wheat and legume fields from above. His 600-hectare spread is on rough terrain and the only way to catch the subtle changes in his chickpea or winter wheat crops is from the air. He paid $9,000 to rent a Cessna to take pictures, but it took three weeks to get the images back. Frustrated, Blair built his own 1.5-metre self-flying plane. "It allows you to cover every square centimetre of field instead of cutting these random paths," he says. During peak growing season Blair sends his 4.5-kilogram drone on a mission every week or two. The images help him decide when to spray for weeds and which wheat fields are looking nitrogen-deprived and in need of fertiliser. And he never has to wait for the photos.**

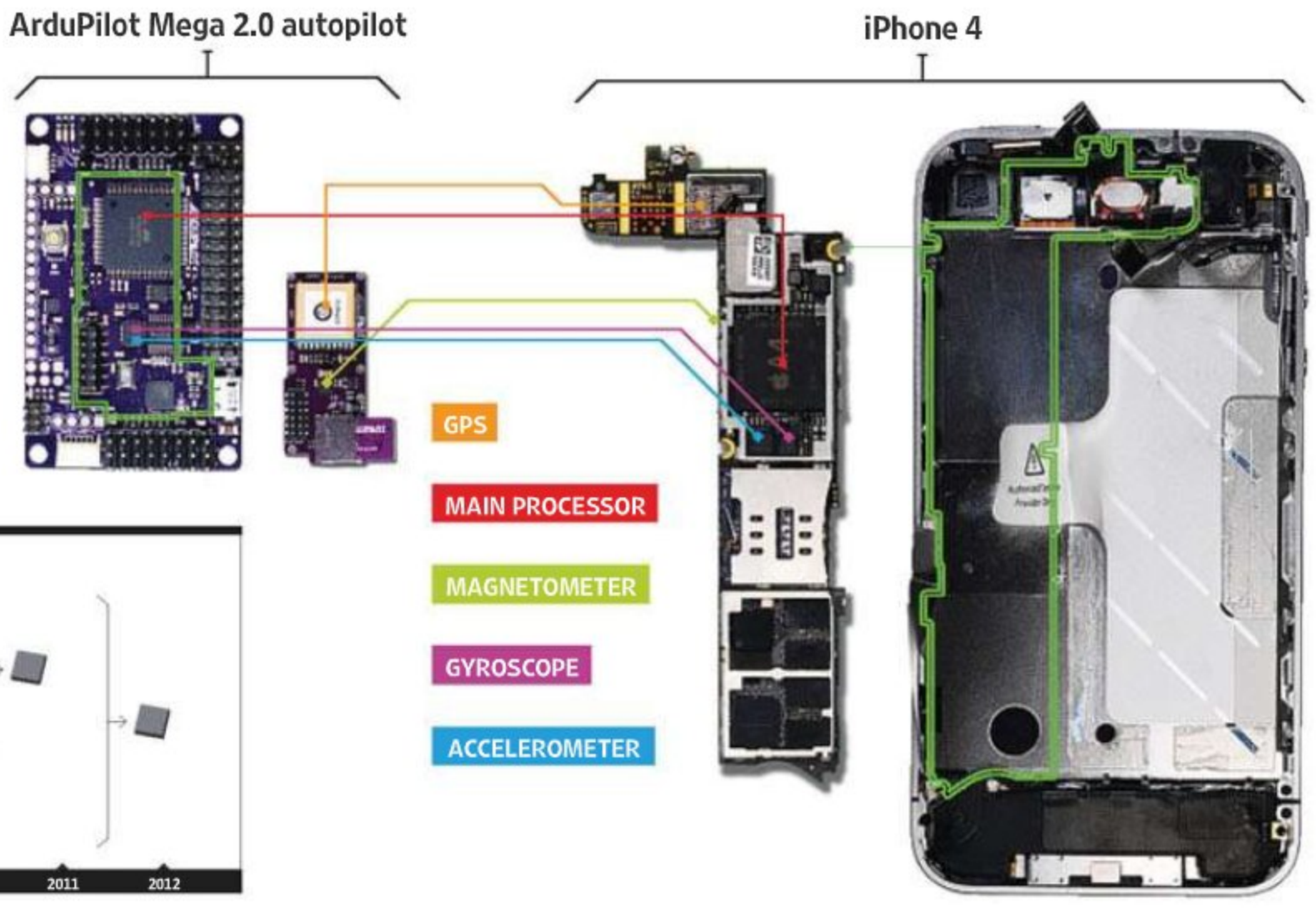


# THE FLYING SMARTPHONE

**Today's personal drones benefit from the same advances that make the iPhone so powerful**

## LESS IS MORE

**It takes three kinds of sensors – each recording data in three dimensions – to gauge an aircraft's orientation. In recent years, the number of components needed has shrunk from six chips costing around £40 to a single £11 chip.**

braggadocio. But over time we set up more organised systems of collaboration, including version control systems and file repositories, wikis, mailing lists and formal team assignments. We were blown away by what people were doing with sensors from mobile phones and chips that cost less than a cup of coffee. Feature by feature, they were matching – or besting – aerospace electronics that had cost tens or hundreds of thousands of pounds just a decade earlier. It felt like the future of aviation: just as the PC emerged from the Homebrew Computer Club hobbyists and eventually overturned mainframe-based corporate computing in the 1980s, it became clear that the same sort of movement would bring robots to the skies. It's become not just a hobby but a second career: I cofounded a company, 3D Robotics, to make the open-source hardware that the DIY Drones community was designing, and we've already shipped more than 10,000 autopilots and countless other drone parts. By our estimates, 3D Robotics' customers alone are flying more drones than the total number operated by the US military (7,494 today, according to a recent congressional report). And there are dozens of other companies making drone technology for the "hobby" market, including Hoverfly, DJI Innovations, Mikro-Kopter, Droidworx and uThere.

But really, it's great exploring the boundaries of what's possible with the technology. This summer I'm planning to tinker with the ultimate "personal droid" idea: an autonomous plane that can film your own activities at the press of a button. For example, if you're into extreme sports, such as kite surfing, you're always looking for better ways to document your exploits. The best vantage point to do this from is the air, about ten metres above and behind you. That's a perfect job for a drone. Just imagine if you could touch a button on your iPhone or Android phone, and it would summon a quadcopter to position itself above you, keeping its camera on you as you perform your stunts then flying back to shore when its batteries got low. We've already assembled a module that contains a GPS sensor to record your position and a wireless module to communicate with the drone; porting it to a waterproofed smartphone is the next step. Your personal cameradroid awaits!

**5** USE
**SURVEYING WILDLIFE**

**DRONE**
HexaKopter

**PILOT**
Phil Groves

**On August 31, 2010, two Idaho Fish and Game scientists took off from Clarkston, Washington, and flew west, looking out of their open doors for nests of threatened salmon. One of the biologists' clipboards broke free and hit the tail rotor. The helicopter plunged into a street, killing all on board.**

**That December, Phil Groves persuaded his bosses to buy two drones from Mikrokopter. In autumn 2011, he took the craft to the Snake River. Through the HexaKopter's lens the salmon nests were clear. Unfortunately, US regulators heard about the experiments and grounded the drones.**

**Drones in pop culture have gained something of a bad** reputation. In novelist Daniel Suarez's new techno-thriller, *Kill Decision*, clouds of killer drones are programmed to swarm like weaver ants, and they attack everything from people to entire container ships. The gun-carrying quadcopters arrive by the thousands and hurl themselves at windows and walls until they break through, sacrificing themselves in countless numbers so that others of their kind can advance. They are entirely autonomous and make their own decisions about where to go and what to shoot. They are single-use, like ammunition, and mass-produced, like cheap mobile phones – a vision of drones as a disposable commodity modelled after insects, not planes.

There's no reason to believe that cheap drones will usher in a weaponised hellscape any more than the invention of helicopters did. Even on privacy issues, there are existing laws that cover most of the concerns people have about personal drones. But in its vision of flying robots that are mass-produced like cheap toys and smart enough to think for themselves, Suarez's fiction is closer to reality than most people think. Indeed, he was inspired not by military drones but by the Parrot AR.Drone, a quadcopter toy you can buy on Amazon and control with your smartphone, complete with dual cameras transmitting real-time video streams to your screen. Although it's not autonomous – you still have to fly it yourself – that's simply a matter of design choice. For less than £20, you can buy a little circuit board that can connect it to an autopilot.

People are already dreaming of what companies could do with drones over our lands, from playful speculations like the "Tacocopter", a meal-delivery service, to real game-changers such as FedEx fleets that use hyper-efficient aircraft designed from the start as drones. A switch to unmanned operation would transform the whole concept of air cargo: aircraft would be free of the design constraints – pressurised cabins, tube-shaped bodies – necessary to accommodate humans, and flocks of such drones could fly in a V-formation like birds to employ aerodynamic slipstreaming.

What we will do with our personal drones? That question is just as unanswerable – but just as tantalising – as the same question about personal computers back in 1977. When the Apple II came out, the answer was not much more than "Programme it!" But as people found uses for PCs in their own lives, they came up with better answers: word processors, spreadsheets, video games, email and, eventually, the web. Today we know what PCs are for, but it took the liberation of the technology to show us.

So too for personal drones. Remember, the military created the internet, but the people colonised it and created the web for their own purposes. The amateur UAV community is hoping to do the same with drones – demilitarise and democratise them so they can find their full potential. Of course, there will be good uses and bad ones, but the same is true of any tool, from a crowbar to an ultrasound machine. Ultimately the way society best figures out how to think about a powerful new technology is to set it free and watch where it flies.

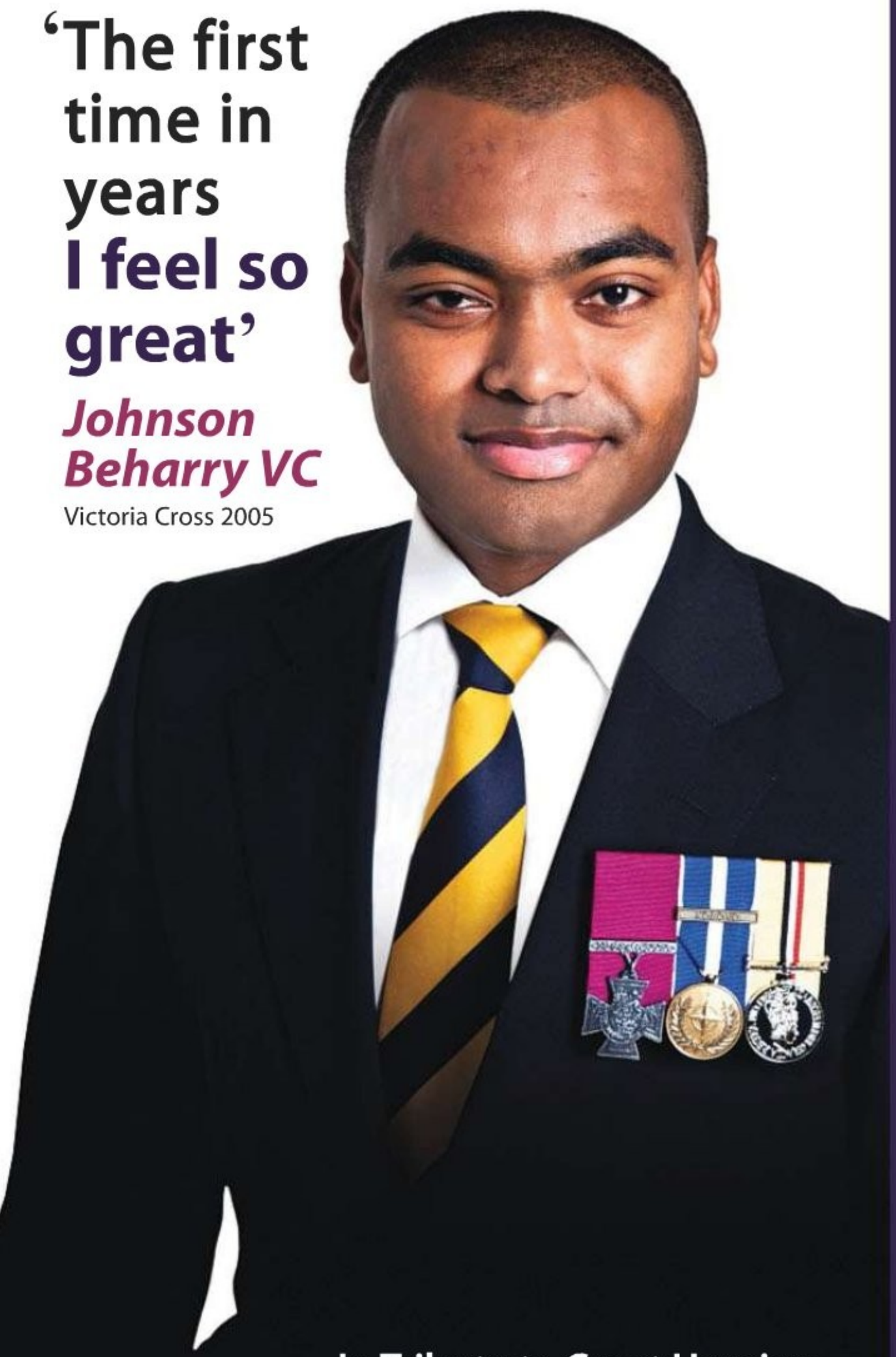
*Chris Anderson is editor in chief of US* WIRED. *He started DIY Drones (diydrones.com) and cofounded 3D Robotics*

SENSOR CHART SOURCE: INVENSENSE. SMARTPHONE ILLUSTRATION: GUS WEZEREK

# ‘The first time in years I feel so great’

## *Johnson Beharry VC*

Victoria Cross 2005



## In Tribute to Great Heroism

**Johnson Beharry is one of a distinguished few to receive the Victoria Cross, Britain’s highest award for gallantry and the ultimate symbol of sacrifice and courage.** Johnson Beharry carried out two individual acts of great heroism by which he saved the lives of his comrades... at great personal risk to himself (one leading to him sustaining very serious injuries). Beharry displayed repeated extreme gallantry and unquestioned valour.

VITABIOTICS
SCIENCE OF HEALTHY LIVING

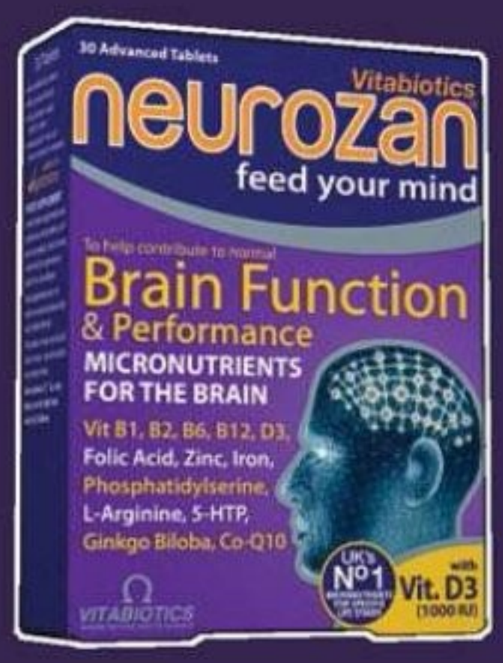
Vitabiotics supports TICKETS FOR TROOPS

BEHARRYMIXCONP 13-06-12

*‘I would like to express my gratitude to Vitabiotics for their supplements.* ***Neurozan®*** *has helped to maintain my brain function, and* ***Wellman®*** *has really helped to maintain my overall health, vitality and performance. I even managed to compete in the highly strenuous* **Dancing on Ice** *due to the help from Vitabiotics.’*

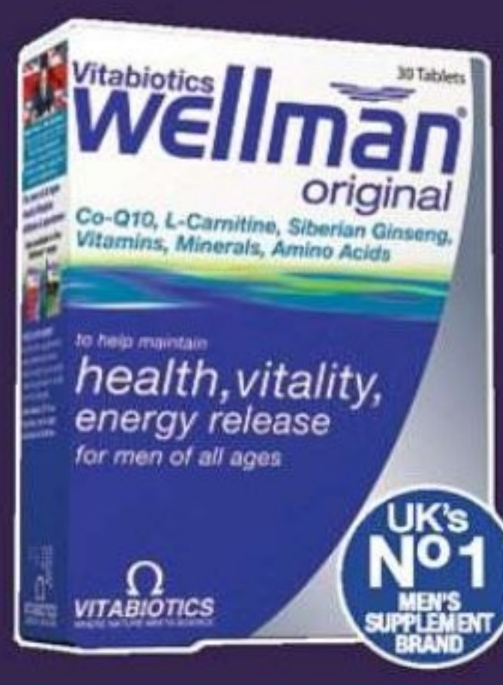
J Beharry VC

**Johnson Beharry VC**




### Neurozan® tablets

Neurozan® is an advanced micronutrient formula with specific nutrients to help contribute to normal brain and neurological function.




### Wellman® tablets

Wellman® is an expertly formulated, award-winning micronutrient supplement, tailored to help support specific male nutritional requirements.

Available from Boots

40 YEARS

Britain's leading supplements for specific life stages

***From*** **Boots, Superdrug, supermarkets, Holland & Barrett, Lloydspharmacy, chemists, GNC, health stores & www.vitabiotics.com**

Vitamin supplements may benefit those with nutritionally inadequate diets.

# TEST

LAB RESULTS
THIS MONTH: 08.12
- COMMUTER BIKES
- FAST BLENDERS
- SOLAR CHARGERS

EDITED BY
JIM HILL

The Blendtec Total uses a 1,560-Watt direct-drive motor to pulverise food

# WIRED'S SPECIAL BLEND

Chefs, start your engines: we pulp the data on top kitchen blenders

PHOTOGRAPHY: SUN LEE

# BIG CITY WHEELS

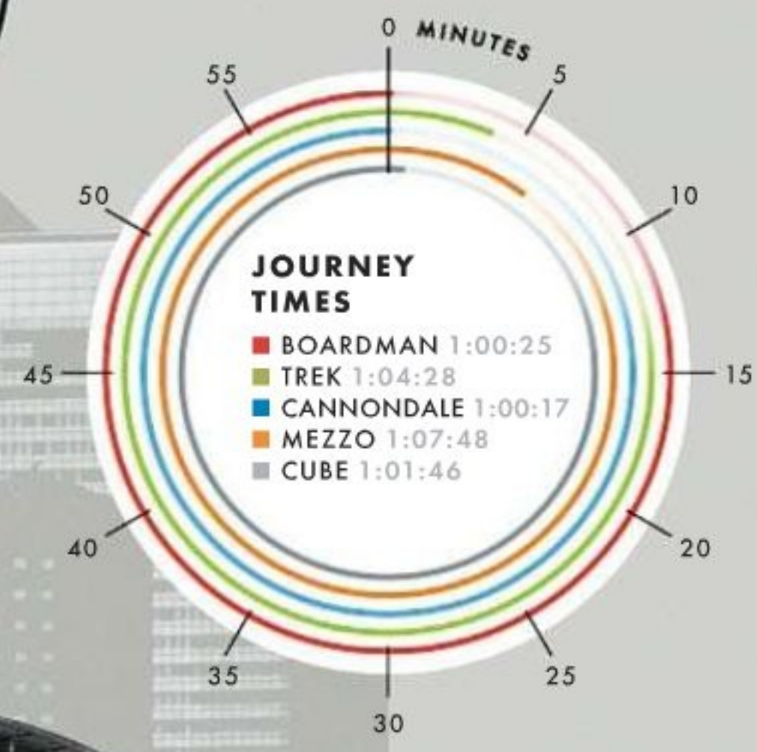
## Bikes built for commuters take the WIRED road-test

### BOARDMAN HYBRID PRO

Purpose-made for commuters, this bike is light and fast, with skinny road-tyres and a carbon fork. Easy-steer flat bars, all-weather hydraulic disc brakes and mounts for a rack and mudguards make for a comprehensive package. In riding, the Hybrid Pro was at its best on long straights and weaving in and out of traffic. It was ultimately so light that it became slightly jittery over steep speed bumps, potholes and gravel – but not so much that it felt too dangerous to ride.

**WIRED** All-round performer
**TIRED** Arguably too light

*£999.99 halfords.com*



## THE CYCLE HYPE

| | BOARDMAN | TREK | CANNONDALE | MEZZO | CUBE |
|---|---|---|---|---|---|
| GEARING | 2 X 10 (MICROSHIFT/ SRAM RIVAL) | SINGLE SPEED | 2 X 10 SHIMANO 105 | 1 X 9 SHIMANO TIAGRA | 3 X 9 (SHIMANO DEORE) |
| BRAKES | HYDRAULIC DISC (AVID ELIXIR 5) | CALLIPERS | CANTILEVERS | CALLIPERS | HYDRAULIC DISC (SHIMANO 445) |
| WEIGHT (W/ OUT PEDALS) | 9.5kg | 9.7kg | 9.6kg | 10.7kg | 18.9kg |
| WEIGHT (W/ OUT PEDALS) | 66cm | 66cm | 66cm | 40cm | 66cm |
| FRAME/FORK MATERIAL | ALUMINIUM/ CARBON | ALUMINIUM/ CARBON | ALUMINIUM/ CARBON | ALUMINIUM | ALUMINIUM |

### HOW WE RATE

**1.** A complete failure in every way
**2.** Barely functional – don't buy it
**3.** Serious flaws – buy with caution
**4.** Downsides outweigh upsides
**5.** Recommended with reservations
**6.** A solid product with some issues
**7.** Very good, but not quite great
**8.** Excellent with only a few niggles
**9.** Nearly flawless – buy it now
**10.** Metaphysical product perfection

### MEZZO D9 CURVE

The Mezzo D9 cycle folds into a compact unit – useful on our tightly packed train, and with less ankle-bashing than most standard folders. Unfolded, it coped well with gravel and speed humps, and had enough gears for hill climbs. However, it's clearly not designed for sprints out of the saddle, and it was the hardest bike to ride the full distance. That said, it was the best bike for weaving in and out of traffic in the city centre.
**WIRED:** Small fold
**TIRED:** Tiring to ride

*£825 mezzobikes.com*

### TREK DISTRICT

Single-speeds, as well as being achingly hip, are also very low maintenance. The District takes that one step further by replacing the traditional chain with a carbon-fibre composite belt. Theoretically stronger and more durable than metal links, they're also oil-free and silent. Here, the belt comes strapped to a retro-style flat-barred hybrid. The bike weaves well in traffic and is solid enough to tackle canal paths, cobbles and potholes. If you choose to ride it fixie, you can't coast on flat terrain, though.
**WIRED:** Low maintenance
**TIRED:** Maybe too knowingly retro

*£700 trekbikes.com*

### CANNONDALE CAADX 5 105

Built primarily for cyclocross racing, the lightweight CAADX 5 offers plenty for commuters, such as drop bars, rack and mudguard mounts, and strong brakes. The CAADX 5 was (just) the fastest bike on test, but could be even quicker if you added slick road tyres. However, the semi-knobbly cyclocross tyres it comes with are ideal for cycling alongside canals and over cobbles.
**WIRED:** Versatility
**TIRED:** Comparatively rather expensive

*£1,100 cannondale.com*

### HOW WE TESTED

We rode a 23km urban route, (including a 3km train leg for the foldable Mezzo) at identical peak times over a number of days. We noted speed, handling, and suitability. Most of the bikes qualify for the government's Cycle to Work scheme, which has a ceiling of £1,000 per bike.

### CUBE EPO FE

This "pedelec" bike uses a 250W motor to bring you up to a top speed of 24kph – as long as you're also pedalling. It's ideal for those not able to do their whole commute under their own leg power, but it means this is a heavy bike. The overly wide handlebars enhance your riding confidence, but are poor for weaving in and out of traffic. On the plus side, dynamo lights and security locks for wheel- and seat-skewers are very commuter-friendly.
**WIRED:** Large range
**TIRED:** Heavy

*£2,699 cube.eu*

PHOTOGRAPHY: SUN LEE; DAVE LIDWELL. WORDS: SIMON MUNK

## IN THE MIX

| | KENWOOD | BLENDTEC | PHILIPS | KITCHENAID | AEG |
|---|---|---|---|---|---|
| SOUP PURÉE | 18 secs | 12 secs | 10 secs | 15 secs | 20 secs |
| ICE CRUSHING | 7 secs | 10.2 secs | 8 secs | 13.4 secs | 15 secs |
| NET WEIGHT | 4.5kg | 3.5kg | 4.4kg | 4.5kg | 4kg |
| POWER | 800W | 1,560W | 750W | 550W | 600W |
| JUG CAPACITY | 1.6l | 1.9l | 2l | 1.5l | 1.5l |

### KENWOOD KMIX BLX51

The sleekest model on test, the compact Kmix blender is made from cast aluminium and feels attractively smooth in its bright raspberry finish. It has an ample 1.6l glass "goblet" and four highlighted settings for a host of jobs. We used the "liquids" setting for the soup test and, although it wasn't the fastest model, it was one of the quietest. The unit also comes with eight recipe cards.

**WIRED** Quality finish
**TIRED** Stiff lid

*£98.99*
*deluxeproduct.com*

### BLENDTEC TOTAL

This powerful blender has an LCD display, but its settings are still hard to navigate. It shows the time remaining per blend cycle and has a giddying array of presets for everything from smoothies to food processing. There are also ten speed-settings – useful for chefs who like a bit more control. However, the plastic jug and base feel very flimsy – considering the hefty price tag, that's a big failing.

**WIRED** Super fast
**TIRED** Super noisy

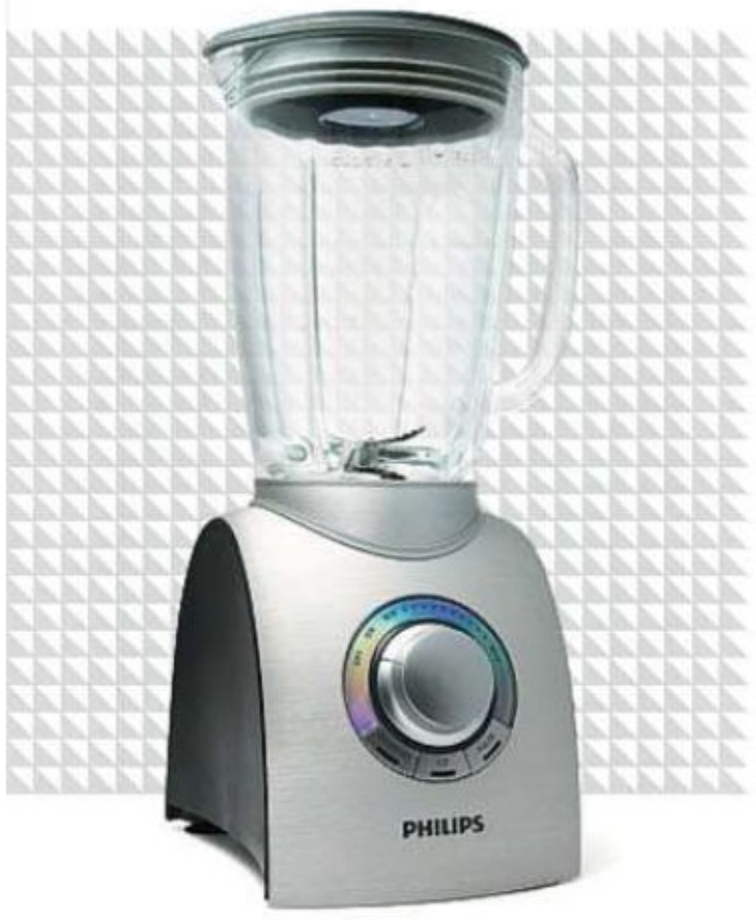
*£455 juiceland.co.uk*

### PHILIPS HR2094 ALUMINIUM

Philips's model uses a variable illuminated dial, so you can set the speed easily. The stylish mark-proof aluminium finish also impressed, as did the "smoothie", "ice-crushing" and "pulse" shortcut functions. The soup test was surprisingly clean and quick on maximum speed – aided by its serrated blades. The HR2094 also comes with a fruit filter for making clear juice without seeds, pips or pulp, and includes a *Jason Vale: Juice Master* recipe booklet, which details his range of juice and smoothie recipes.

**WIRED** Attractive illuminated design
**TIRED** Additional jug would be useful

*£79.95 johnlewis.com*




### KITCHENAID ARTISAN

Available in 13 eye-catching finishes, the Artisan features a sturdy die-cast metal base. It has a large 1.5l glass pitcher with an easy-pouring mouth, as well as a 750ml culinary jar, ideal for single servings. We used the "purée" setting for the soup test, which it made short work of – though it was noisier than on its other settings. Crushing ice was also impressively speedy.

**WIRED** Compact form
**TIRED** Illustrated mode-indicators are confusing to interpret

*£159 kitchenaid.co.uk*

### HOW WE TESTED

Tester Emily Peck put the blenders through a series of chopping challenges. She recorded the time taken to reduce chunks of potato and ginger into 300ml of smooth purée for soup, and the time taken to pulverize ten ice-cubes. A sound-pressure level meter was used to measure each blender's engine volume when at the highest speed setting.

PHOTOGRAPHY: SUN LEE; DAVE LIDWELL WORDS: EMILY PECK

# MIX MASTERS

## WIRED discovers the perfect blend of form and function

### AEG POWERMIX SILENT SB4600-U

The jug clips on to the base securely, making this the sturdiest design in our test. It's also the quietest and most stable machine in the group. The soup was blended on the maximum setting and it was reassuring to see that the blender doesn't start unless the jug is locked in place. The "pulse" setting and the speed dial give you flexibility and the former can be used for ice crushing. As well as a 1.5l-capacity jug for blending, it comes with a fruit filter for smooth juice, a measuring cup and a separate mini-chopper.

**WIRED** Versatile tool

**TIRED** Ice-crushing function is not clearly highlighted

*£129 aeg.co.uk*

The AEG's variable power-control dial allows for more gradual mixing of your ingredients

### THE WIRED STRAWBERRY SMOOTHIE

BRAIN-FUEL BY JASON 'JUICE MASTER' VALE

**Peel and blend the following fruits. Core the apples and pour in a glass of apple juice to loosen the mixture.**

- **Two kiwi fruits**
- **One banana**
- **Four Golden Delicious apples**
- **12 strawberries**
- **300ml apple juice**

# POCKET POWER

## We go off-grid in Madagascar to test five portable solar chargers

**ETON RAPTOR**
Eton hasn't heard that less can be more. Its Raptor has a solar panel on one side; the other has AM/FM radio controls, an altimeter, a thermometer, a barometer, a compass, an LED flashlight and even a bottle-opener – none of which work very well. It requires a big charge just to run itself, let alone boost another device.
**WIRED** Feature-packed
**TIRED** Confusing to use

*£100 firebox.com*







Our intrepid tester, professor Jonathan Drori, endured hour after hour of bright Madagascan sunshine to bring us the results of this Test. It's a tough job...

## POWERMONKEY EXTREME

The Extreme has the largest solar panel of the group and comes in a sturdy zipped case. The external rechargeable battery is robust, and though a little heavy can easily charge an iPod or other devices with a standard, mini or micro USB port.

The rechargeable battery is a separate unit, so devices can be charged from this, or from the fold-out solar panel, which is tough and waterproof to one metre.

**WIRED** Superbly designed; dedicated high-power output for an iPad

**TIRED** Power output not compatible with 12v or 19v devices

*£120*
*thesolarcentre.co.uk*

## FREELOADER PRO

This solar charger quickly boosted our smartphone's battery by 24 per cent in just 30 minutes, and it comes with a useful and versatile adapter suitable for a wide range of batteries. The swivelling design looks good but tends to trap scratchy grit. The black case feels flimsy and gets painfully hot in direct sunlight – an oversight for a solar device.

**WIRED** Fast; useful multi-way adapter

**TIRED** Unit's battery must be fully charged before your device's

*£70*
*freeloaderpro.co.uk*

DAYLIGHT AND SUNLIGHT – UNITED KINGDOM

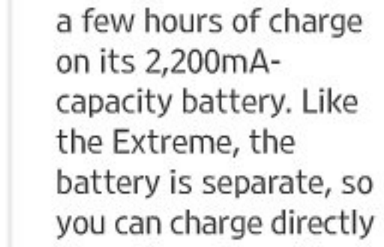

## FREELOADER CLASSIC

This sleek, compact charger has panels that unclip and plug into either side of its central battery. As with the Freeloader Pro, you first need to charge the battery before use – which took around six hours – before transferring that energy to your device. An LCD display provides information on battery-power level, power input and connectivity.

**WIRED** Compact; stores lots of energy

**TIRED** Slow to charge its internal battery

*£40*
*solartechnology.co.uk*



## POWERMONKEY EXPLORER

The Extreme's little sister has a smaller panel and battery, making it compact enough to fit in a trouser pocket. However, this means it takes longer to gather solar energy and it can store only a few hours of charge on its 2,200mA-capacity battery. Like the Extreme, the battery is separate, so you can charge directly from the solar cell.

**WIRED** Small, light, tough and cheap

**TIRED** Lacks the power of the Extreme

*£65*
*thesolarcentre.co.uk*

## HOW WE TESTED

Jonathan Drori (*left*), a trustee at the Royal Botanic Gardens in Kew, took five compact solar chargers with him on a seed-collecting expedition in Madagascar. He left each device out in the midday Madagascan Sun to recharge a fully run-down HTC One X smartphone and logged the time taken for the phone to reach full battery status. "It revealed big differences in their ability to convert light into useful energy," Drori says. He also assessed any included extra utilities, ease of use and portability.

### DATA HOTSPOTS

| | ETON RAPTOR | POWERMONKEY EXTREME | POWERMONKEY EXPLORER | FREELOADER PRO | FREELOADER CLASSIC |
|---|---|---|---|---|---|
| % CHARGE IN 30 MINS OF SUNLIGHT, WITHOUT INTERNAL BATTERY | 0* | 14% | 5% | 0* | 0* |
| % CHARGE IN 30 MINS OF SUNLIGHT, WITH FULLY CHARGED BATTERY | 13% | 24% | 14% | 14% | 24% |
| POWER DISPLAY READABLE IN DIRECT SUNLIGHT? | YES | YES | YES | YES | NO |
| WEIGHT (CHARGER + BATTERY) | 327g | 450g | 163g | 133g | 161g |
| WEIGHT (SOLAR PANEL ONLY – IF DETACHABLE) | N/A | 200g | 86g | N/A | N/A |

*Device wouldn't charge our smartphone without attempting to charge its internal battery first
**Totally discharged internal battery if present in 30 minutes of bright sunlight

PHOTOGRAPHY: SUN LEE. WORDS: JONATHAN DRORI

# THE COLOPHON


INSIDE CONDÉ NAST IN THE USA:
**The Condé Nast Publications Inc**
Chairman:
**S I Newhouse, Jr**
CEO:
**Charles H Townsend**
President:
**Robert A Sauerberg, Jr**
Editorial director:
**Thomas J Wallace**

IN OTHER COUNTRIES:
**Condé Nast International Ltd**
Chairman and chief executive:
**Jonathan Newhouse**
President:
**Nicholas Coleridge**
Vice presidents:
**Giampaolo Grandi, James Woolhouse and Moritz von Laffert**
Director of planning:
**James Woolhouse**
President new markets:
**Carol Cornuau**
Vice president – editorial director new markets:
**Anna Harvey**
Director of licences & new business:
**Natascha von Laffert**
Editorial director new markets:
**Alexandra Harnden**
President of Asia-Pacific:
**James Woolhouse**
President Condé Nast International Digital:
**James Bilefield**

THE CONDÉ NAST GROUP OF MAGAZINES INCLUDES

**US**
Vogue, Architectural Digest, Glamour, Brides, Self, GQ, Vanity Fair, Bon Appétit, CN Traveler, Allure, Wired, Lucky, Teen Vogue, The New Yorker, W, Details, Golf Digest, Golf World

**UK**
Vogue, House & Garden, Brides & Setting up Home, Tatler, The World of Interiors, GQ, Vanity Fair, CN Traveller, Glamour, Condé Nast Johansens, Easy Living, GQ Style, Love, Wired

**France**
Vogue, Vogue Hommes International, AD, Glamour, Vogue Collections, GQ, AD Collector

**Italy**
Vogue, L'Uomo Vogue, Vogue Bambini, Glamour, Vogue Gioiello, Vogue Sposa, AD, Sposabella, CN Traveller, GQ, Vanity Fair, GQ Style, Wired, Vogue Accessory, Myself

**Germany**
Vogue, GQ, AD, Glamour, GQ Style, Myself, Wired

**Spain**
Vogue, GQ, Vogue Novias, Vogue Niños, Sposabella, CN Traveler, Vogue Colecciones, Vogue Belleza, Glamour, Vogue Joyas, Vogue Complementos, Sposabella Portugal, AD, Vanity Fair

**Japan**
Vogue, GQ, Vogue Hommes, Vogue Girl, Wired

**Taiwan**
Vogue, GQ

**Russia**
Vogue, GQ, AD, Glamour, GQ Style, Tatler, CN Traveller, Brides

**Mexico and Latin America**
Vogue Mexico and Latin America, Glamour Mexico and Latin America, AD Mexico, GQ Mexico and Latin America

**India**
Vogue, GQ, CN Traveller, AD

PUBLISHED UNDER LICENCE

**Australia**
Published by News Magazines: Vogue, Vogue Living, GQ, GQ Style

**Bulgaria**
Published by Liberis Media Group SA Bulgaria: Glamour

**China**
Published under copyright co-operation by China Pictorial: Vogue, Vogue Collections Published by IDG: Modern Bride. Published under copyright co-operation by Women of China: Self, AD. Published under copyright co-operation by China News Service: GQ, GQ Style

**Greece**
Published by Liberis Publications SA: Vogue, Glamour, Lucky, CN Traveller

**Hungary**
Published by Axel Springer-Budapest Kiadói Kft: Glamour

**Korea**
Published by Doosan Magazine: Vogue, GQ, Vogue Girl, Allure, W

**Poland**
Published by G + J Media Sp. z o.o.: Glamour

**Portugal**
Published by Edirevistas Sociedade de Publicações SA: Vogue, GQ

**Romania**
Published by Liberis Publications SA: Glamour, GQ

**South Africa**
Published by Condé Nast Independent Magazines (Pty) Ltd: House & Garden, GQ, Glamour

**The Netherlands**
Published by G + J Nederland: Glamour, Vogue

**Turkey**
Published by Dogus Media Group: Vogue, GQ

PUBLISHED UNDER JOINT VENTURE

**Brazil**
Published by Edições Globo Condé Nast SA: Vogue, Casa Vogue, Vogue Passarelas, Vogue Noiva, GQ, Glamour

**Spain**
Published by Ediciones Conelpa SL: S Moda


**Become a fan of our Facebook page (facebook.com/wireduk) and join the community. And don't forget the free, weekly podcast, too...**

**Office additions:**
Welcome to Liat Clark, who joins the wired.co.uk team as junior staff writer. And welcome to our comfy new sofas. It's been a busy month.

**Office hygiene:**
The scaldingly hot water from the tap in the WIRED kitchen is "audited to be between 50 and 60 degrees Celsius," apparently "to prevent the spread of disease through stagnant water in the pipes... such as Legionnaires' Disease." This has been reduced to its legal minimum, but it is still lava-like. If you spot a typo, blame our burnt fingers.

**Overheard this month:**
"It's incredible the way that Rihanna is credible."
**Editor: "I don't think 'Big Data' is sexy enough for a coverline."**
**Chief sub: "I never thought I'd hear you say that. Never."**
"I drank Baileys with Matt Goss in the Hard Rock Café, in Lancaster."
**"Can I smell *instant coffee*?"**

**Office beverages:**
Going price for a single Nespresso pod during The Great Coffee Drought of June: £1 (usual price: 30p).
Conclusion: sell your Facebook shares and hoard coffee-pods instead.

**Rejected this month:**
"If a woman can use it, surely an elderly person can too" – genuine subhead from a Japanese WIRED feature.
Rejected for possibly offending 50 per cent of the planet.

**Extra credit:**
**People carrier [p28]:** Japanese-to-English translation by Mariko Kato.


**WIRED gets its Moshi on:**
After we put Michael Acton Smith of Mind Candy on the cover of our 05.12 issue, he returned the favour in the official *Moshi Monsters* magazine by creating this special Moshi of our editor. There's no word on what special characteristics "David Groan" may possess, but having a fluffy pink tail can only be an improvement.

**Sources for the WIRED index [p34]:**
**[1]** uk.pc.ign.com/articles/122/1220280p1.html
**[2]** tinyurl.com/7mv33ck
**[3]** tinyurl.com/7gfdefc
**[4]** tinyurl.com/c4q742n
**[5]** technologyreview.com/tr35/profile.aspx?TRID=631
**[6]** tinyurl.com/d8ml5bu
**[7]** twitter.com
**[8]** tinyurl.com/c9gvfz9

**Want to write for WIRED? Editorial guidelines from *editorial@wired.co.uk*.**

**PRs please contact us at *pr@wired.co.uk* and not by phone.**

**Want to intern? Details from *interns@wired.co.uk*.**

**Join us at *wired.co.uk* and follow us on Twitter at *twitter.com/wireduk*.**

# THE WIRED CIRCUITBOARD

**Protronica.**

HyperShield Denim - Combine style and protection with this Limited Edition cover for iPad 2. It's snap-on back makes the thin cover easy to use- it works perfectly with Apple Smart Cover (not included). Combining both protection and style, the Hypershield boasts a great "feel" of real denim, whilst offer 3 layer protection for iPad - ridged polycarbonate shell, soft inner liner and real denim outer cover, all for only £34.95. Available in 11 other colours!

It's only available from **www.protronica.co.uk** where you can find more products, or call **01420 481137** for more details.

**Visit TEZER this August!**

Pendants so unique and individual as the woman, who wears them. To wear on a short omega or a long chain. A real must have in Sterling Silver.

**Visit www.tezer-design.de or call UK contact Sharon Acton on 07774 928045** for more information.

**Foffa Bikes** and Befit4 have teamed to offer the first 5 WIRED readers to design their own unique bike at foffabikes.com, free Befit4 CYCLING classes, to improve performance, efficiency and recovery. Commuter, touring and racing bikes, with millions of combinations- the training bike created for photographer Tyso Sadlo.

Call **020 7481 2516** or visit **www.foffabikes.com**

**ETON SHIRTS**
The perfect choice.
Checked Poplin Shirt. £130.
Brand Store,
65 Kingsway, Holborn.

**Visit www.etonshirts.co.uk or call 020 7430 1433.**

Concession in Selfridges in London.
**Call 020 7318 3497**

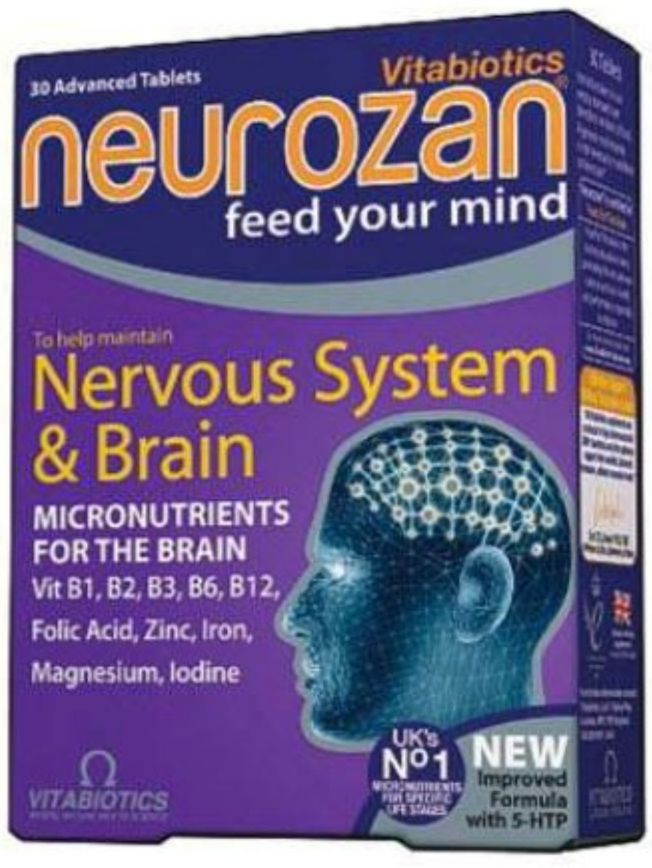
**IWANTPANTS.COM** For over 6 years iwantpants.com has been bringing CondéNast Wired readers the latest designer underwear and loungewear from Emporio Armani, Polo Ralph Lauren, Calvin Klein,Bjorn Borg, HOM, Pants to Poverty andmany more. Get these and hundreds morepants with FREE UK Delivery at **www.iwantpants.com** or call **01792 812 147**.

**Music. Whenever. Wherever.**

**The Bose® SoundLink® Wireless Mobile speaker**

Start the party wherever you are. You've got the music on your phone or other Bluetooth® device. Now flip open your Bose® SoundLink® speaker and get things going with bigger sound than you thought you could get from a speaker this small.

Call FREE on **0800 081 3542**
or visit www.bose.co.uk/SoundLink




**Vitabiotics Neurozan**
is an advanced comprehensive formula to help safeguard your daily intake of essential vitamins and minerals, as well as providing specific nutrients to help maintain normal brain function and performance. It contains a specially developed combination of nutrients including B complex, iron, zinc, magnesium and iodine. Available from Boots, Holland & Barrett, Waitrose, chemists, health stores and online at **www.neurozan.com** RRP £9.95

Call **0208 955 2600** or visit **www.neurozan.com** for more information.


**Blowing Fuses with Hayfever?**
Invisibly apply HayMax™ organic drug-free pollen barrier balm and trap pollen before it gets in. Less pollen – less sneezing and itchy eyes, and no drowsy side effects. HayMax™ has won 7 awards and is featured by Dr's on TV, radio and press. Available in selected Boots, Holland and Barrett, Supermarkets, Health food shops and chemists.
**Call 01525 406600** or visit **www.haymax.biz** for info, stockists or to order.

# Brands from the future

**027: YouBand** Thanks to wearable deep-data-tracking devices, you can keep a life-coach on your wrist and become a better person – or at least one who smells fairly inoffensive and doesn't tell bad jokes.




ILLUSTRATION: STEPHEN COLLINS. Have you seen a brand from the future? Share your vision of tomorrow at editorial@wired.co.uk

Samsung
GALAXY S III

Three.co.uk

# Blue has landed.

**The awesome new Pebble Blue Samsung GALAXY S III.**
**Made even more awesome with all-you-can-eat data on Three.**

**Also available in Marble White**


**Get the very best out of this star player. Its stunning large HD screen, super-fast quad core processor and amazing, unique and innovative features are even better with all-you-can-eat data.**

## The One Plan.

All you can eat data
2000 Any network minutes
5000 Three-to-Three minutes
5000 Texts

**Get it today, call**

# 0800 358 4431

**Pop into a 3Store or go online**

Sign up for 24 months to get this deal · Minutes and texts are for most UK mobiles and landlines · Do you ever dial 08/070 numbers? They're 20p per call/£1.02 per call, plus 71.5p per minute respectively - check price at Three.co.uk/nts · Sorry we do not accept Visa Electron or Solo cards

# SPICEBOMB

THE NEW EXPLOSIVE FRAGRANCE


VIKTOR&ROLF

WWW.SPICEBOMB.COM