

**THE GENIUS, WORLD-
CHANGING MATHS
OF KNITTING → P26**

**HOW TO
CLONE A WOOLLY
MAMMOTH → P30**

**SOLVING THE MYSTERY OF
AMELIA EARHART WITH A
NUCLEAR REACTOR → P36**



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The COVID-19 global pandemic has affected us all for several years now, but scientists are working hard to beat it. One of the tools of the battle is Summit, a supercomputer that can perform 200 quadrillion operations per second. Turn to **page 48** to read about how it's being used to combat the virus.

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BEST TOOLS FOR THE JOB

IF IT WASN'T FOR my bank balance, I'd be a tool addict. But resisting the urge to acquire more and more tools has become rather difficult lately, ever since toolmakers have become so innovative in what they're creating.

I was fortunate enough to spend a day recently with the folks at Vermont Sales, at their Midrand headquarters. They're one

of the largest, if not the largest, tool and accessory wholesalers in Southern Africa. And I hadn't quite realised how big and efficient their set-up was until I visited their premises. In the last few years they've converted what was their original office block into a permanent expo centre, at which they're constantly showcasing the exciting brands that they work with,

including the high-quality in-house products they've created and tested themselves. Tools are rotated through the exhibition area, and my visit happened to coincide with the WORX range. If you're not familiar with it, and you're someone who likes and uses tools, best you become acquainted fast, because this brand is taking the industry by storm. They have come up with a host of interesting solutions to challenges presented by more conventional tools, from a safe-to-use battery-powered jaw-saw, to their tough cordless 'Slammer' hammer drill, to a compact circular saw, to a mobile high-pressure cleaner... I could truly go on and on. And yes, while this is a relatively new brand to the market, I witnessed for myself how robust and durable the WORX products are.

The Vermont Sales distribution warehouse made my jaw drop – this building is only about four years old, yet its massive footprint is stacked several storeys high with tools and accessories of all types, that make their way all over Southern Africa, as far north as Kenya. If there's a tool you need, I'm confident Vermont Sales will have it. Indeed, these guys are wholesalers, but they're committed to helping and advising the end user – you – too.

A lot of what PM is about involves using tools, and I know many of our readers are enthusiasts. In that vein, we've included a number of interesting tool and wood-working articles in this issue. If you're an avid DIYer, hobbyist, gardener or outdoors-person, I'm sure you'll enjoy those stories, particularly the tips on using a chainsaw to fell a tree, the perfect springtime activity, on page 77.

Mark

MARK SAMUEL
Editor





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Editor-In-Chief **Mark Samuel**
Chief Copy Editor **Roshaan Bouwer**
Deputy Chief Copy Editor **Shaneen Noble**

Creative: Art Director **Tauriq Loofer**
Designer **Tyrone Michaels**
Intern Designer **Keenan Petersen**

RSA Contributors **Tiana Cline, Nick Dall, Tobias Lochner, Evan Samuel**

Digital: Digital Group Web Developer **Cicero Joseph** Webmaster **Lizelle Leonard**

Ad Sales: Sales Director **Ryan Nicolle** (ryan@ramsaymedia.co.za) Advertising Sales **Jean de Ridder, Callie Romburgh** Debtors Manager **Janice Segers**

Production: Production Manager **Rushaan Holiday** Deputy Production Manager **Maggie Wasserfall** Ad Design Manager **Brümilda Fredericks**

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Cape Town Head Office: 36 Old Mill Road, Ndabeni, Western Cape, South Africa, 7405 • PO Box 180, Howard Place, Western Cape, 7450 • 021 530 3300
Gauteng Office: Caxton House, 368 Jan Smuts Avenue, Randburg, 2196 • PO Box 78132, Sandton, Gauteng, 2146 • 011 449 1100 • popularmechanics@ramsaymedia.co.za, ramsaymedia.co.za

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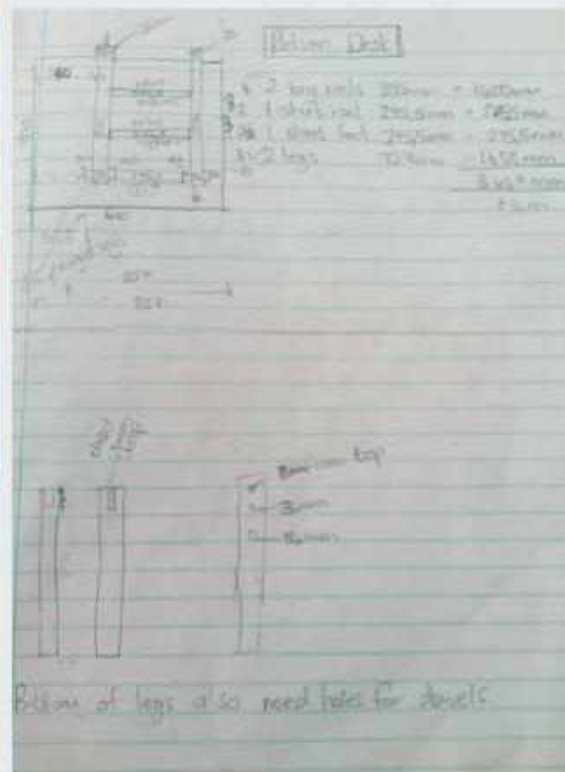
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WINNING LETTER



Hot desk

It's been two years now that my husband, who's an IT business unit manager, has been working from our home in Durban because of the coronavirus pandemic. This proved to be challenging, especially with four young sons who are constantly playing with a bat, ball or bicycle and making a noise.

After one year of working on a trestle table in the garage (for some peace and quiet), my husband had a Wendy-house office put up in the back garden. But he continued working on the trestle table. Earlier this year, in January, he ordered a simple chipboard L-desk online. After waiting four weeks for the delivery, the company informed us that the desk had arrived from overseas all damaged. It was at this point that I decided to build him an L-desk for his office. After checking out a few YouTube videos on how to build an L-desk, I set to work drawing up the plans and a cutting list.



My husband wanted the desk to be 1 600 mm × 1 400 mm. We bought a pine board measuring 2 400 mm × 610 mm to use for the desktop. The frame of the desk was built using 32 mm × 69 mm pine planks. I purchased a sliding mitre saw to cut the frame pieces to size, using straight cross-cuts. I assembled the frame using dowel joinery and glue; I don't have a drill press, so I had to improvise, and use a simple home-made jig to help me drill perpendicular holes for the dowels. I then chiselled out the area in between to accommodate the long rails.

If I were to do the project again I wouldn't pre-drill the holes... Rather, I'd just glue

the rails into the legs and then drill straight through to fit the dowels.

I decided to use table fasteners to attach the top to the frame. I had to improvise as I don't own a router or biscuit cutter, so I used a drill and chisel to make holes for the fasteners.

I sanded everything down, ultimately using 220-grit sandpaper. I finished the legs with two coats of grey wood paint. The top was finished with wood wax.

Working mornings only it took me one and a half weeks to complete, all the while continuing with the boys' school rounds and homework tasks in the afternoons. I was quite satisfied with the outcome of the desk ... for a

mum of four boys. Next I will be attempting to build some office cabinets.

My two older sons – aged 13 and 15 and who are both avid POPULAR MECHANICS readers – encouraged me to write in, as they were very impressed with what mum ended up building.

BRONWYN THOMAS

What a fantastic solution to your husband's work-from-home desk needs, Bronwyn! From the looks of things, you (and your boys) really ought to be very proud of the end result. I look forward to hearing how your next project turns out. In the meantime, I hope you enjoy the WORX prize, for your efforts. Congrats!
– Mark, Editor

↓ WHAT'S ON YOUR MIND?

**LIFELONG WORK
(THAT MATTERS)**

I received my May/June issue yesterday, and while reading your editor's note entitled 'Work that matters', I happened to receive the attached photo from my older brother. What a coincidence indeed! Although he's 84 years of age, my brother still loves engines.

The image on the left shows him, as a young man, working on an MG at Meissner Motors in Paarden Eiland, Cape Town, in 1969. The one on the right was taken this year – he's working on a similar MG in Wellington, in the Western Cape.

He's spent many years working on carburettors, and he's always enjoyed his work.

JAAP VON MOLENDORFF



That's a wonderful photo comparison, Jaap. More than 50 years have passed between the two photographs, and your brother still clearly enjoys what he does – that's really remarkable.

– **Mark, Editor**

PORTABLE POWER

In this period of frequent load-shedding, I figured out a way to run my fibre internet off a 12 V car battery.

We tend to forget that most household AC-powered electronic devices are fundamentally low-voltage DC devices. I'm referring to routers, fibre hubs, TV decoders, laptops, bedside clocks and the like. An AC adaptor is used to 'drop down' or convert the voltage from mains 220 V AC, to a low 12 V or 5 V DC to power these devices.

This is how you can run your router and fibre hub off a car battery during power outages, for under R200 (excluding the battery and charger). First you need to find the DC requirements of the router and fibre hub. If both units are 12 V, life is simple. If one or both are 5 V you'll need a buck converter (switching regulator) to reduce

12 V to 5 V without generating heat. A cable is made up with two 4 mm DC plugs at one end, to plug into the router and hub. The other end could be wired to a car-lighter plug, for plugging into a car's 12 V socket, or half-size clamps, to clamp on to the 12 V battery's terminals. The devices draw about 500 mA each, so a 1 amp draw from a typical car battery will last five to 10 hours, enough to get you through load-shedding.

HANSELL WILLIAMS

It's really helpful to hear about the ways our readers are combatting the inconvenience and frustration of load-shedding, Hansell. Thanks for sharing your advice and ideas.

– **Mark, Editor**



WRITE TO US, ENGAGE IN DEBATE, and you could win an exciting prize. The writer of this issue's winning letter has won a WORX Garden Tool Combo containing a WORX Cordless Blower and Cordless Trimmer, valued at R3 285 (worxtools.co.za, vermontsales.co.za).

The writer of the winning letter in the September/October 2022 issue will win a **Tork Craft Drill and Impact Driver 20 V Twin Pack** valued at R2 700, generously sponsored by Vermont Sales.

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The drill driver has a 10 mm keyless chuck, for increased drilling convenience, and 19 torque settings. Each of the

tools has a built-in LED light, to light up those dark and awkward work spaces.

Find out more about the Tork Craft range of tools by visiting torkcraft.com.

Vermont Sales is Southern Africa's leading tool and accessory wholesaler, and has been providing top-rate services for more than 35 years. Over nearly four decades, the company has grown ten-fold, and now stocks the best international brands, and markets well over 20 000 products. The secret to Vermont Sales' continuing success lies in its diverse product ranges and effective solutions provided to trades and other customers.

Connect with Vermont Sales directly by visiting vermontsales.co.za, worxtools.co.za, calling 011 314 7711, on Instagram (@vermontsales), or on Facebook (toolsupplier).



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Angular range (°)	-1 - 47
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Cutting depth 45° (mm)	43
Dust extraction connection dia. (mm)	27/36
Weight (kg)	3,60kg

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View of field	7	Continuous measurement	Yes
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↓ THIS DAY IN HISTORY

JULY 2022

SUNDAY

3

1993: Kenyan Yobes Ondieki becomes the first person to run 10 000 m in under 27 minutes.

10

17

1917: The espionage trial of Mata Hari begins.

24

1971: Astronauts James Irwin and David Scott drive the Lunar Roving Vehicle on the Moon for the first time.

31

7

1880: Having begun in 1248, construction work on the Cologne Cathedral is finally completed.

14

21

2004: The artwork named *The Scream* by Edvard Munch is stolen at gunpoint from a museum in Oslo, Norway.

22

1867: The US takes possession of the Midway Atoll.

28

MONDAY

1817: Construction begins on the Erie Canal, an artificial waterway joining the Hudson River and Lake Erie in the US.

4

11

1918: Nelson Rolihlahla Mandela is born, in the small village of Mvezo.

18

25

2007: A powerful tornado strikes Brooklyn, NY, the first to hit the borough since 1889.

8

15

2004: The artwork named *The Scream* by Edvard Munch is stolen at gunpoint from a museum in Oslo, Norway.

22

29

TUESDAY

5

1975: São Tomé and Príncipe, an island country off the west coast of central Africa, declares independence from Portugal.

12

19

1943: Mick Jagger, musician and lead singer of the Rolling Stones, is born in Dartford, England.

26

1990: Iraqi forces invade Kuwait, an act that eventually leads to the Gulf War.

2

National Women's Day

9

1906: The Valparaíso earthquake hits central Chile.

16

23

1979: The comet Howard-Koomur-Michels collides with the Sun. The energy released is equal to ±1 million hydrogen bombs.

30

WEDNESDAY

1885: Louis Pasteur successfully tests his rabies vaccine.

6

13

1944: Adolf Hitler survives an assassination attempt by German military officers.

20

27

2006: In response to the '2006 transatlantic aircraft plot', all toiletries are banned on commercial aeroplanes.

10

17

2011: Steve Jobs resigns as CEO of Apple. He dies six weeks later, from complications related to a pancreatic tumour.

24

31

THURSDAY

7

165: British mountaineer Edward Whymper becomes the first person to summit the Matterhorn.

14

21

1821: Peru declares its independence from Spain.

28

1961: Barack Obama is born in Honolulu, Hawaii. He served as the 44th president of the United States, from 2009 to 2017.

4

11

2011: The price of gold hits \$1 826 per ounce, a record at the time.

18

25

FRIDAY

1

1889: In a boxing match lasting 75 rounds, John L Sullivan defends his heavyweight championship title.

8

15

1992: Colombian drug lord Pablo Escobar escapes from police custody. He dies in a shoot-out with law enforcement in 1993.

22

29

1985: 520 people are killed in the world's worst single-plane air disaster, when Japan Airlines Flight 123 crashes into Osutaka Ridge.

12

19

1966: The South African Defence Force and SWALA clash in the 'Battle at Omugulug-wombashe' in Namibia.

26

SATURDAY

1937: US aviator Amelia Earhart goes missing over the Pacific Ocean.

2

9

1861: The first major land battle of the American Civil War begins.

16

23

2012: A massive power outage in India leaves more than 300 million people without electricity.

30

1962: Jamaica becomes independent from the UK.

6

13

1914: The German Army captures Brussels, during the country's initial invasion of Belgium in WWI.

20

27

AUGUST 2022



5 POPULAR PRODUCTS FOR THE PROFESSIONAL MECHANIC, AUTOMOTIVE ENTHUSIAST & DIY CAR GUY

Whether you're a specialist mechanic, classic-car collector, or a DIY vehicle enthusiast, you'll know that **CRC Industries** is synonymous with expert-quality automotive products.

On that note, here are 5 popular automotive products from **CRC** ...



QD CONTACT CLEANER

Dust, oil, grease and corrosion tend to build up on electrical contacts, and, if left unattended, can lead to contact failure and malfunction. CRC Industries' QD CONTACT CLEANER is a precision cleaner that's designed to improve electrical connections in your vehicle.

However, because the formula is plastic safe, dries quickly, and leaves no residue, you don't have to worry about overspray harming plastic parts, housings, or rubber components nearby.



KNOCK'ER LOOSE

While many multipurpose oils claim to have excellent penetrating properties, if your job frequently involves loosening overly tight or seized components, then a dedicated release agent is what you need.

Rather than relying on a thinned-down oil to do the job, KNOCK'ER LOOSE goes a few extra steps by including several additives in its formula:

- A high solvent value for better oil, dirt and grime breakdown
- An oil-based acid for rust removal, and...
- A corrosion inhibitor for future rust protection



BRAKLEEN

CRC's BRAKLEEN is the world's top selling brake-parts cleaner, and a global leader for more than 40 years! The formula is specially designed to do most of the hard work for you by blasting off brake dust, grease, oil, and road grime without requiring any elbow grease.

BRAKLEEN can also be used for CV joints, clutches, housings, springs, bolts, fasteners, and engine parts.



MASS AIR FLOW CLEANER

If your vehicle is showing signs of a rough idle, loss of power, or even a "Check Engine" light warning, there's a good chance your Mass Air Flow (MAF) sensor is dirty. In most cases, the MAF sensor gets dirty with accumulated debris, leading to inaccurate sensor readings that can affect the engine's air-to-fuel ratio.

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WHITE LITHIUM GREASE

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On that note, WHITE LITHIUM GREASE is ideal for long-term lubrication, vertical applications, and where the prevention of water ingress is needed in electrical contacts.

For more information on **CRC** products, or to view the full range, visit www.crcindustries.co.za. Alternatively, call Rick on 078 097 8028 to find a distributor near you.

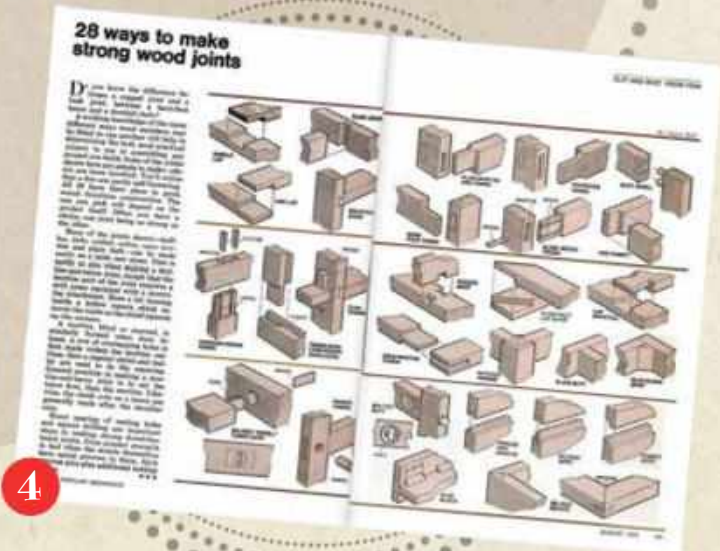
It made perfect sense at the time



1 JULY 1986

► **Silent Running**

According to the cover story of this issue, in the mid-'80s, airships were back! The three-page feature kicked off with an account of a demonstration to the US Navy of a British-made Skyship 500, carrying a crew of six and flying 'at just under 1 000 feet'. Amazingly, due to the airship's Kevlar gondola and polyurethane fibre envelope filled with helium, it was almost invisible to radar detection. The article went on to explain how the resurgence in interest in these airships would be beneficial to military, videography and advertising applications.



2 AUGUST 1980

► **Terror on Wheels - by Design**

This story focused mainly on Worlds of Fun's Orient Express roller coaster in Kansas City, but it also shed light on the two main global players in roller coaster design and manufacturing, Arrow Development Co and West Germany's Schwarzkopf. The differences in the companies' work were highlighted, including brake types, lubricants, and materials used for wheels.

3 JULY 1977

► **New Styles for Staying Afloat**

New regulations instituted in the US in the '70s made it a requirement to carry the right number (and type) of life preserver flotation devices on board any type of boat, including rafts, rowboats, canoes and kayaks. This report detailed the preservers' design requirements, as well as the various styles that had recently come on to the market.

4 AUGUST 1974

► **28 Ways to make Strong Wood Joints**

A key part of becoming a better woodworker is mastering the many different types of joints. This article presented clear diagrams of 28 different wood joints, and included an explanation guiding readers on which ones to use for various applications. Some joints were self-fastening, while others required glueing or pinning.

5 JULY 1968

► **Build This Roll-Away Bathroom Darkroom**

Digital cameras were several decades from being invented, and people certainly didn't carry around high-resolution cameras in the form of their phones. The '60s was the era of film cameras, and this short piece advised readers on how to turn their bathrooms into a darkroom for developing photographic film. **PM**



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↓ THE BIGGER PICTURE





A V-22 OSPREY lands on board HMS *Prince of Wales*, during its planned deployment earlier this year to Norway as the NATO command ship. A second V-22 can be seen in the background, on its approach to the aircraft carrier platform.

Unlike most other aircraft carriers, HMS *Prince of Wales* is not fitted with catapults and arrestor wires, but is instead designed to operate V/STOL (vertical and/or short take-off and landing) aircraft, such as Bell Boeing's V-22 Osprey.

The United States-built V-22 Osprey combines the conventional capabilities of a helicopter with the high-speed cruising performance of a turboprop aircraft. **PM**

PHOTOGRAPHY: ROYAL NAVY/©UK MINISTRY OF DEFENCE CROW 2022

Psychedelic society

In *This Is Your Mind On Plants*, Michael Pollan explores the mind-altering plants growing in his garden, and yours.

PLANTS ARE TRULY extraordinary. Some more so than others. Take the opium poppy – while its seeds are commonly used in cakes, the flower pod contains natural quantities of morphine, codeine and thebaine (which is also why poppy pods have been cultivated for more than 130 years by pharmaceutical companies).

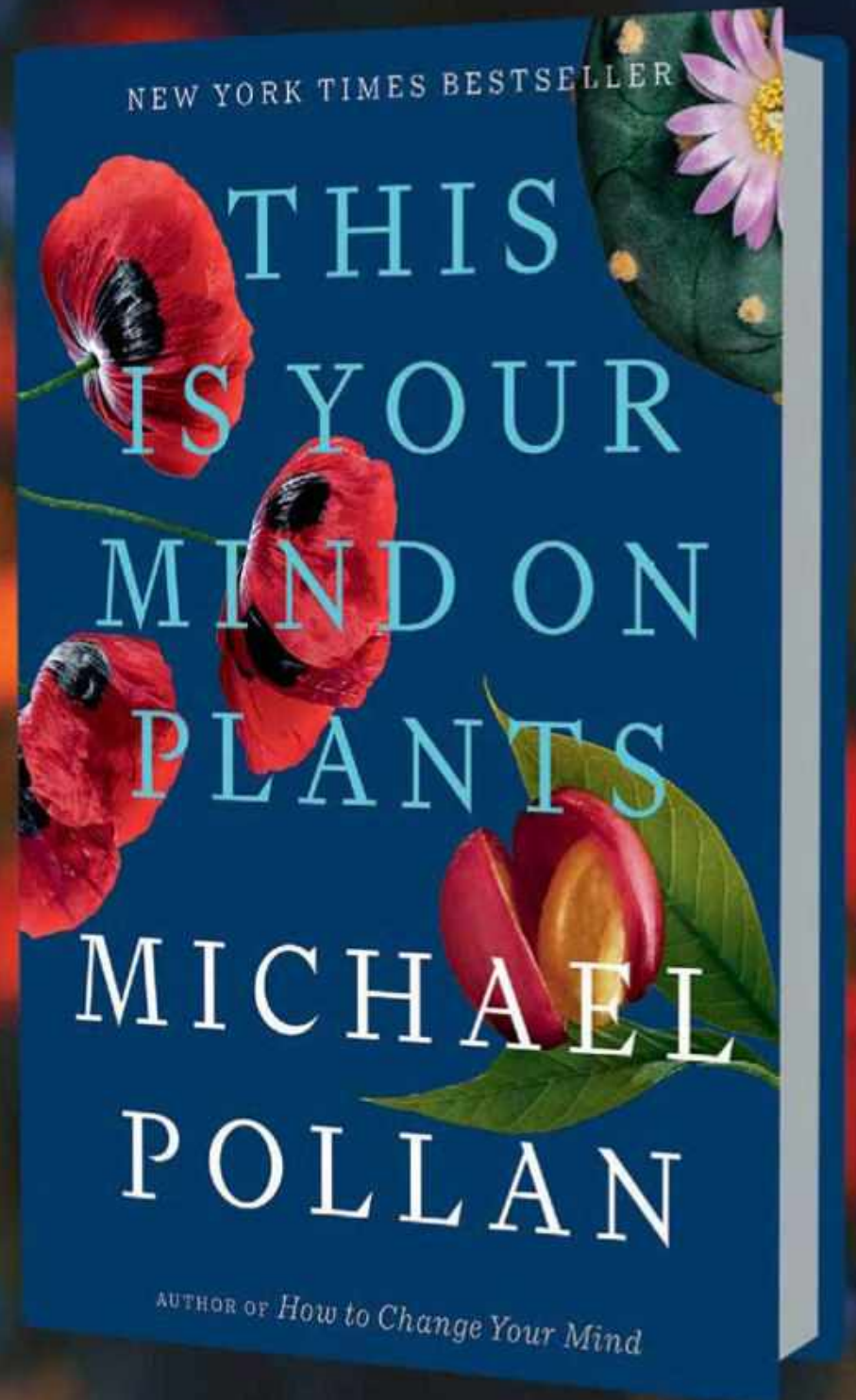
Michael Pollan's *This Is Your Mind On Plants* explains that as humans, we're always looking for ways to alter or extend our consciousness, and that we've discovered molecules in nature that enable us to do so. This

'Is chicken soup a drug? What about sugar? Artificial sweeteners? Chamomile tea? If we define a drug simply as a substance we ingest that changes us in some way, whether in body or in mind (or both), then all those substances surely qualify.'
– Michael Pollan

book is made up of three essays on three plant drugs – morphine, caffeine and mescaline – all of which are known to be psychoactive substances. From drinking that non-negotiable cup of coffee every morning, to using opioids to relieve pain, we depend on plants for many reasons... So what makes a plant turn into an illicit drug?

Caffeine is a mind-altering substance, but society seems to agree that it's just fine as it makes us more efficient. Psychedelics are just as toxic as caffeine, less addictive, but criminalised. Why? Because they change us in a way that isn't seen as 'normal'. *This Is Your Mind On Plants* doesn't condone the abuse of drugs; instead, Pollan says that how we use drugs – the dose, intention and setting – matters.

This is a book for those interested in exploring Pollan's personal history with opium, his adventures with caffeine and his journey as he gets to know a certain cactus species in his own front yard. *This Is Your Mind On Plants* is about plants and the people who consume them, all looked at in an interesting, conversation-inducing way. Coffee anyone? **PM**



This Is Your Mind On Plants by Michael Pollan (Penguin Random House) is now available online, and wherever good books are sold.



Who is Harley-Davidson? (Who cares?)

THE CUSTOMERS WHO TYPICALLY BUY Harley-Davidsons are getting too old to keep riding, and too few young buyers are taking their place. Part of the solution, Harley management says, lies in a few brand-new motorcycles that will convince riders typically dedicated to other brands to reconsider. The strategy seems to be working – on me, at least.

Which is surprising. To me, the large, expensive cruisers synonymous with the brand never had the agility and affordability that made motorcycles special, or at least distinct from cars. But two new bikes have quieted my prejudices.

One is the all-electric LiveWire, which came out in the US back in 2019. Yes, it's expensive, but it's also the closest thing I've ridden to one of those speeder bikes from *The Mandalorian*. The combination of useful range (about 110 km), low centre of gravity, and build quality puts it near the top of my list of things I'd buy now if I had bought more Dogecoin and Ethereum back in 2015.

The other bike, the Pan America, is just hitting dealerships here. It's an ADV, or adventure bike, meant for on- and off-road long-distance riding in an upright seating position. These bikes are comfortable, and can hop curbs when needed. They're also loaded with genuinely useful technology, and powered by big engines that make them unexpectedly fast for their size.

I've always believed that KTM and Ducati do ADVs best, but every spec I can find on the Pan America has me thinking otherwise. The Harley is lighter than a BMW GS, the category king. The valves adjust themselves, so most of your maintenance will be 8 000 km oil changes. It has an optional trick suspension that, when you roll to a stop, lowers the seat height to 79 cm, so you don't have to go



HARLEY-DAVIDSON PAN AMERICA 1250 /



HARLEY-DAVIDSON LIVEWIRE /

on your tippy-toes at stop lights. And the 150 hp (112 kW) engine has variable valve timing, for immediate and smooth torque. On a V-twin such as this, that means using twice as many control actuators as you would on an inline engine set-up. Cool.

After my years spent reporting on news about slightly better smartphone cameras, a wild brand departure like Harley's has my attention. It's as close as a big, publicly traded corporation gets to doing something radical. It's refreshing, and not only because of the corporate strategy. These bikes just make me want to travel again. **PM**

Craft brewers have broken the IPA

INDIA PALE ALES DOMINATE TODAY'S CRAFT beer landscape, with 10 or so styles laying claim to the name. Now there's one more: the 'clear hazy' IPA. San Diego's Ballast Point Brewing Co pioneered the category, which upset plenty of beer nerds and confused others, with the February 2021 release of Big Gus.

'IPA is a familiar acronym to beer drinkers, regardless if you're a novice or a total nerd,' says Dan Lamonaca, owner of Beer Karma Bottle Shop in Brooklyn, New York. That's why so many brewers (and their marketing departments) label beers with these three letters, even if they don't really fit the IPA mould. For example, Lamonaca says people who come in looking for sour IPAs are 'not really looking for something that mirrors an IPA but definitely want something with bold flavours.'

Flavour, not appearance, is also at the heart of the somewhat absurd clear hazy term. The signature attributes of tongue-numbing bitterness and intense resinous hop aroma in clear IPAs give them a reputation of being hoppier than their hazy IPA counterparts that display less aggressive hop characteristics like soft mouthfeel and rounded tropical hop aromas. In truth, clear IPAs and hazy IPAs use about the same amount of hops per barrel. It's not how many hops are used in brewing, but when in the process they are added, that determines the flavour and category of the final beer.

'With historical English IPA, hops were added during the boil, and then the wort was run over more hops in a hop back,' says Mitch Steele, author of *IPA: Brewing Techniques, Recipes, and the Evolution of the India Pale Ale* and brewmaster and co-founder at Georgia's New Realm Brewing. The boil addition extracted maximum bitterness from hops, as alpha acids become bitter iso-alpha acids at temperatures over 82.2°C. Meanwhile, the cooler, post-boil hop back preserves aromatic essential oils and converts fewer alpha acids into bitter compounds.



American brewers such as Ballast Point use the IPA as a template to experiment with new ingredients and techniques.

Bitter, earthy English IPAs remained the definitive style until an improved understanding of hops and access to newly bred American hops like Cascade met the nascent craft beer world's search for more flavourful ales. This confluence catalysed the inception of the American IPA in the 1970s and '80s with beers like Anchor Liberty Ale.

Steele, who was formerly the brewmaster at Stone Brewing, an iconic US West Coast IPA producer outside of

San Diego, says, 'The Stone "standard" hop regimen was like many West Coast brewers' practices.' It consists of a boil addition for bitterness followed by a whirlpool addition – a post-boil step similar to the old-school hop back. Once fermentation is complete, more hops are added to maximise flavour and aroma in a process called dry hopping. These three hop doses and the varieties of hops used create the recognisable dank grapefruit and pine aromas with substantial bitterness of West Coast IPA.

The hazy New England IPA is made by dialing back the initial bittering hops and tweaking the dry-hopping timing. Here, hops are added at the height of fermentation, instead of waiting for yeast activity to finish. This allows a chemical interaction between hop compounds and the yeast called biotransformation that creates the juicy, tropical flavours that beer enthusiasts flock to.

Selecting bold, high-quality hops is central to the hazy style, too. Breeze Galindo, brewer at Other Half, an archetypal NEIPA brewery in Brooklyn, says hop varieties such as Strata contribute 'bright grapefruit, creamy pineapple-strawberry' flavours to Other Half's hazy beers. Instead of introducing these hops in the boil, the team uses whirlpool and dry-hopping additions.

By adding less bittering hops during the boil, brewers also set up the conditions to create a lasting haze. Hops with lower concentrations of bitter alpha acids also have higher levels of polyphenols, says Scott Janish, author of *The New IPA* and co-founder of Sapwood Cellars Brewery in Maryland. Polyphenols bond with proteins in malt that are especially abundant in NEIPA brewing to create haze so stable that the beers can go through a centrifuge – typically used to make brilliantly clear beers by spinning out solids – and still come out distinctly opaque. In contrast, the hop schedule of clear IPAs reduces the interaction between these proteins and polyphenols, inhibiting the creation of haze. Any bonds that do form and create haze can be filtered out before packaging.

Further tinkering has led to IPAs named for specific characteristics or brewing techniques, instead of hop regimen. Adding lactose – an innovative or abominable move, depending on who you ask – creates a milkshake IPA. Yeast can't ferment this milk sugar, so it winds up in the finished beer, lending a full, creamy mouthfeel. The milkshake moniker becomes even more appropriate when lactose is added to an already hazy NEIPA, but every now and then you'll see it thrown into a clear IPA, too.

There are other beers on the shelf that are IPAs in name only, like session IPAs. These are brewed to a lower alcohol by volume, typically around 4–5 per cent. Could these be called pale ales? Sure, but it seems the pale ale name just isn't as catchy.



PEOPLE ARE FAMILIAR WITH THE TERM IPA. THAT'S WHY SO MANY BREWERIES LABEL BEERS WITH THESE THREE LETTERS, EVEN IF THEY DON'T REALLY FIT THE IPA MOULD.

Trendy cold IPAs, which date back to 2019, borrow heavily from lagers. Cold refers to the style's cooler fermentation temperature, which is usually reserved for lagers. Sometimes, brewers even use lager yeast in place of typical ale yeast. The idea is that the flavour will be lighter and more refreshing than a traditional IPA.

Clear hazy IPAs might be the next big thing, or they may fade from memory as quickly as the dry and bubbly brut IPA to make room for the next creative spin a brewer decides to call an IPA. One thing is for sure, they won't be the last brewing innovation to use those three recognisable letters. **PM**

Tips for brewing an IPA at home

Just like in a professional brewery, making IPA at home is all about the quality and timing of the hops.

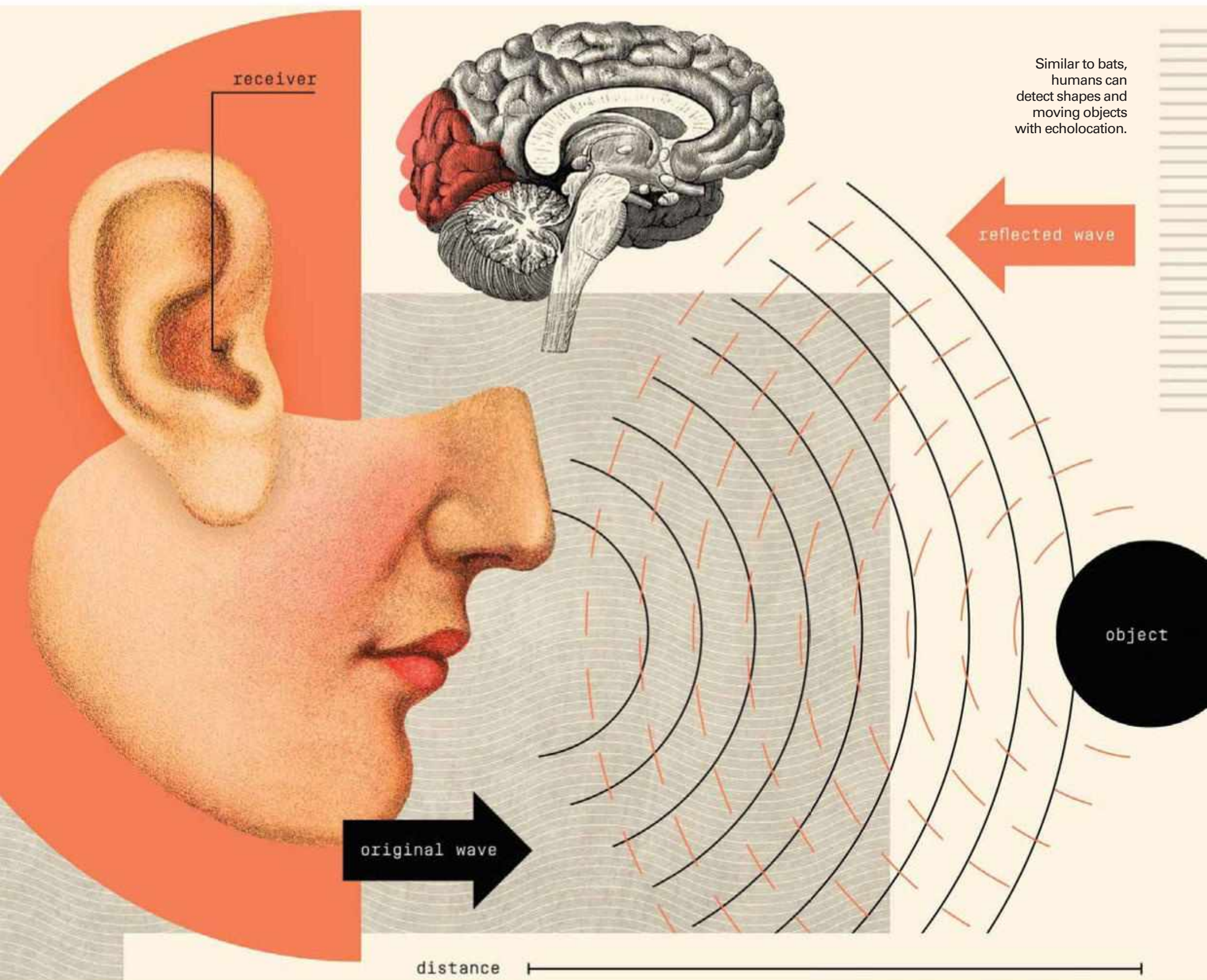
1 / Always smell hops before using them. A cheesy or sour odour is a sign they're too old; if used, those flavours will end up in the beer.

2 / For the brightest hop flavour punch, try using Cryo Hops. This hop powder is created by freezing hops with liquid nitrogen, then separating the lupulin – a waxy, yellow substance containing both alpha acids and ultra-flavourful essential oils – from the plant matter. Tropical,

fruity, and herbal notes from hop oils are clean and intense without being weighed down by grassy, vegetal flavours.

3 / Add hops late in the boil to simulate a pro brewer's whirlpool addition. Hops can sit in a whirlpool for an hour, while a home brew can be knocked out in 10 to 20 minutes. Try adding a large charge of aroma hops in the last five minutes.

Sources: Mandy Naglich, beer educator with Advanced Cicerone certification, and Joe Correia, head brewer at Torch & Crown Brewing



Similar to bats, humans can detect shapes and moving objects with echolocation.

Humans can develop a sixth sense, study proves

AS ANIMALS GO, HUMANS HAVE RELATIVELY limited senses. We can't smell as well as dogs, see as many colours as mantis shrimp, or find our way home using the Earth's magnetic poles as sea turtles do. But there's one animal sense we can learn: bat-like echolocation.

Researchers in Japan demonstrated this feat in a paper published in the journal *PLoS One*, proving that humans can use echolocation – or the ability to locate objects through reflected sound – to identify the shape and rotation of various objects without light.

As bats swoop around objects, they send out high-pitched sound waves that then bounce back to them at different time intervals. This helps the tiny mammals learn more about the geometry, texture, or movement of an object.

If humans can similarly recognise these three-dimensional acoustic patterns, it could literally expand how we see the world, says study author Miwa Sumiya, PhD, a researcher at the Center for Information and Neural Networks in Osaka, Japan.

‘Examining how humans acquire new sensing abilities to recognise environments using sounds, or echolocation, may lead to the understanding of the flexibility of human brains,’ says Sumiya. ‘We may also be able to gain insights into sensing strategies of other species by comparing with knowledge gained in studies on human echolocation.’

This study is not the first to demonstrate echolocation in humans – previous work has shown that people who are blind can use mouth clicking sounds to ‘see’ two-dimensional shapes. But Sumiya says that this study is the first to explore a particular kind of echolocation called time-varying echolocation. Beyond simply locating an object, time-varying echolocation would enable human users to better perceive its shape and movement as well.

To test subjects’ ability to sense echolocation, Sumiya’s team gave participants headphones and two tablets – one to generate their synthetic echolocation signal, and the other to listen to the recorded echoes. In a second room not visible to participants, two oddly shaped cylinders would either rotate or stand still. The cross-section of these cylinders resembles a bike wheel with either four or eight spokes.

When prompted, the 15 participants initiated their echolocation signals through the tablet. Their sound waves released in pulses, travelling into the second room and hitting the cylinders.

It took a bit of creativity to transform the sound waves back into something the human participants could recognise. ‘The synthetic echolocation signal used in this study included high-frequency signals up to 41 kHz that humans cannot listen to,’ Sumiya explains. For comparison, bat echolocation signals in the wild range from 9 kHz all the way to 200 kHz – well outside our range of hearing of 20 Hz to 20 kHz.

The researchers employed a one-seventh scale dummy head with a microphone in each ear to record the sounds in the second room before transmitting them back to the human participants.

The microphones rendered the echoes binaural, like the surround-sound you might experience at a movie theatre or while watching an autonomous sensory meridian response (ASMR) video recorded using a binaural mic. The signals were also lowered in frequency when received by the miniature head to an eighth of the original frequency so the human participants could hear them ‘with the sensation of listening to real spatial sounds in a 3D space,’ says Sumiya.

Finally, the researchers asked participants to determine whether the echoes they heard were from a rotating or a stationary object. In the end, participants could reliably identify the two cylinders using the time-varying echolocation signals bouncing off the rotating cylinders by listening to the pitch.

They were less adept at identifying the shapes from the stationary cylinders. Nevertheless, the researchers say that this is evidence that humans are capable of interpreting time-varying echolocation.

Sumiya hopes it could one day help humans perceive their spatial surroundings in a different way; for example, helping visually impaired users better sense the shape and features of objects around them.

The next step for this research is to give participants freedom to move around when they’re interpreting these echolocation signals, Sumiya says. That will more closely mimic the action bats might take when using echolocation ‘because echolocation is “active” sensing.’ **PM**

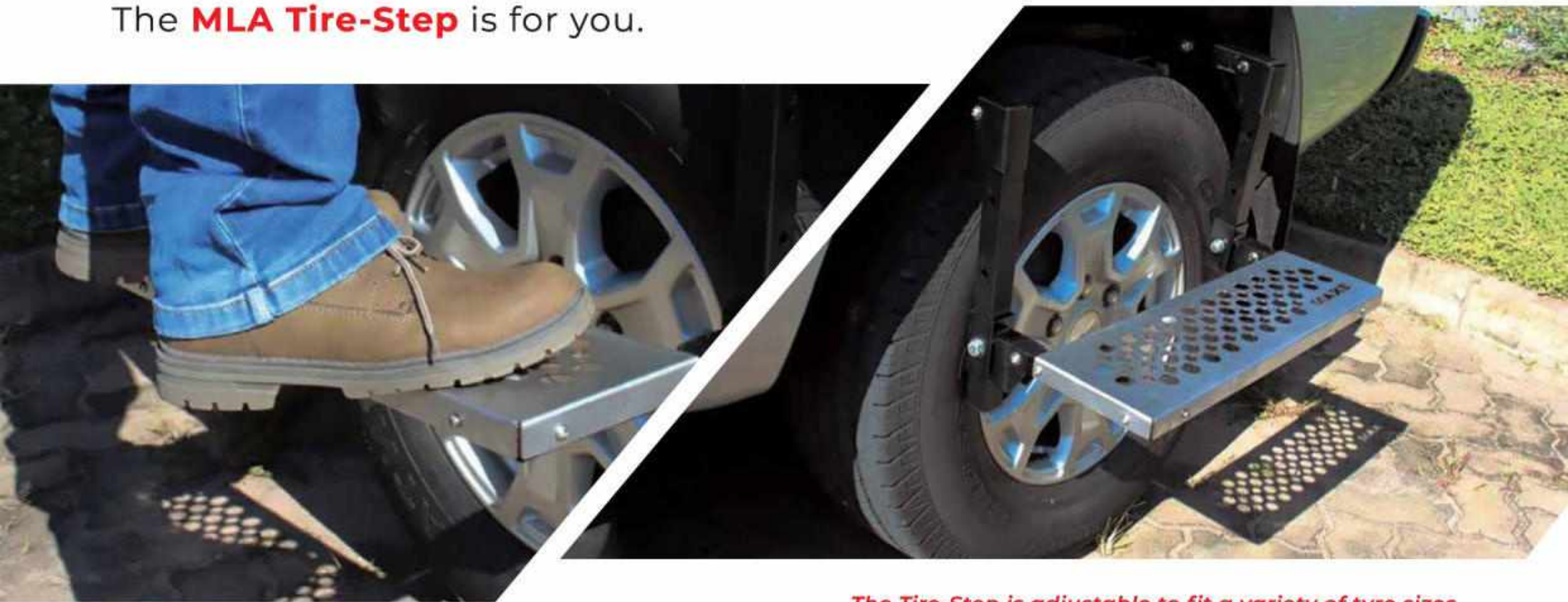
How visually impaired people develop a new sense

Losing one sense can heighten others. It’s a phenomenon known as neural reuse or neural repurposing, in which the brain adapts and heightens remaining senses, and it has helped some people who are blind develop the ability to use two-dimensional echolocation by making clicking sounds with their mouths. Research shows that a portion of the brain – the primary visual cortex located in the occipital lobe – involved

with visual processing can restructure itself to treat the echoes resulting from the clicks as visual stimuli. In essence, the brain can ‘see’ the echoes as they bounce back and use the sound to help a person reconstruct the space and objects around them. This has given some echolocators the ability to draw a room and its contents by merely walking around it while making clicking sounds and listening for echoes. – *Daisy Hernandez*

THE VEHICLE ACCESSORY YOU NEVER KNEW **YOU NEEDED** (BUT DO!)

Own an SUV, LCV, Mini-Bus, Crossover or even a smaller truck?
The **MLA Tire-Step** is for you.



The Tire-Step is adjustable to fit a variety of tyre sizes

Always struggling to reach up there? Enter the MLA Tire-Step!

This ingenious piece of gear is ideal for anyone who needs to reach the roof of their vehicle to load gear, clean or repair it. In addition, it allows one to reach the centre of the bonnet and windscreen to help with washing.

The MLA Tire-Step has been customised specifically for South African consumers and conditions; from humid coastal regions to the dry and dusty interior.

The Tire-Step is adjustable to fit a variety of tyre sizes on local and imported vehicles and carry a variety of weights and movements on the step.

The Tire-Step is the latest in a long line of innovative products from MAXE, which turns 25 this year. We are always looking for ways to make the consumer's life just that little bit easier. That is why it is adjustable, so you can use your Tire-Step on a variety of vehicles and is ideal for a variety of different heights and weights of people.

Testing is a huge part of the R&D process. It typically takes up to 18 months to develop and test a new Bar, Sidestep or Screen guard and currently the team is working on 37 new projects.

The R&D team starts from the ground up with every product with the focus on the functionality of our products first and then the visual appeal.

We have tested the Tire-Step extensively, and we are conservatively comfortable in the Tire-Step being able to handle up to 120kg for extensive periods of time. We are always very aware of people's safety and thus always are conservative with life expectancy claims on our products.

The MLA Tire-Step has been sprayed with salt spray for just more than 1000 hours to test hinges and coating. The steps are manufactured to best in class and OEM standards.

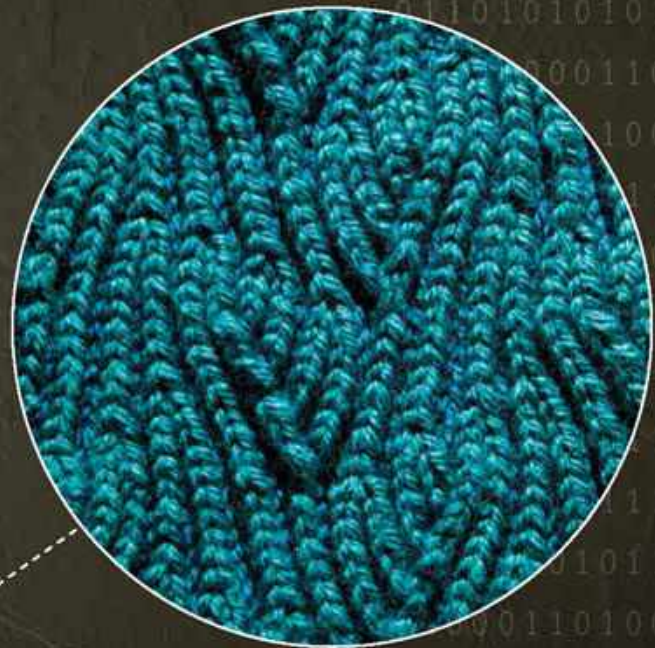
The MLA Tire-Step will be available for sale from August at MAXE fitment centres countrywide. For more information: visit the website: www.maxe.co.za or Facebook page.



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Sabetta Matsumoto knits a scarf with a two-colour brioche stitch, which creates a ribbed texture.



The hidden binary of knitting could create the toughest gear you've ever worn

THE UNRULY STITCH OF A DRAGON FIRST attracted Sabetta Matsumoto to the mathematics of knitting. Unlike the regimented stitches of a sweater that march two-by-two across a textile, the whiskers of this dragon stretched daringly across a lace shawl in a way Matsumoto had never seen before – and she was determined to understand the maths behind it.

'I knit really crazy things, and this was the first time that I'd really encountered something that was [so] different,' she says.

Matsumoto, an assistant professor of physics at the Georgia Institute of Technology, studies the limits and

possibilities of knitted materials to understand how different stitches transform the mechanical properties – the stretchiness and support – of everyday fabrics.

In her latest project, funded by the National Science Foundation, Matsumoto and her students are searching for a fundamental equation (such as those that describe gravity or the flow of water) to perfectly describe the properties of knitted fabrics.

Such an equation could be transformative not only for pure mathematics and the study of theoretical knots, but for applied maths in the form of customisable prosthetics, wearable electronics, and new ultra-tough materials. For the astronauts who will one day journey to Mars, for instance, it could mean previously unimaginable spacesuits that protect against the radiation in space.

Knot theory is essential to finding the grand equation of knitting. This type of topology investigates the fundamental traits and limitations of knotted objects. In the case of physical knots, this might take the form of studying how deformations – twists or compressions – affect a fabric's elasticity, or how far it can be stretched.

In the 1800s, early knot theory focused on the alleged microscopic 'knots' of atoms. The physicists and mathematicians behind these concepts had a fairly limited point of reference for such shapes. They looked at large, bulky sailing or farming knots – a more limited form than knots used in textiles, says Karen Daniels, a professor of physics at North Carolina State University who uses knitting in her research.

'Trade knots, like those used in sailing, were typically tied along a single, linear plane – like a rope. But knitted or crocheted knots are more topologically complicated,' she says. Knitting knots and crochet knots need to feed from one knot to the next in a way that won't unravel and leave a hole in the two-dimensional sheet.

Matsumoto's research group is interested in how physical qualities, such as stiffness and stretch, can be 'programmed' into knitted items to control their elasticity and deformable characteristics.

'Knitting has this inbuilt grammar that is quite complex, but I like to think of it as a programmable material: The order of the "letters" or "words" you pick can give you textiles with different mechanical properties,' says Matsumoto.

For example, varying the order of knits or purls in a simple fabric square can create a spectrum of stretchiness and stiffness, like a pair of knitted pants or a swimsuit where different stitch patterns, or 'grammars' in

Matsumoto's parlance, can be applied to different areas of the garment for customised stretch or support.

Matsumoto says these grammatical characteristics are related to some of the world's oldest computers. The Jacquard machine, an 1803 loom attachment, used mechanical punch cards to instruct the loom's crossing orientations. As computer algorithms transform binary 0s and 1s into graphics and calculations, knitters 'program' the mechanical properties of fabrics by choosing the order of their stitches. Knits and purls, inverse stitches of one another, are the 0s and 1s of knitting.

With a fundamental theorem of knitted materials that can describe any possible stitch, Matsumoto says it would be possible to come up with a universal code to program existing industrial knitting machines to spit out bespoke knitted items.

In the future, such a machine could be used to stitch anything from attachments for customised prosthetics to medical wearables. These completely customisable products would not only take the guesswork out of buying your next blazer or wetsuit off the rack, but could help reduce the economic burden of cookie-cutter fast fashion, says Matsumoto.


Ultimately, she says, there's no wrong way to design a new knitted material. Just like the dragon that first drew her into the mathematics of knitting, new opportunities for mind-blowing creations and materials are just waiting to be discovered. **PM**

2 essential tips for ultra-tough knits



You don't have to wait around for Matsumoto's high-tech knitting machine to construct heavy-duty, unyielding sweaters, blankets, and socks. 'Our research has [shown] that when you have two stitches of the same type (for example, knit-knit or purl-purl) next to each other (either laterally or vertically), the fabric will

be stiffer than fabric with opposite stitch types next to each other (for example, knit-purl),' Matsumoto says. But stiffness also depends on the specific yarn you use. In comparing stockinette, garter, rib, and seed fabrics, Matsumoto found stockinette is the stiffest both laterally and vertically. – Courtney Linder



Like a fighter jet's head-up display, the IVAS goggles project information, such as maps, across the soldier's field of view.

The US Army's new goggles let soldiers see right through walls

THE US ARMY IS DEVELOPING INTEGRATED Visual Augmentation System (IVAS) goggles for close-combat forces, including mounted and dismounted troops, particularly infantry. The goggles can help soldiers see in the dark, check around corners, and even project digital maps and other data on to the lenses.

Because these goggles access feeds from the omnidirectional cameras mounted on the outside of armoured vehicles, a squad of six soldiers, nestled safely in the back of a Bradley or Stryker infantry vehicle, can 'see' through the walls of the vehicle, getting a clear picture of the scene.

'Now guys aren't hanging out of vehicles in dangerous situations trying to get views on what's going on,' Sgt Philip Bartel of the 1-2 Stryker Brigade Combat Team said in an interview. 'Leadership will be able to manoeuvre

their elements and get view-on-target without having to leave the safety of their armoured vehicles. Manoeuvring elements with that kind of information will minimise casualties and will overall drastically change how we operate and increase our effectiveness on the battlefield.'

The US Army designed the IVAS goggles to mimic the head-up displays (HUD) on fighter jets. Like an HUD, the goggles project information including maps, video, and night vision across the soldier's field of view. Soldiers have long had that sort of data at their disposal, but IVAS gives them instant access during combat. Instead of digging through their pockets for a laminated paper map, soldiers can quickly call up a digital map on their goggles without taking their eyes away from the objective.

IVAS can also use a rifle-mounted thermal-imaging night vision scope to project the soldiers' surroundings across their field of vision. A soldier can point a rifle from behind cover or around a corner and see through the scope, gaining a view that would otherwise expose the soldier to enemy fire. Soldiers can even use IVAS to access microdrone cameras as they fly over the battlefield.

A 2020 report on the IVAS system describes how soldiers train with it. According to the Pentagon, soldiers with IVAS can enter and clear six rooms as a team in a building with virtual training targets using synthetic M4 airsoft rifles and trackers. After each run-through, soldiers are critiqued on their shots taken, kills, and shots received. The soldiers can then use the goggles to watch their avatars replay their actions in a virtual recap.



LEADERSHIP WILL BE ABLE TO MANOEUVRE THEIR ELEMENTS AND GET VIEW-ON-TARGET WITHOUT HAVING TO LEAVE THE SAFETY OF THEIR ARMoured VEHICLES.

With IVAS, even mounted soldiers can see outside their vehicles. Mechanised infantry, cavalry, and engineers usually ride in the back of armoured vehicles. They know where they're going, but the soldiers often rely on a single screen or vehicle crews to let them know where they are in real time. Once the vehicle stops and the ramp comes down, the soldiers must quickly acclimatise to their surroundings, determine where the enemy is, and orientate themselves to carry out the mission.

The US Army requested to spend \$1.1 billion in 2022 to buy 40 000 IVAS goggles – enough to equip every frontline soldier. US Congress pumped the brakes on the programme, cutting the requested budget by 20 per cent. But the army has already resolved many of the issues that concerned lawmakers, such as GPS accuracy, which means soldiers may be wearing these super goggles soon. **PM**



SMART SCOPES

The US Army recently tested the Israeli-made SMASH scope, the infantryman's version of the targeting computer built into main battle tanks. The scope mounts on top of a rifle or carbine and includes night vision and a ballistic computer. A soldier equipped with the scope can simply place crosshairs on the target and pull the trigger, but the weapon will only fire when the scope determines that a round will hit the target.

JETPACKS

The Pentagon is holding a competition to develop a 'portable personal air mobility system' that would allow a soldier to conduct scouting, search and rescue, infiltration and exfiltration of a combat zone, and special-operations missions. Think jetpacks, gliders, wingsuits, and parafoils, possibly powered by electricity, hydrogen cells, and traditional jet fuel. The system should be capable of low-to medium-altitude flight with a range of five kilometres.

HAND WARMERS

Sub-zero temperatures – like those in the Arctic, a potential theatre of war – can slow blood flow to soldiers' extremities. And cold hands lose dexterity, making tasks such as loading a rifle difficult. So the US Army has developed battery-powered armbands that warm a soldier's blood, especially in their hands. Not only can soldiers retain feeling in their fingers, but they can also wear thinner gloves, allowing them to perform more complex tasks.

BATTLEFIELD INNOVATIONS OF THE FUTURE



Elizabeth Ann is the first clone of a US endangered species. She was 33 years in the making

FOR THE FIRST TIME, SCIENTISTS HAVE CREATED a clone of an endangered US species – a black-footed ferret named Elizabeth Ann. The researchers used cells from a donor that had been dead for more than 30 years, and the procedure’s success could mean not only rescue for one of North America’s most endangered mammals, but a watershed moment in conservation biology.

After the donor ferret Willa died in 1988, scientists sent her cells to the Frozen Zoo at San Diego Zoo Wildlife Alliance in order to preserve her DNA. Their foresight paid off in November 2020, when Willa’s genes were injected into an embryo, zapped ‘awake’ with a bolt of electricity, and implanted into the uterus of a domestic ferret, who gave birth to Elizabeth Ann in December 2020. ‘Cloning, itself, is actually not cutting-edge,’ says Ben Novak, lead scientist at the California-based non-profit Revive & Restore, which led the black-footed ferret project. ‘What’s really innovative about what we’ve done is that we reached back in time to bring back something that had been lost.’

The greatest threat to endangered species such as the black-footed ferret is the loss of genetic diversity, Novak says. Genetic variation bolsters a species' fitness, or its ability to bounce back from environmental stresses such as disease, habitat loss, and climate change. Critically, diversity lowers the risk of inbreeding within a species. 'Inbreeding creates problems for [an animal's] fertility, so they end up having fewer offspring, which of course leads to less diversity,' Novak says.

Many endangered species don't see an influx of new genetic material. That's when genetic rescue – a range of techniques that includes everything from low-tech fixes such as introducing new individuals into closed populations, to high-tech solutions like cloning and genetic engineering – can revive these dwindling species. One of the first steps of genetic rescue, though, is to map a species' genetic information, or genome.

'It's a cascade of information,' says Oliver Ryder, PhD, about the genome. The director of conservation genetics at San Diego Zoo Wildlife Alliance and head of the Frozen Zoo explains that the order of the genetic information within a species' genome can dictate things like fur colour and resistance to disease, but also reveal an evolutionary phenomenon called a genetic bottleneck – essentially a point where a species' genetic diversity shrinks. The roughly 400 to 500 black-footed ferrets alive today – except for Elizabeth Ann – are descended from a gene pool of just seven individuals.

With the genome sequenced, scientists can decide which methods of genetic rescue will benefit the species most. The cloning method used to produce Elizabeth Ann won't work on a reptile or bird, for example, because those types of animals have complicated reproductive strategies and hard-shelled eggs. 'Cloning is not the silver bullet to saving endangered species, but it can be a valuable tool, infusing unique genetic material into managed breeding and wild populations,' says Paul Marinari, PhD, a senior curator at the Smithsonian Conservation Biology Institute, who manages the Species Survival Plan for black-footed ferrets.

In the future, Novak's team hopes to combine reproductive technologies such as cloning with genetic engineering. Even though Elizabeth Ann has a separate genetic lineage than all other black-footed ferrets alive today, her genetic material stems from the same population, a group of ferrets once native to Wyoming. Researchers could increase genetic diversity further by mapping the genome of extinct black-footed ferret populations native to another region, say Texas, pinpoint sections of their genetic code with beneficial traits, and then edit those traits into the DNA of future clones.

This strengthens the case for the kind of DNA sample collection that scientists performed on Willa in the '80s. Elizabeth Ann is alive today because Willa's cells were cryopreserved years ago. Not all endangered species have preserved tissue around for scientists to work with.

Novak is hopeful that continued preservation practices will eventually pay off. 'People could be going out and saving the genetic diversity that exists in rare species,' he says. A tissue sample the size of a grain of rice could save a species like the California condor or the mountain gorilla from future extinction. Biological samples from insects, birds, and reptiles could prove valuable, too, while we wait for cloning methods to catch up to the nuances of nature's various reproductive methods.

After all, it was forward thinking that led to Elizabeth Ann's birth. 'There was no technology at the time that could have made those cells into an animal again,' Novak says. 'They were banking those with the hope that some day it was coming.' **PM**

DE-EXTINCTION DEMYSTIFIED

Reviving long-dead animals sounds like sci-fi. But advances in genetic engineering could some day allow scientists to resurrect extinct species like the passenger pigeon, little bush moa, and even the woolly mammoth.



QUAGGA

LAST SEEN: 1883
The South Africa-based Quagga Project is working to revive the extinct quagga, a striped plains zebra subspecies. In 1983, scientists mapped the Quagga's genome, the world's first mapped genome of an extinct species.



THYLACINE (TASMANIAN TIGER)

LAST SEEN: 1936
The Thylacine Cloning Project replicated some Tasmanian tiger DNA in 2002, but couldn't complete a genetic picture of the animal. In 2017, scientists finally sequenced the species' entire genome.



WOOLLY MAMMOTH

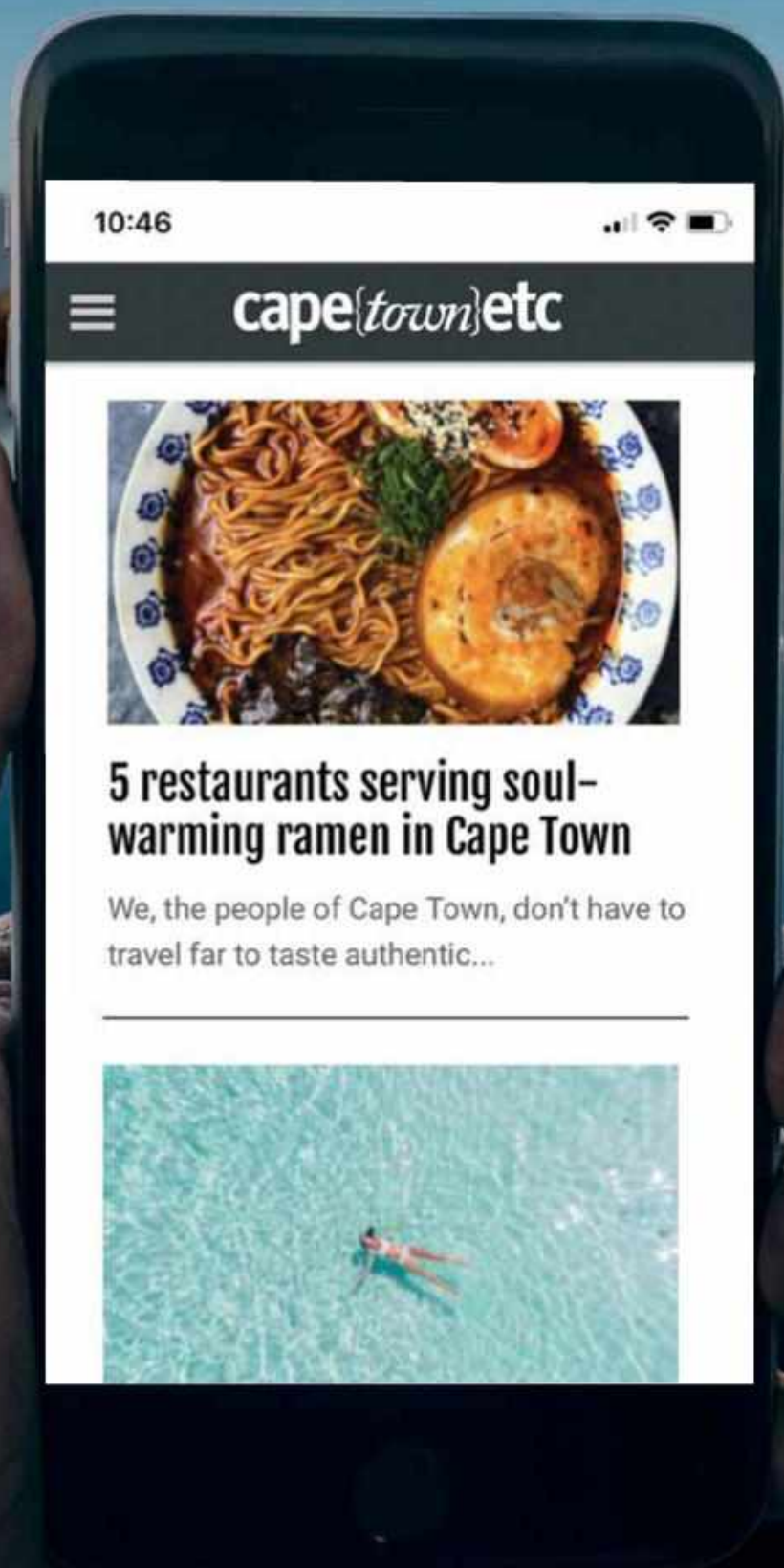
LAST SEEN: 1650 BC
Revive & Restore believes that by tweaking the genome of the Asian elephant – the closest living relative of the woolly mammoth – they could create a hybridised 'mammophant'. But it's estimated to cost tens of millions of dollars and is reliant on degraded DNA samples.

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CAPE TOWN FOR CAPETONIANS



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Scientists just figured out how to turn your body into a battery

With this device, a brisk walk could generate enough electricity to power your fitness tracker.

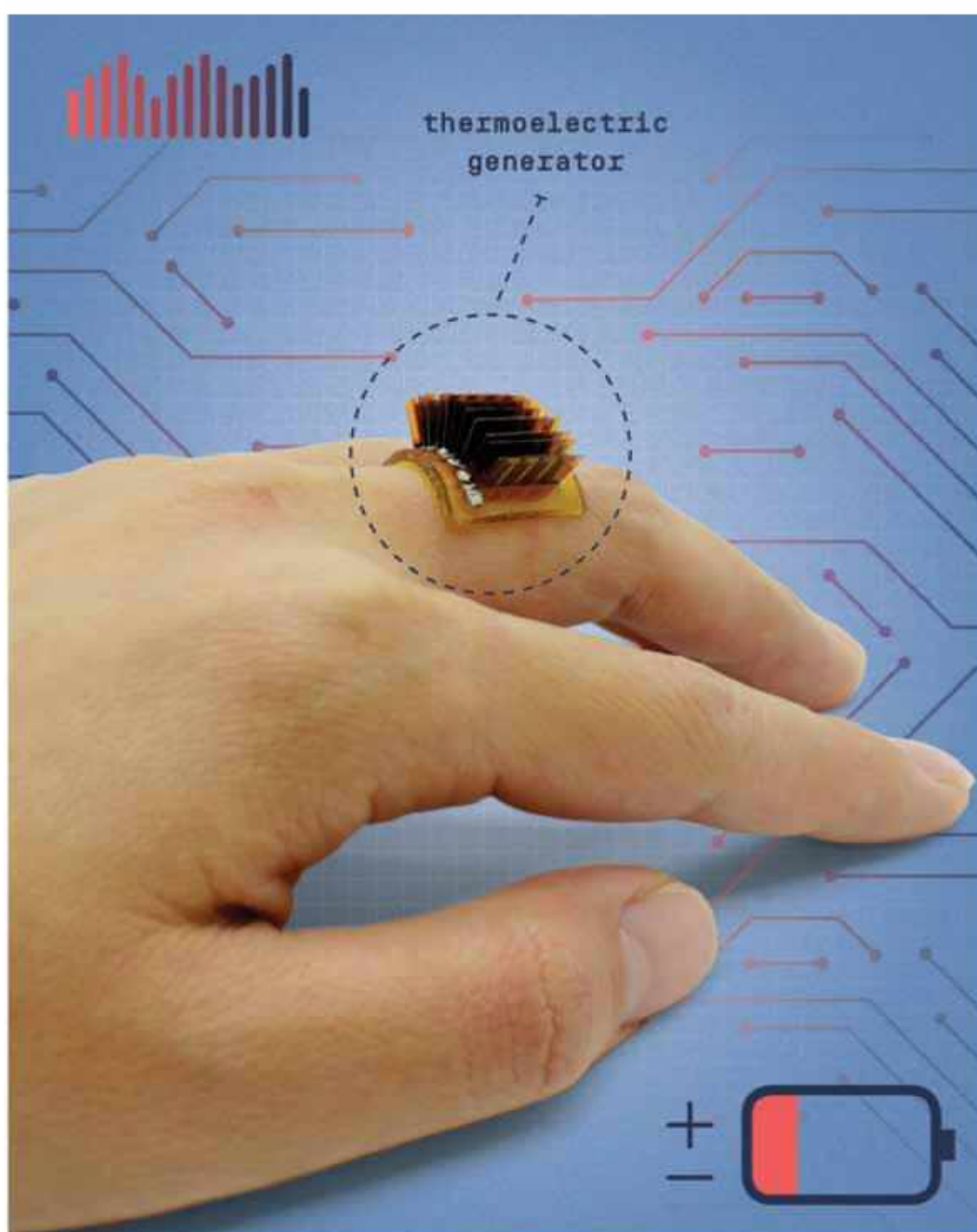


PHOTO ILLUSTRATION: ALYSE MARKEL USING PHOTO COURTESY XIAO LAB

PACEMAKERS, DRUG DELIVERY PUMPS, Fitbits, and other wearable devices could soon run on a new kind of renewable energy: you.

A tiny new wearable gadget called a thermoelectric generator (TEG) directly turns your body's heat into electrical energy. TEGs use a difference in temperature – such as your body's temperature versus the surrounding air – to turn that energy into power. To establish equilibrium, heat automatically dissipates into cooler locations, and TEGs harness the electric current produced when energised particles move from hot to cold along a chip.

That's convenient, since body heat is a pretty stable resource. To maintain a constant temperature of about 37°C (98.6°F), your body must regulate a tight balance between heat gain and heat loss. And because your body isn't actually that efficient, you lose approximately 75 per cent of the energy it produces through heat.

While the part of the gadget that touches your skin turns your warmth into energy, the wearable shields its cold side from the Sun's rays with a wavelength-selective film to preserve the temperature differential.

But this gadget's success as a wearable comes down to its extreme flexibility and self-healing properties, which allow it to bend with your body and bounce back from damage. A special material embedded inside the gadget heals itself from cuts by resealing breaks on a micro level. It's flexible because each component is flexible in turn, like building elastic circuitry on a rubber band by using stretchable wires.

Ronggui Yang, a professor of energy and power engineering at Huazhong University of Science and Technology, who was involved in the study, says that this design vastly improves on previous, more rigid wearable thermoelectric generator designs.

That's thanks to a few significant enhancements. For the substrate, or base, of the wearable, Yang's team combined three commercially available compounds to synthesise a stretchy polyimine material. The resulting substrate is bendy, sort of like a rubber bracelet.

By laser-cutting slits into this polyimine substrate, the researchers created small notches for the power-generating thermoelectric chips. To create a wearable of a different size or shape, the scientists can simply cut in more notches to add more chips, or reorganise their order.

The end result: ‘superior stretching, self-healing, recycling, and Lego-like reconfiguration capabilities,’ Yang says. These qualities mean that the final product is durable like never before.

The researchers say the flexible design will tile and stack, allowing for many kinds of devices with the same basic pieces. While the team of researchers – made up of scientists from China and the University of Colorado Boulder – behind the stretchable device tested their TEG in the form of a small ring, this modularity and scalability means that the tiny generator could theoretically be larger, depending on how much power you want to generate. The greatest amount of power could be gathered by, for example, a Fitbit-like ‘sports bracelet’ that powers a watch – or even a full sleeve of modular ‘generator’ cells.

These new forms of TEG could create even more power, charging up devices with higher electrical requirements. Still, considering that these wearables can generate only about one volt of energy for every square centimetre of skin space, which is less voltage per area than most existing batteries, there’s still work to do. An AA or AAA battery is rated 1.5 volts, for instance, and that’s about how much power it takes to run some insulin pumps.

Batteries, for their part, are a pretty dirty technology that sometimes use rare-earth metals and corrosive materials. When batteries break down in landfills, the chemicals inside – including hydrochloric acid, the same stuff found in your digestive tract – leach into the soil, contaminating ground and surface water. Lithium-ion batteries, which are common in fitness wearables, frequently explode and catch fire in landfills, releasing noxious greenhouse gases.

If your body could do the same work as a watch battery with cleaner, more recyclable technology, that’s a win for the environment. Yang’s wearable even features completely recyclable technology. You can simply soak the TEG in a special recycling solution for six hours at room temperature, causing the polyimine substrate to break down.

Better yet? For people with implanted medical technology such as pacemakers, wearable batteries like this TEG could mean a future without battery-replacement surgery. According to Johns Hopkins Medicine, patients with pacemakers must undergo this kind of surgery every five to 10 years, as the lithium-ion battery inside their implant starts to fail.

The TEG design may seem lofty and complex. In reality, it’s just a masterfully balanced combination of technologies

IF YOUR BODY COULD DO THE SAME WORK AS A WATCH BATTERY WITH CLEANER, MORE RECYCLABLE TECHNOLOGY, THAT’S A WIN FOR THE ENVIRONMENT.

meant to open the door to personalisation. Yang says users will be able to customise circuitry on their own using something as simple as a home soldering kit. Enthusiasts could even build out their own custom wearable tech with the exact number of battery cells they desire.

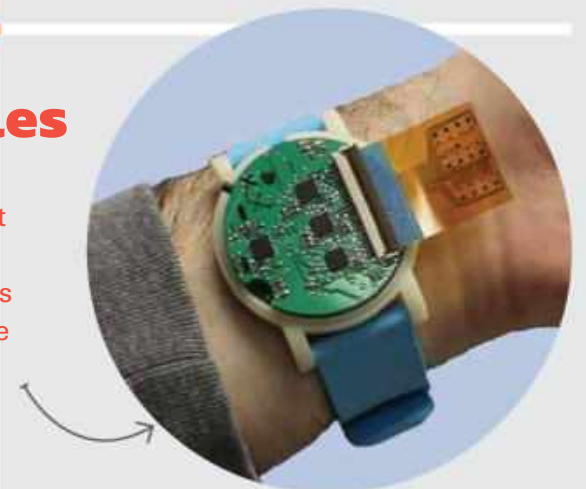
The best part? You could see these wearables in stores in the next five to 10 years, the researchers believe, with medical devices to follow. In the meantime, don’t toss that Fitbit charger. **PM**

Sweaty wearables

When it comes to wearables, body heat isn’t the only human by-product that scientists are interested in. Researchers at North Carolina State University have developed a **wearable prototype** that uses your sweat to provide an overall picture of your health.

Using a replaceable test strip embedded with chemical sensors, the device can measure the amounts of certain metabolites present in your sweat to analyse your body’s glucose, lactate, pH, and temperature levels. One day, that could tip off your doc to underlying health conditions.

‘We’re optimistic that this hardware could enable new technologies to



reduce casualties during military or athletic training, by spotting health problems before they become critical,’ says Michael Daniele, an assistant professor of electrical and computer engineering at NC State who was involved in the work. – Courtney Linder

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5	R	64,995.00	R 18,198.60	R 4,549.65	R 4,549.65	R 4,549.65	R 4,549.65	R 73,444.35	R 109,841.55
10	R	129,990.00	R 36,397.20	R 9,099.30	R 9,099.30	R 9,099.30	R 9,099.30	R 146,888.70	R 219,683.10
20	R	259,980.00	R 72,794.40	R 18,198.60	R 18,198.60	R 18,198.60	R 18,198.60	R 293,777.40	R 439,366.20

STANDARD TERMS AND CONDITIONS APPLY E&OE

A small nuclear reactor might help solve Amelia Earhart's disappearance



ON 2 JULY 1937, AMELIA EARHART AND her navigator, Fred Noonan, were en route from Lae, Papua New Guinea, to Howland Island in the Pacific, about 2 700 km southwest of Honolulu, in their Lockheed Model 10 Electra. By then, Earhart had already become the first woman to fly solo across the Atlantic and the first person to fly solo from Hawaii to the US mainland; yet her globetrotting trek was to be a crowning achievement for the aviation pioneer.

Noonan and Earhart atop the Lockheed Model 10 in which they ultimately disappeared.

But Earhart and Noonan never made it to Howland, and researchers have spent decades searching the surrounding ocean for any sign of the Electra, Earhart, or Noonan. With no definitive clues to what happened on 2 July, a cottage industry of Earhart theories and hoaxes has attempted to fill in the fateful details: possible Earhart skeletons, an argument that her remains were scattered by giant crabs, first-hand accounts of people who claim to have seen Earhart, and suspected pieces of plane debris.

That latter group includes one particular piece of aluminium that Richard Gillespie, head of the International Group for Historic Aircraft Recovery, found in 1991 on the island of Nikumaroro, roughly 480 km from Howland Island. In global terms, and with our limited understanding of Earhart's distressed flight, that's just a stone's throw. And a popular theory holds that Earhart and Noonan landed on the island's reef after missing Howland.

While design plans and photos of the Electra have shown that the metal may have come from the plane, the field of neutron science could finally determine whether it's a legitimate clue.

Daniel Beck, the manager of the engineering programme for the Penn State Radiation Science and Engineering Center (RSEC), home to the Breazeale Nuclear Reactor, invited Gillespie to test the scrap at the university using reactor-generated neutron radiography, after seeing Gillespie and the aluminium sheet in a documentary on Earhart. Using a form of imaging that utilises neutrons to show what the inside of objects look like, Beck's laboratory can see trace amounts of substances, such as paint, that look to the naked eye to have worn off.

'The neutron radiography provides us with an image that is analogous to an X-ray image you may have taken for a broken bone,' say Beck and his colleague, Kenan Ünlü, PhD, director of Penn State's RSEC.

Inside the one megawatt Breazeale reactor, neutrons are gathered into ports and aligned into a beam. The neutron beam – with the help of bismuth and sapphire crystals, which remove the reactor's gamma rays that cloud results – is then transmitted through an object, with



The Breazeale Nuclear Reactor, which first went critical in 1955, at Penn State in State College, Pennsylvania.

neutrons being absorbed differently by certain elements, such as hydrogen and carbon. The neutrons are measured by an imaging plate behind the artefact to produce its X-ray equivalent.

The Penn State scientists will also study the edges of the patch to understand how it was removed using a second technique called neutron activation. One side of the metal, they say, appears to have axe marks. The neutron beam can identify any axe material that could be left in quantities as small as in the parts-per-million.

The patch will require months of detailed study, but Ünlü and Beck expect to release findings soon. Even if the researchers determine that the metal has no ties to Earhart, eliminating the artefact still aids in the search for answers, says Gillespie. And Ünlü and Beck believe that, either way, the testing will advance the search for Amelia Earhart. 'Each step towards solving this mystery keeps the intrigue fresh and creates discussion that leads to more findings,' they say. **PM**

PHOTOGRAPHY: CERN (LHC), PENN STATE UNIVERSITY/KENAN ÜNLÜ (REACTOR), GETTY IMAGES



A GIANT MYSTERY, SOLVED BY PHYSICS

In July 2012, researchers announced that they had observed the elusive Higgs boson at CERN's Large Hadron Collider (LHC). Scientists working independently on the ATLAS and CMS particle detectors both measured a new subatomic particle

that was similar in make-up to the theorised Higgs boson particle.

After nearly a year of further analysis, scientists confirmed the 'measured interactions of the new particle with other particles' strongly indicated it was indeed a Higgs boson

particle. The discovery validated decades of work and furthered our understanding of the Standard Model, a group of theories explaining how the building-block particles for everything in the universe interact with each other. – Daisy Hernandez

GEAR & GADGETS

Must-have hardware for humans on the go

STANLEY QUICK FLIP WATER BOTTLE RANGE

IT'S HARD TO BEAT the enjoyment of an ice-cold drink after a long, hot day spent in the great outdoors. Or perhaps you're on a road trip and need to fend off the winter chill with a steaming coffee. Tried-and-trusted brand Stanley has created the perfect solution in the form of the Quick Flip Water Bottle range that not only looks great, but also functions exactly as it's supposed to. While they're called 'water bottles', they're certainly much more than just that...

There are several size options to choose from – 0.47 L (16 oz), 0.7 L (26 oz), and 1.06 L (36 oz) – and depending on which one you choose, you can expect them to keep your beverage ice cold for seven to 18 hours, or hot for five to 10 hours. The 1.06 L option will retain ice blocks for up to 2.5 days!

All of the bottles feature double-walled vacuum insulation constructed from corrosion-resistant 18/8 stainless steel. The clever quick-flip lids make for easy drinking while on the go, but they also seal leak-free, with a stainless-steel clasp that clips over the push-button lid as an extra safety measure against spills. The bottles are BPA-free, dishwasher safe, car cup-holder compatible, and come in a variety of interesting colours.

According to the packaging, Stanley bottles have endured '-55°C wind chills, speeding bullets, 4 000 foot drops, and category 5 hurricanes', so they should survive your adventures. And if they somehow don't, there's always the lifetime warranty to fall back on.

RRP from R605

awesometools.co.za



KEEN

TARGHEE III MID WATERPROOF BOOTS

The Keen shoe brand, out of the USA, is all about creating functional, hard-working, well-made and comfortable outdoor footwear. And the good news is that Cape Union Mart is now stocking several of their products.

The Targhee III hiking boots are fully waterproof, thanks to the KEEN.DRY breathable membrane that keeps rain, puddles, and dew out, but still allows moisture from your skin to dissipate so your feet remain dry and comfortable. The uppers are made from ethically sourced leather and performance mesh, and the generously proportioned toe box provides space for your toes to spread out, a much healthier situation for your feet when you're walking for hours on end. The rubber outsole boasts 4 mm multi-directional lugs, delivering extra grip when you need it, while the rubber toe cap wraps right over the front of the boot, giving added protection for your feet, and extra durability for the boot.

A stability shank is built into the sole, a much-desired feature when carrying a heavy backpack, as it offers added support to your feet. Eco Anti-Odour technology keeps stinky smells at bay, something your fellow hikers will appreciate. The long-lasting polyurethane insole is designed with arch support in mind, and the footbed as a whole cradles the natural contours of your foot.

At around 480 g, these are excellent lightweight yet durable boots for wherever your adventures take you.

RRP R2 499

capeunionmart.co.za



RAZER

KRAKEN V3 HYPERSENSE WIRED USB GAMING HEADSET

If you're familiar with Razer, you'll know that HyperSense, the brand's intelligent haptics ecosystem, is particularly special. So, when we saw that Razer's Kraken V3 headset had a HyperSense model, we knew it would quickly become an audio favourite of ours.

What does it mean to have a headset powered by haptic technology? Imagine being able to feel what you hear – rumbling explosions, whizzing bullets, the ground shifting beneath your feet. It's similar to when your game controller used to shake in your hands and you got the fright of your life when a monster appeared ... but this time it's in your head. That said, it isn't an overwhelming experience – the Kraken V3 HyperSense headset is all about multisensory gaming that feels natural. Each ear cup is fitted with cutting-edge haptic drivers that convert audio cues into vibrations, and what's particularly impressive is that this isn't something that requires additional drivers or complex installation. This is intelligent audio processing that works across games, music, and movies. This technology is for anyone who's looking for a much more immersive audio experience, which is advanced even further by the 7.1 surround sound and true-to-life acoustics. Sure, the device might be wired, but when you experience the haptic feedback, you'll realise that slight compromise is worth it.

RRP R2 999

evetech.co.za

DRILL DOCTOR 500X

The notion of sharpening your drill bits might seem complicated, and not worth the effort. That's probably because you don't have a Drill Doctor 500X in your garage or workshop. This device is perfect for hobbyists, or even professionals, who need to frequently sharpen bits that have lost their edge. Once you've invested in the machine, you'll be spending far less money on buying new bits, as you can prolong the lives of the ones in your toolbox. What that means is less unproductive downtime, making unnecessary trips to the hardware store.

It can sharpen bits to 118° or 135° point angles. It's designed to accommodate carbide, cobalt, high-speed steel, black oxide, tin-coated, twist and masonry bits. The machine's longer chuck jaws hold your bits more precisely, which eliminates twisting of smaller bits. The 500X is even able to create and sharpen split-point bits.

The machine's magnet motor provides consistent power, regardless of the speed or load, which ultimately means better sharpening results. When the times comes, the 180-grit diamond sharpening wheel is easy to replace, prolonging the effectiveness of the sharpener. For added peace of mind, it comes with a three-year warranty.

RRP R4 790

vermontsales.co.za



K-WAY SCORPION TWO-PERSON HIKING TENT

This compact tent has been designed for lightweight adventures, when you're trying to eliminate every unnecessary gram from your backpack. Yet in spite of its lightweight nature, it'll still accommodate two adults, though the fit will be quite snug. If you're on your own, there will be space for you plus your backpack alongside you when you settle in for some shut-eye. The dimensions when it's set up measure 2.1 x 1.4 x 1.1 m.

It's fully waterproof, with a respectable 2 500 mm waterhead. The bathtub-style groundsheet section, as the description suggests, has high sides, so if there's water run-off underneath the tent during the night it won't make it inside. The nylon mesh inner tent can be set up on its own, protecting you from mosquitos and other unwanted guests of the insect and reptile variety, but be sure it's going to be a clear, dry night. If heavy dew or rain is predicted, definitely go for the full set-up with the fire-resistant 210T ripstop polyester flysheet.

There's a single zipper door, one of the ways weight has been kept to a minimum, and packed away the tent measures only 410 x 145 x 145 mm, compact enough to slip down the side of a backpack. The poles are aluminium, so lightweight yet strong, and the orange guy ropes are easy to see, so there's less chance of tripping over them at camp.

RRP R1 999

capeunionmart.co.za



MSI

PULSE GL76 12UGK

MSI TEAMED UP WITH Belgian 3D artist Maarten Verhoeven when creating the Pulse GL76, integrating his distinct Dragon Warrior concept in the design. The detailing of the titanium grey metal body resembles armour, a theme that's carried through on to the keyboard and cooling vents.

This ultra-fast gaming laptop boasts a 17.3" full HD display with a 360 Hz refresh rate – yes, this is a hefty device, that certainly doesn't pretend to be lightweight and easy to transport. But that really wasn't the objective here. Its dimensions are 398 x 273 x 24.2 mm, and it weighs 2.8 kg. The key specs list clearly shows MSI's intentions with this device... The graphics processing unit is NVIDIA's GeForce RTX 3070 8 GB GDDR6, a card that's ideally suited to high-paced gaming and 4K video. The 12th Gen Intel Core i7 CPU offers up exceptional responsiveness, and a significant performance upgrade on the previous model. On-board storage is a noteworthy 1 TB, and there is 16 GB of RAM. There is a four-cell 90 Wh battery.

Along with high performance comes high temperatures, which is why the Pulse GL76 has two fans and six cooling pipes, the design of which has been improved for optimal heat dissipation. There is no shortage of ports – these include one Type-C USB 3.2 Gen 1, two Type-A USB 3.2 Gen 1 sockets, one Type-A USB 2.0, one RJ45 (for LAN connections), one HDMI (4K at 60 Hz), and an audio jack combo. Customising the keyboard backlight colour is a cool feature, enabling you to align the lighting with your gaming style or mood.

Though it looks good, the true appeal of this notebook is its gaming performance and silky smooth visuals, and in that respect MSI has certainly nailed it with this device.

RRP R44 999

computermania.co.za





OPPO

RENO7 5G

OPPO CONTINUES TO cause a stir in the smartphone arena, with the recent launch of its new flagship model, the Reno7 5G. Incredibly, it can be charged to 100 per cent in less than 35 minutes, good news for those of us who don't have time to get bogged down by a phone with a flat battery.

It features a 6.4" AMOLED screen, with a 90 Hz refresh rate and a 180 Hz touch sampling rate. This tech offers up a better all-round user experience, where content appears more vivid and touch gestures are registered more smoothly.

It comes with 8 GB of RAM and 256 GB of onboard storage as standard. With OPPO's RAM Expansion Technology, an additional 2, 3 or 5 GB of temporary RAM can be allocated from unused ROM. The large 4 500 mAh battery is fast-charge compatible; just five minutes of charging will give you two hours of gaming time, or four hours of streaming. The chipset includes support for 5G and WiFi 6 connectivity, which bodes well for mobile gaming experiences.

On the photography front, Portrait Mode is sure to become a go-to feature for users. It delivers DSLR-like images, without the fuss of carrying a bulky camera around.

Despite its high-paced performance, the Reno7 is slim and light, measuring 7.81 mm thick and weighing 173 g. It comes in two attractive colours, and is available from MTN, Vodacom, Cell C, Telkom, and selected retailers.

RRP R14 999

[oppo.com/za](https://www.oppo.com/za)

XIAOMI MI MINI VACUUM CLEANER

We're not out to judge ... but remember that time you were watching a movie in bed and accidentally tipped a bowl of popcorn over your laptop's keyboard? Accidents happen, but sometimes it's not so easy to do a quick clean-up. Actually, we take that back... With Xiaomi's Mi Mini vacuum cleaner, it's never been easier.

While USB-charged vacuum cleaners are not uncommon these days, the 13 KPa max sucking ability and super portability of the Mi Mini is unmatched. The vacuum is only 26 cm long, and comes with a clever two-in-one nozzle option (which can be used separately or together) and a charging cable. It features a high-performance brushless motor and a straight dual-vent design that's said to reduce energy loss and improve cleaning efficiency. In one charge – and the push of one button – the Mi Mini can keep going for about 30 minutes at two different suction speeds. When you're finished cleaning, it's extremely easy to empty out the dust canister – simply pop off the top, and shake it out.

Beyond a regular clean-up of your grubby desk, the Mi Mini is ideal for a quick car clean, reaching into those hard-to-reach spots, and going wherever your old-school chunky vacuum simply can't reach.

RRP R999

incredible.co.za



LINKSYS AC1000 DUAL-BAND WIFI 5 ROUTER

Getting online can sometimes be complicated, but this no-nonsense router from Linksys changes all that. Ideal for a small office, apartment or single-storey house, the AC1000 Dual-Band WiFi 5 router is a mid-range device with a slim design that's simple to operate.

The set-up process is super-straightforward. In only our first attempt, we managed to get it up and running in less than five minutes. While it comes with an easy-to-follow instruction sheet – a useful inclusion if you're not at all tech savvy – you can use almost any smart device to take you through the browser-based installation process... Plug it in, launch the browser site, choose a password, and you're good to start surfing the web.

Tucked away on the back are four Ethernet ports for fast wired connections and quick file transfers. The AC1000 has WPA2 encryption and an SLI firewall, which provides added online protection. The guest access system lets you give WiFi access to visitors using a different password to your regular one. The router has parental controls, too, allowing you to restrict access to content, control usage, and oversee which devices are able to access the web.

The Linksys AC1000 is a solid option if you're looking for an affordable router that offers good range, speed and security.

RRP R1 199

builders.co.za



FESTOOL PHONE CHARGER PHC 18

The battery life of some smartphones just isn't up to snuff. If you're someone who is always on the move, and you also need to stay in contact with the outside world, Festool's PHC 18 is the way to go.

This slick phone charger serves as an adapter, transforming every 18 V Festool battery pack into a reliable and heavy-duty power bank (with the exception of the 3.1 Ah Ergo battery packs). You also don't need a cable to use it, assuming your phone is compatible with inductive charging. Simply attach the Festool charger to the battery pack, then lie your phone on the inductive charging panel. Of course, should you need them, there are USB-A and -C ports, and you can use all three simultaneously, charging three devices at once.

When combined with a fully charged 5.2 Ah Festool battery pack, you'll be able to charge a 3 000 mAh smartphone battery up to eight times.

This is a robust charging device with a tough rubberised finish, that's perfectly suited to hardworking environments, such as the worksite or warehouse.

RRP R1 565

vermontsales.co.za, festool.co.za

WANDERSAFE BEACON

Whether we like it or not, we now live in a world where wearables, or personal 'Internet of Things' devices, include items concerned with our safety. The Beacon by WanderSafe is a must-have device for solo travellers, students, those who exercise at night or in remote areas, or anyone else who would feel safer carrying a digital panic button.

The Beacon is the size of a key ring, designed by a female travel professional and retired CIA officer. It's particularly useful in countries where defence measures such as pepper spray are illegal; it's a non-violent emergency option that you can take with you, anywhere.

It pairs with a smartphone app, which has a virtual safety concierge named JENI that offers curated safety tips based on your location. Its design is smart, too – the anti-slip grips make for easier handling in wet weather, and it can be used in either hand. Among its key features is a 140-decibel twist-to-engage personal alarm, a strobe light designed to disorientate and fend off an assailant, and a 1 000-lumen torch beam for illuminating a potential threat. Most importantly, when you press the activation button, the Beacon sends an SMS notification to three preset contacts, including exact map coordinates, and it states that you need to be called, urgently.

RRP ±R1 800 (plus shipping)

wandersafe.com





SHIFU ORBOOT INTERACTIVE EARTH GLOBE

Children love globes, so what could be better than one that comes alive with augmented reality? While gazing at different continents and countries can be interesting, this STEM gadget from Shifu adds a new dimension to learning by including visual storytelling, music, animal facts, world quizzes, globe puzzles, challenges and more. And no batteries or Bluetooth connectivity is needed.

Once you've downloaded the free companion Orboot app, the interactive globe works with any smart device. Simply scan the different icons to uncover cool facts across six main categories – cultures, cuisines, monuments, inventions, animals and maps. There are several different ways to interact with the globe using the app, and we particularly liked the mystery mode where clues lead you to different parts of the world.

If your kids are obsessed with atlases, facts or geography, they will get a lot out of the Shifu Orboot. The different countries are brought to life in an interactive and educational way that makes screen time that much more meaningful. In addition to the globe, there's a passport to fill in as well as stamps and country flag stickers to track your child's journey around the world.

RRP R899
toysrus.co.za



KREG PANEL CARRIER

Lugging large panels of wood around your workshop or construction site can be tricky business, especially when you're trying to get the job done as quickly and efficiently as possible. Dropping something is not only going to cause damage to your expensive hardware, it might also result in an injury such as a crushed foot, or worse.

Kreg's Panel Carrier has an ergonomic grip that's linked to a sturdy set of clamp jaws. Simply slide the large jaw pads over the panel of wood you want to carry, lift up on the handle to clamp the material, and the tool automatically adjusts to the right thickness, up to 2 cm.

The pads are covered with Kreg GripMaxx, a non-slip material that won't cause damage, dents or marks, even if you're carrying fragile plywood veneers. This is a highly useful tool that all avid woodworkers should have in their kit.

RRP R589

vermontsales.co.za





AMIGA A500 MINI

Remember the good old days of blocky graphics and gaming? If you're feeling somewhat nostalgic, the A500 Mini is a device you'll want to hear about, in all its pixelated glory. It's a minicomputer that's been created to bring back the heights of 16-bit gaming from 30 years ago. It even comes with an original-style two-button mouse, as well as a newly engineered eight-button precision gamepad.

After plugging it into a screen or smart TV, you'll be fully immersed in a 50 Hz world of Commodore Amiga. The A500 mini includes 25 classic games and you can expect to rediscover favourites such as *Alien Breed 3D*, *Another World*, *Battle Chess*, *Pinball Dreams*, *QWAK*, *Simon the Sorcerer* and *Worms*. But what happens if your favourites aren't there? (*Lemmings*, we're looking at you...) You can easily add more games using a USB thumb-drive. Plug one in and you'll be presented with a QR code that takes you straight to WHDLoad bundles, also known as Amiga software packages. So while you could, in theory, buy a Raspberry Pi for retro game emulations, this is far less complicated ... and you'd be missing out on the whole Amiga look-and-feel that the A500 Mini brings.

RRP R2 299

btgames.co.za

ASUS VIVOBOK 15 OLED

You probably think that this 15" laptop looks good – with its minimalist design, 6.1 mm bezel and 85 per cent screen-to-body ratio, it's definitely got that going for it. But there's a whole lot more to this device, one of the most affordable OLED display notebooks available in South Africa.

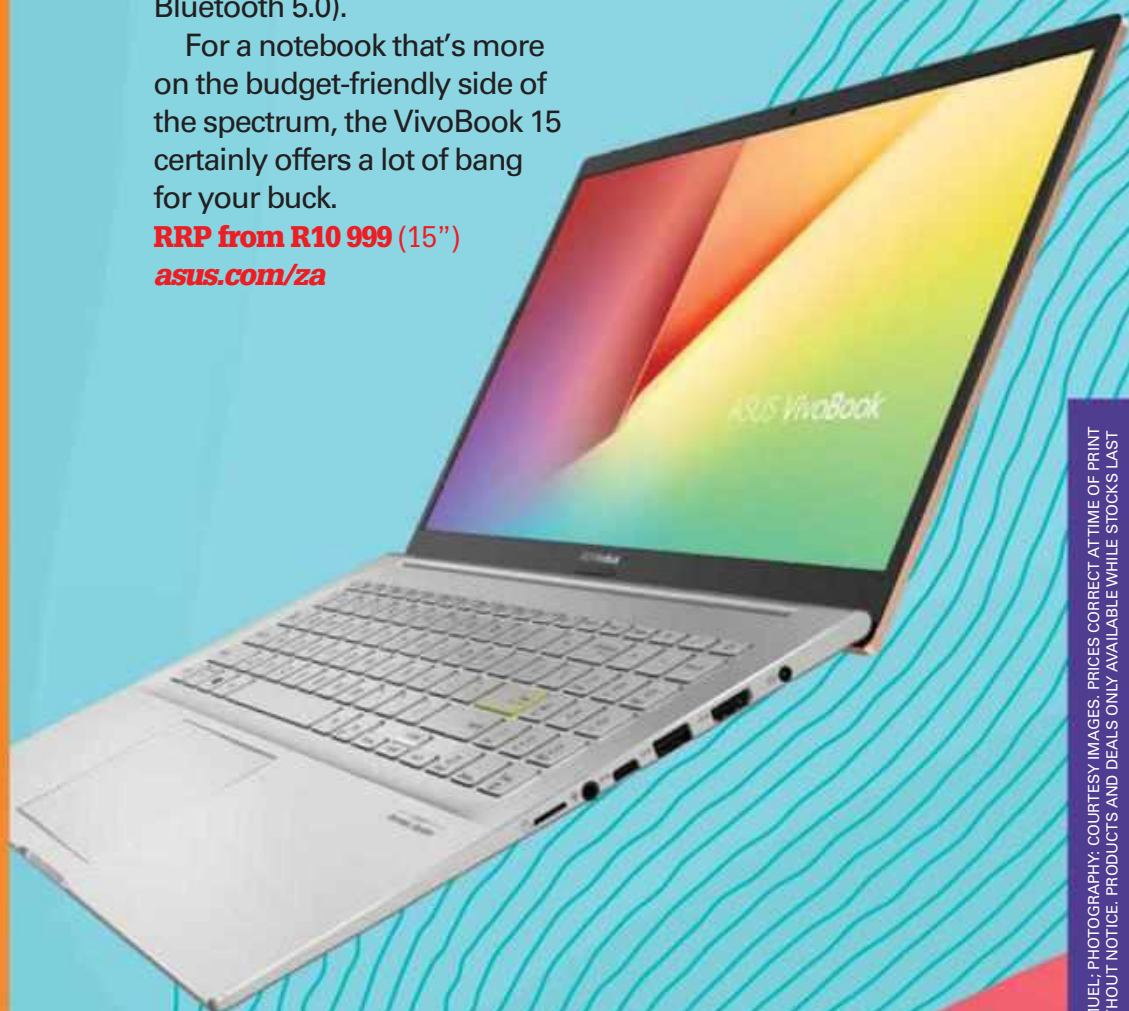
One of the standout features, especially at this price point, is the OLED display. OLED, or organic light-emitting diode, works without a backlight, because it itself emits visible light. Practically, this means screens that are thinner, and a crisp display with deeper blacks, as well as higher contrast ratios regardless of ambient light conditions. It has a 178° viewing angle, a wide-view panel that delivers excellent colour variation, especially if others are viewing your screen.

It boasts up to a quad-core 11th Generation Intel Core i7 processor and NVIDIA's GeForce MX350 graphics card. These will handle multiple apps simultaneously, as well as gaming while on the go. Storage options on the i7 are up to 1 TB. A fingerprint sensor is optional, while connectivity is fast (WiFi 6, and Bluetooth 5.0).

For a notebook that's more on the budget-friendly side of the spectrum, the VivoBook 15 certainly offers a lot of bang for your buck.

RRP from R10 999 (15")

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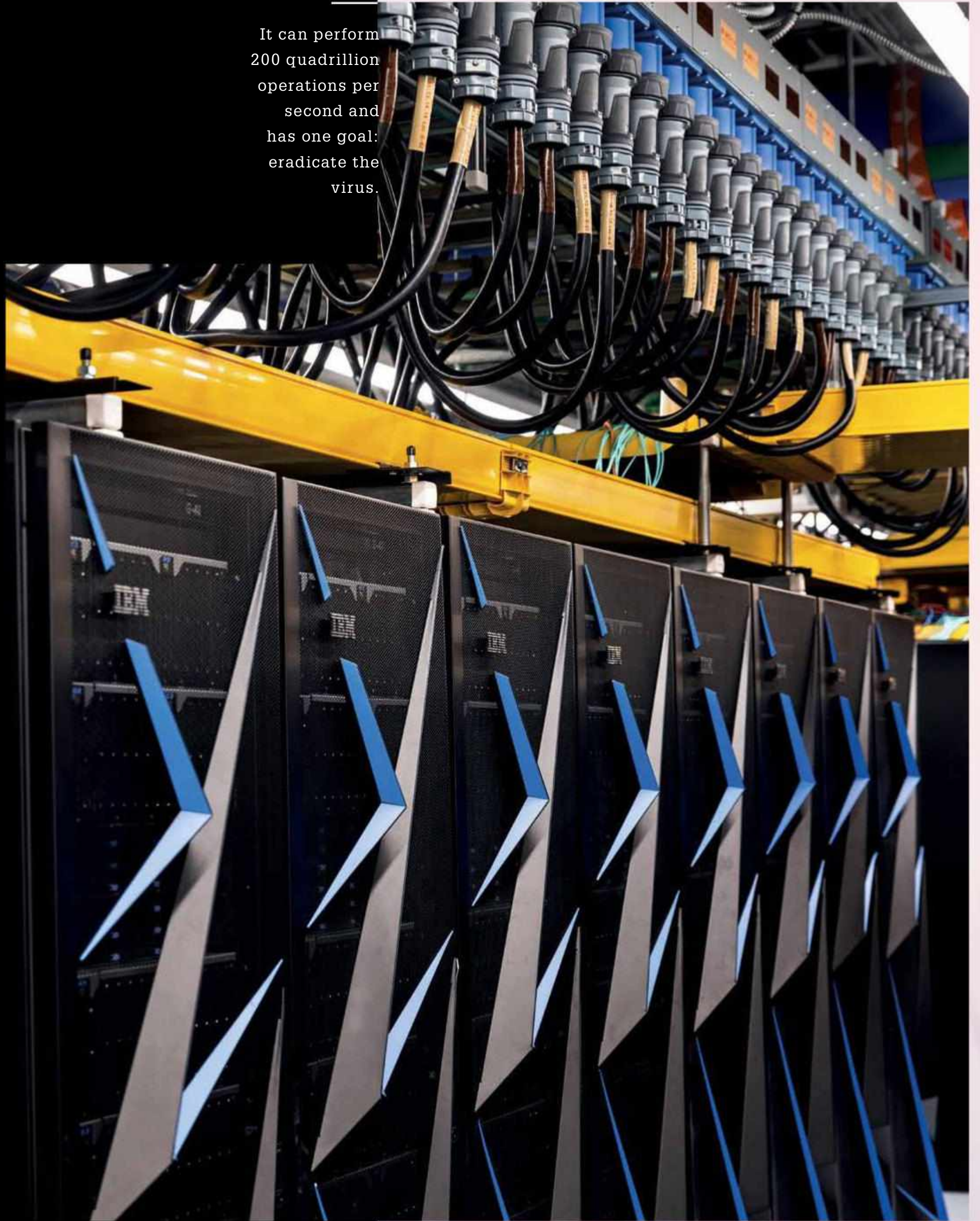
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It can perform
200 quadrillion
operations per
second and
has one goal:
eradicate the
virus.





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Marti Head, PhD, had a bad feeling. It was mid-February of 2020. She'd just returned to her home in Tennessee from a work trip. Somewhere, probably in an airport, she'd picked up what she thought was just a cold.

Sure, physically she felt crappy. But the bad feeling, which she described as 'itchy', came from the news coming out of China. A career spent working with infectious diseases had given Head all the info she needed on what, exactly, the novel coronavirus might be capable of.

And so, when her nose started running and her throat got scratchy, Head quarantined herself and her husband. Instead of watching trashy TV in bed to recover, she tucked into her quarantine cocoon of a home office – with tissues and tea at hand – and started hunting.

Head is a drug hunter. A computational chemist by training, Head uses complex computer simulations to search for molecules that can gum up the gears of a virus hell-bent on infecting human cells. She focuses on

therapeutics – the things doctors rely on to treat disease. Head spent decades at a major drug company searching for drugs that would combat diseases, including viruses like HIV. But in February of 2020 she was working at the Oak Ridge National Laboratory, in Oak Ridge, Tennessee. Moving to the public sector meant Head had an obligation to find something, anything, that might serve the public good in this time of crisis. It also meant that she had access to one of the most powerful supercomputers in the world.

While the most visible war against COVID-19 was being fought in ICUs and emergency rooms across the country, another line of defence was assembling in Tennessee. The nation's brightest computer scientists were pressing Summit, a 200-petaflop supercomputer, into service as a Covid-fighting machine. The only problem? They had to keep the machine – which demands constant monitoring from a crew of on-site technicians – running, despite a global pandemic.

SOMEONE HAS TO do it, Bronson Messer, PhD, told himself in January of 2020 as he decided to return to his old job at Oak Ridge. Messer is a computational astrophysicist, who prefers to spend his days noodling out questions like, Where did all the uranium in the universe come from? From 2010 to 2011, Messer had pushed aside his own research while he served as the Director of Science at the Oak Ridge Leadership Computing Facility. It's a job that required, in large part, helping other researchers achieve their data goals on Summit at the expense of his own work. Messer says he missed the research life and stepped away. But in late 2019 the job opened again. Messer knew how to do it and allowed himself to be pulled back in. What he

did not know was just how chaotic – and high-stakes – this role would become in two months.

On 22 March 2020, President Trump announced the formation of the COVID-19 High Performance Computing Consortium, an effort to pair researchers working on Covid-related solutions with time on 16 of the nation's supercomputers, including Summit. Within days, Messer had on his desk a pile of projects – like finding how Covid attacks the body, and searches for drugs that might save lives. These researchers needed time on Summit. It was up to Messer to make sure the brightest minds and the worthiest projects rose to the top of the pile. By April, three to four of his workdays per week were spent just allocating time to researchers requesting a turn on the machine. See you later, supernovas, he thought.

As proposals crashed into Messer's inbox, Paul Abston was trying to figure out just how, if the pandemic got as bad as predicted, he would keep Summit running. Abston is the group leader for infrastructure and operations at the Oak Ridge Leadership Computing Facility. Keeping the lights on and the computer working is his responsibility. With the formation of the High Performance Computing Consortium, Summit was designated as critical infrastructure – right alongside America's power grids and water pipes – and effectively ordered to stay online. Every employee who worked on Summit was now essential. Come a power outage, or water leak, or Covid outbreak in the facility, Abston was going to have to find a way to keep it humming.

Humming is not hyperbole. Supercomputers are more like a high-powered telescope than a laptop. Summit is a collection of 9 468



CPUs (central processing units, the processing systems your home computer runs on) and 27 756 GPUs (graphics processing units, what your gaming systems run on). They're stored in refrigerator-sized cabinets, lined up in rows like recruits at boot camp, standing shoulder-to-shoulder and ready to take orders. Inside each cabinet are 18 nodes, or drawers. Each node contains two CPUs and six GPUs. One hundred and eighty-five miles of high-speed cable connects all those CPUs and GPUs. Pipes jut in and out of the ceiling, bringing water to cool down the cabinets, which burn up to 13 megawatts an hour – enough energy to power more than 10 000 homes. Stepping into the building that houses Summit is an auditory experience, like standing next to the ocean.

Calculations can be pushed through Summit remotely. But Summit is a machine, things break. At least weekly there's a communication issue or a storage failure where someone's work doesn't get saved, Abston says. And those are just software problems. The 15 000 litres of water running through the room to cool the machine could become a nightmare if a pipe sprung a leak. So, too, could a cyber attack. Or an attack on the power grid. There was a lot that Abston was tasked with protecting – and a bevy of workers he'd need to do it. At least some would have to be on site, which meant Abston needed to do everything in his power to stop a Covid outbreak before it could even begin.

First he reviewed exactly how few people he could get away with having in the building at a time. Then he reviewed his employees' workstations. If someone had tasks that had to be performed in a tight space, he'd try to move them to shifts where they worked alone. Then he considered testing. Thankfully, Oak Ridge National Laboratory got its own testing facility up and running at the beginning of the pandemic.

And it would be needed. By April, Tennessee was seeing hundreds of new cases every day. By autumn, they were in the thousands. Over the winter, the situation was dire, peaking at more than 10 000 new cases and upwards of 100 deaths daily. Still: Abston kept the lights on. He juggled schedules as colleagues needed to quarantine after they were exposed by a spouse or child. Sometimes he just came in and filled the gap. But, whatever happened, Abston simply could not allow an outbreak of Covid among his staff to stop Summit's steady march towards progress.

THERE'S A STORY that Ray Smith likes to tell about how 24 000 ha of Appalachian farmland became a secret hub for American science. In 1939, Albert Einstein wrote to President Roosevelt warning of fission chain reactions utilising uranium that could likely produce large amounts of power, and his belief that Germany was pursuing the research. 'They were worried that they were going to build a bomb,' says Smith, historian for the City of Oak Ridge.

Roosevelt knew America needed to act. Smith says that Roosevelt went to Senator Kenneth McKellar, then head of

the Senate Appropriations Committee. 'He said, "Senator, I need to put a large amount of money against the war effort. And I can't let the press or anyone know how much it is or what it's being used for. Can you help me with that?"'


The good senator from Tennessee responded that he could help with that – and where in Tennessee was it going to go?

By 1943, Clinton Engineer Works, which would later become the Oak Ridge National Laboratory, was up and running under the Manhattan Project to produce weapons-grade plutonium. Scientists from around the country were soon reporting for duty in a town that was too new to exist on maps.

After the war, Oak Ridge continued to be a hub for science. In recent years, it's become known for its hosting of America's most powerful supercomputers. Traditionally, we've talked about supercomputers mostly by how fast they can do calculations. That term is a 'FLOP', or a floating point operation, says Jeff Nichols, the associate



Marti Head's Summit research may lead to drugs that treat those who get infected.



laboratory director for computing and computational sciences at Oak Ridge. A floating point operation is just an addition or a multiplication, and when we rate supercomputers, we add up how many operations they can do per second. A million per second, that's a megaflop. A billion is a gigaflop, and a trillion is a teraflop.

Summit is a 200-petaflop machine, meaning it can do 200 quadrillion operations per second. But back around 2009, supercomputer builders were stymied by how to continue to expand FLOP capacity without making these machines into monster energy guzzlers. The supercomputer then at Oak Ridge, named Jaguar, used up to about 8.2 megawatts per hour, says Nichols. 'We knew that if we were going to double the computing, we were going to double the power, and we couldn't do that anymore,' he says.

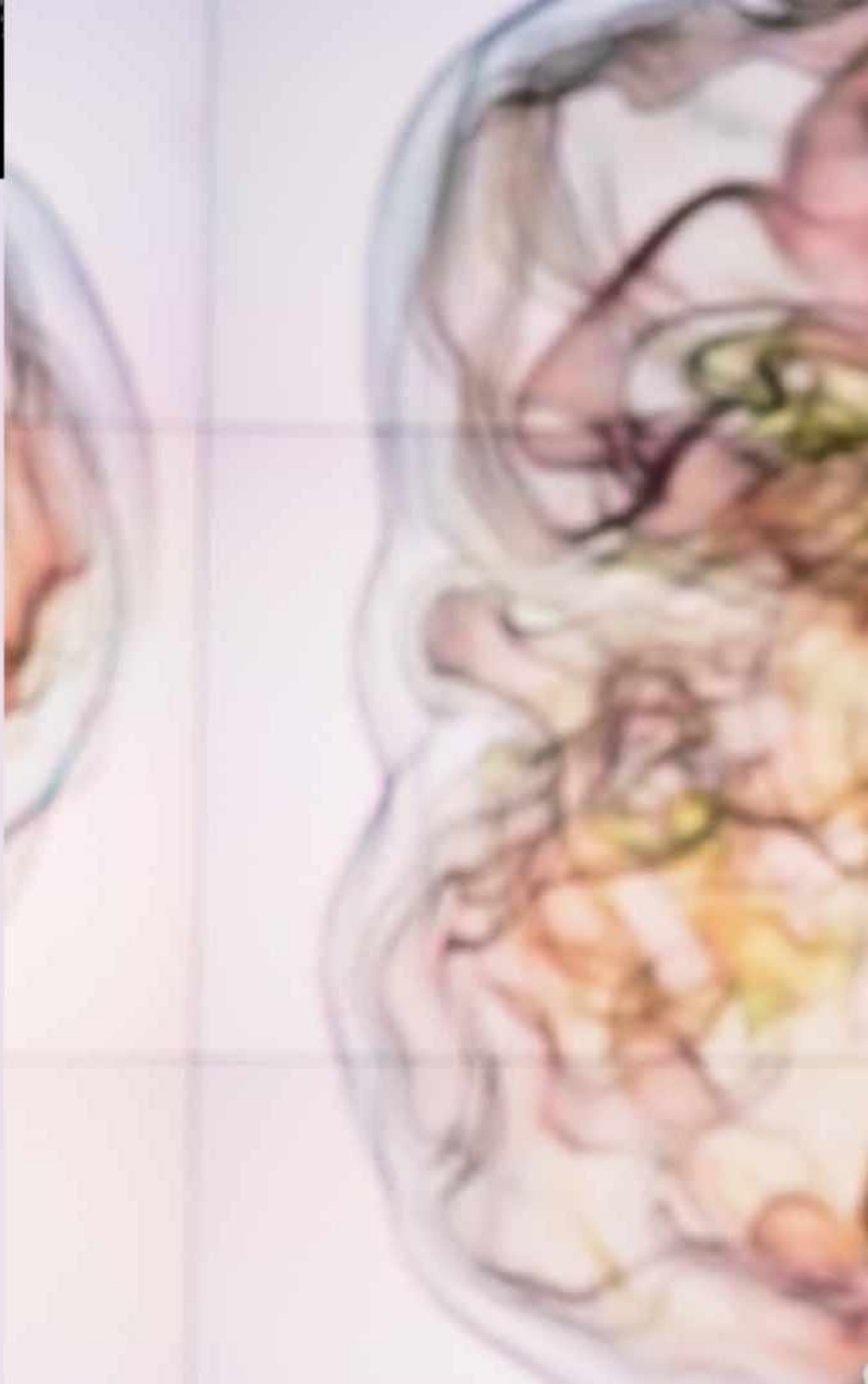
Looking for a solution, supercomputer designers wondered if they could use gaming processors to boost their energy efficiency. GPUs can be 10 times as powerful as CPUs, says Nichols. The problem, however, is that they were not as accurate. If Superman's foot doesn't quite hit the edge of the building when he jumps, our imaginations can close that gap. If a supercomputer misses a calculation when doing crucial drug research, it is useless.

Nichols says that the team building Summit approached NVIDIA, a Santa Clara, California-based GPU manufacturer, and asked if it could build a GPU with the accuracy of a CPU. By altering the type of silicon used in the chip, NVIDIA was able to pull it off: They created a GPU that was both efficient with power and accurate with its calculations. The first supercomputer at Oak Ridge to be built with GPUs was named Titan. It was 10 times more powerful than Jaguar. In 2017, Titan was replaced by Summit, which was, again, 10 times more powerful than its predecessor.

Of course, power is good, but it's not the only thing that matters. What researchers like Head and Dan Jacobson, PhD, really need is a smart supercomputer. Artificial intelligence – Summit's biggest advantage over Titan – allows supercomputer users to build a model, and then tell the machine to look for patterns that might be like that model. Without this machine learning, you can only send a computer off to look for exact matches. That doesn't help when you're seeking molecules that may dock up with a virus. If there's no exact match, your search will come up empty, when really, something that might have been close enough to work was overlooked. And machine learning allows researchers to be extremely specific in what results they do and don't want returned to them. If the computer isn't giving you what you want, you can teach it to do better.

Thanks to a special type of processor core, called a tensor core, Summit became both extremely fast and a quick study when it came to machine learning. Tensor cores allow computers to group and compare related data to identify connections and see how they interact. A normal core knocks out operations as they come, but a tensor core can also compare that operation to another that it's been told is related.

A RANGE OF scientists from all over the country applied and got time on Summit for Covid-related projects. But perhaps two of the most important queries on the computer attacked the virus from opposite ends of the scientific spectrum. One wanted to know how



Covid attacked the body, so we could better understand the disease. The other wanted to discover how we could stop the virus in its tracks.

The lab's own Jacobson was charged with writing the code that would get answers on exactly why Covid was behaving in ways doctors had never seen before. Jacobson is a computational biologist. His work is specifically in systems biology, which involves deciphering the interconnected complexity of living organisms at the cellular level – whether that's in plants destined for biofuels or in the human brain, unwinding the causes of various neuropsychiatric conditions such as Alzheimer's and autism.

Jacobson was watching the pandemic well before the rest of us. Through another project, he had contacts working in the Beijing embassy when the first cases in Wuhan were reported. He instantly understood the trouble humankind might be in. 'There were a few of those *ruh-roh* moments, where we said, 'Yeah, this could go really quite poorly,'" Jacobson says.

Jacobson looks for patterns in data that reveal what exactly is happening in the molecular relationships within and between cells.



▲ Messer and his team write the code for every query that gets run through Summit.

At first, there wasn't much data to work with. But then, as so many scientists across the globe put their other research on hold to work on Covid-related projects, it was like a firehose, and Jacobson wanted all of it. He approaches biology in a holistic way, using huge amounts of data from all types of enquiries to look for patterns and interesting interactions between systems. When it came to Covid, he hoarded everything: gene expression information, immune system information, physiology data, genetics data, protein structural data, electronic health records, environmental data, microbiome data, and autopsy data. The goal was to look for patterns that changed when people became infected, were sick, and then recovered from Covid. Looking at everything all at once 'allows us to find things that often are missed otherwise. If you're just looking at one thing at a time, you're taking a very

traditional approach,' he says. And you may find that one thing you're looking for, but 'you'll overlook important things because you're focused very narrowly.'

Marti Head wanted her turn, too. Before joining the Oak Ridge National Laboratory, Head spent part of her two decades at pharmaceutical giant GlaxoSmithKline hunting for drugs that would attack bacteria. Fighting Covid was going to be markedly harder. 'Bacteria are alive, so you can kill them. They fight back, but you can kill them,' she says. 'Viruses aren't really alive, and it's much harder to kill something that's not really alive.'

Instead of going for the kill, Head's drug-hunting hopes rested on finding molecules that could, essentially, throw a wrench in how the virus worked. In one case, she and her colleagues started looking at the main protease, an enzyme that essentially cuts the protein chain found in a cell infected with Covid into little tiny protein bits that then go off and do the virus's bidding. Head needed a molecule that was exactly the right size and right shape to dock with a small groove they'd identified on the main protease. Step one was writing an

algorithm that would essentially search for molecules that could possibly be the right size and shape to dock with the virus.

But it's not just enough for the two parts to fit, says Head. 'Proteins are not just sitting there waiting for us in a static way to do something. They're constantly moving as part of what they are, and so we need to understand those motions.'

A SUPERCOMPUTER IS only as super as the people writing code for it. A misconception, says Messer, is that you log on to Summit and can simply click on programs that help you run your query. For the vast majority of calculations on Summit, someone has to write all the algorithms. Usually, that someone is actually a group of someones. The researcher writes some of the code, but Messer adds that the graduate students doing code development are the lifeblood of Summit.

What makes writing code for these projects hard is that there's rarely a single answer you're seeking. An if-then algorithm won't

work, because you don't want just one answer. 'When I run an astrophysics code, there's no answer at the end,' says Messer. Instead, he watches as a stream of data is produced that might point him towards possible answers. 'And then I have to climb inside all the data that are generated to be able to infer some scientific insight,' says Messer.

To crack exactly why Covid was making so many people so sick, Jacobson was going to have to crawl inside a whole mess of data, too.

Jacobson started at the beginning, focusing on how the virus hooks on to cells. This he already knew: Covid goes after the ACE2 protein, which isn't a typical receptor for a virus to latch on to. When he began looking at data from other coronaviruses – such as the ones that cause the common cold – he realised that many of them target proteins in the renin angiotensin system (RAS) as entry points into cells. The RAS is partially responsible for regulating blood pressure and fluid and electrolyte balance. Jacobson figured he'd start there.

Covid previously had seemed like purely a respiratory disease. So targeting the RAS was a little unexpected. His next step was to use Summit to evaluate gene expression in lung tissue samples from infected and uninfected patients. Summit went searching, plowing through 2.5 billion calculations. The analysis coughed up a trove of data on exactly how genes are normally regulated and how those regulatory patterns were dramatically altered by SARS-CoV-2 infection.

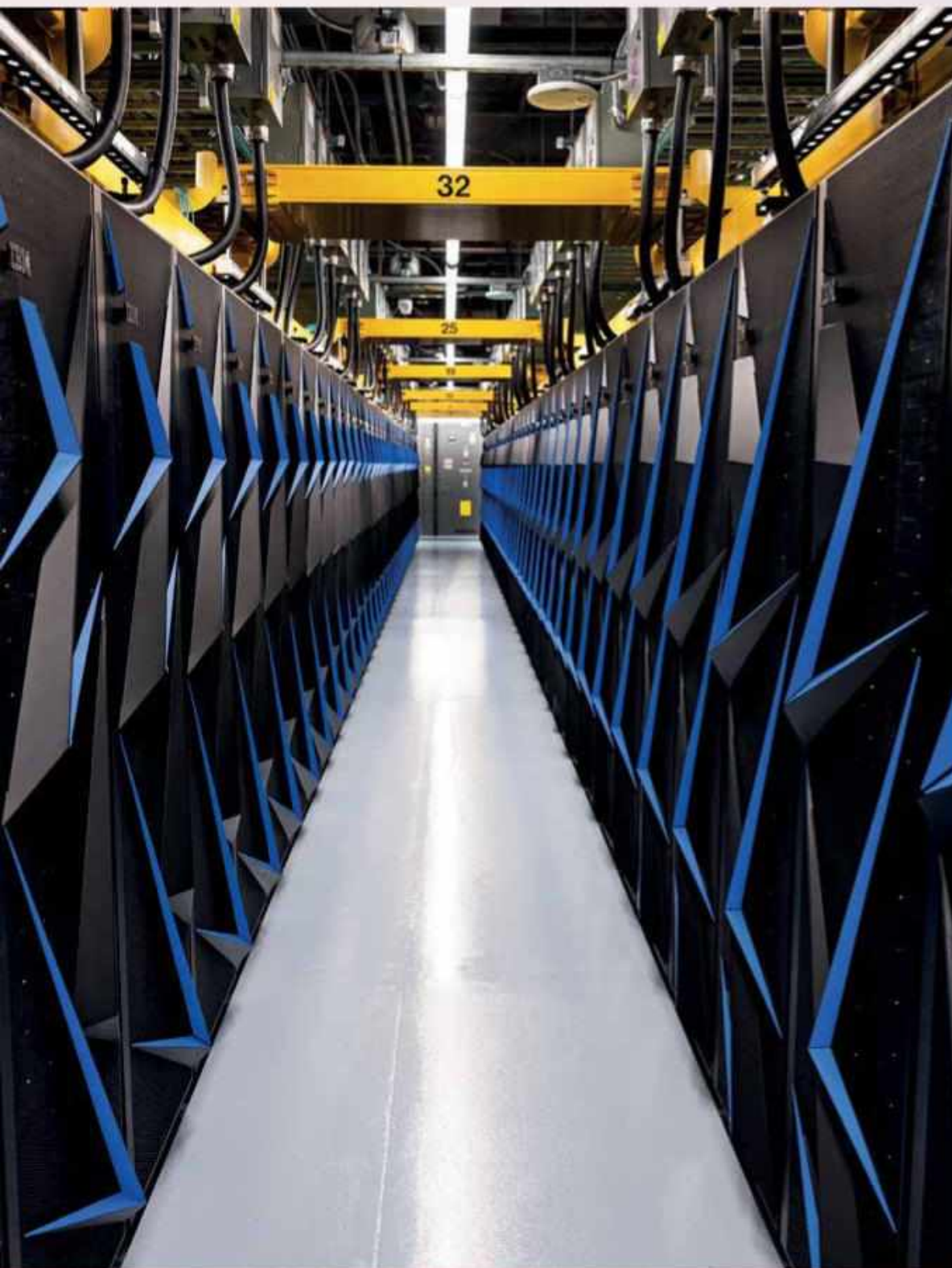
And then: 'I had that eureka moment. Not many times in my career can I go back to a discovery where there was a single eureka moment,' says Jacobson. But it was right there in the data: Covid was causing a massive dysregulation in the RAS.

Back to Summit Jacobson went. Because of the computer's massive computational abilities, Jacobson was able to see changes in many cellular functions – ranging from inflammatory and permeability responses, to hyaluronic acid synthesis and degradation, to electrolyte balance and coagulation, that connected in some way to the RAS. From that resulting data set, it became clear that something strange was happening at the intersection between the RAS and the kallikrein-kinin (bradykinin) system, which both play roles in inflammatory responses. 'We then dived into the clinical literature of what happens when you dysregulate those systems,' he says. 'You look at those predictive symptoms in different parts of the body and, wow, they match up really well with what's going on in COVID-19.'

This research helped reframe the discussion of Covid being as much a vascular disease as a respiratory one. Dysregulation of the bradykinin system can cause blood vessels to essentially leak – which could explain why doctors were seeing patients with so much fluid in their lungs. Thanks to Summit and Jacobson's research, and that of similar groups, clinicians began thinking about whether Vitamin D, a known regulator for the RAS,

▶ The control room monitors Summit's 37 224 processors.

▶ Two of the 260 rows of racks that make up Summit.





might help some patients. While just going outside and standing in the sunshine certainly won't prevent Covid, there is evidence that it could reduce the severity of infections.

Likewise, the bradykinin hypothesis brought ibrutinib, a drug that acts as a bradykinin B2 receptor antagonist, into clinical trials. Though these drugs are not a cure-all for Covid, the bradykinin hypothesis is helping doctors understand what they're seeing.

While Jacobson was discovering what was causing severe disease, Head was working the other side of the equation, hunting for a drug to beat back that severity.

Drug hunting takes a lot of patience. While Head has numerous patents and has taken several molecules fairly far in the drug testing process, she had yet to find a molecule that got to market as an efficacious drug. So much can go wrong in the development process: Maybe the molecule only docks with the protein in the lab. Or maybe it works when injected into mice, but won't survive the acid of a stomach when swallowed in capsule form.

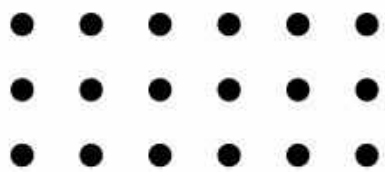
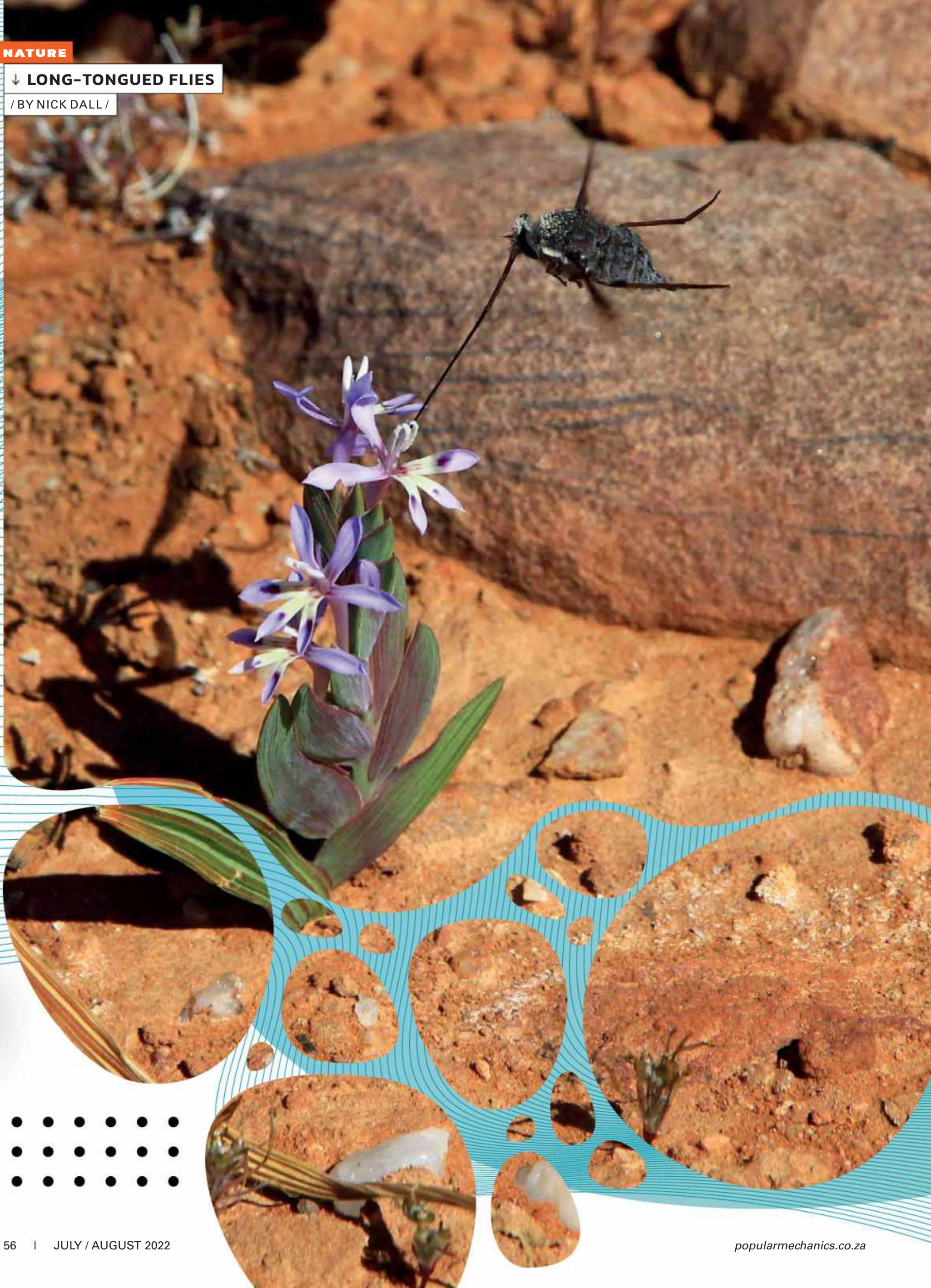
'We need it to be that one-in-a-million,' she says, describing the odds of finding a molecule that does it all.

Thanks to Summit, Head has a lead on that one-in-a-million. It's called MCULE-5948770040, and it both binds and inhibits the main protease. In late March of 2021, she published a pre-print paper on her team's finding. That research is currently undergoing peer review. New variants, meanwhile, have made her work even more important. So far, vaccines appear to be effective against the new variants, but should that change, therapeutics will again become a most precious tool in the fight against Covid. Highlighting the importance of the development of effective Covid drugs, in June 2021, the Biden administration announced \$3 billion in funding for drug development projects such as Head's.

But Head is thinking well beyond the variants, too. What she's truly hoping to build is code that's a starting point for fighting the next pandemic. Because there will be a next pandemic. 'We want those platforms ready to go, so we can respond quickly to the next Zika, Ebola, influenza, and coronavirus,' she says. 'When, heaven help us, SARS-CoV-3 comes along, as long as we have the will to stay invested and vigilant, we will have the data, the platforms, and the people around the globe who are going to respond.' **PM**

↓ LONG-TONGUED FLIES

/ BY NICK DALL /





LONG- TONGUED FLIES:

BOLD POLLINATORS

OF NAMAQUALAND

The recent discovery of a new fly species deepens our understanding of what it'll take to conserve a bevy of endemic long-tubed flower species in Namaqualand. But still, there are far more questions than answers.

↓ LONG-TONGUED FLIES



Above: *Prosoeca peringueyi*, foraging on *Lapeirousia silenoides* (commonly known as Springbok pinated petals).

Below: *Prosoeca peringueyi*, photographed in the Nootgedach area.

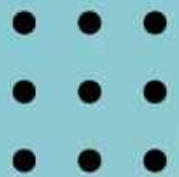


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UNTIL RECENTLY, *Prosoeca peringueyi* – an otherworldly creature with a needle-like tongue twice the length of its body (in other words, more than an inch long) – was thought to play a vital role in the reproduction of around 28 Namaqualand plant species whose tubular flowers could only be accessed by its oversized proboscis.

But ongoing research by French botanist Florent Grenier and South African

entomologist Genevieve Theron has shown the number of plant species to be at least 42 – a conservative estimate suggests no fewer than nine of which are at risk of extinction. *Hesperantha oligantha*, for example, is critically endangered, with a single known population in the Hantamsberg of about 30 individuals. This dainty little pink flower's only hope of survival lies in the long-tongued flies.



POLLINATION 101

Most flowers have both male and female parts. The male parts produce pollen, while the female parts – the stigma – actually contain eggs. To reproduce, the pollen needs to reach the stigma, but ... plants can't move. Wind is one (rather inefficient) option of pollination, but 80 per cent of flowering plants rely on some type of pollinator. These are drawn to the flowers' sweet nectar and end up carrying the sticky pollen from flower to flower without even realising it. While bees are far and away the most famous pollinators, flies, beetles, wasps, moths, rodents and even lizards also pollinate many plant species.



Above: This figure, from a 2020 edition of the *Biological Journal of the Linnean Society*, shows the external morphological differences between the two long-tongued fly species.

Prosoeca torquata is on the left and *P. peringueyi* is on the right.

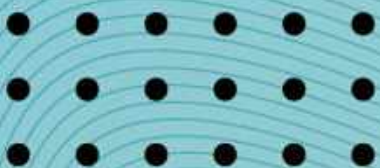
Below: *Lapeirousia silenoides* from Anenous Pass in the Richtersveld.

ONE BECOMES TWO

Theron's research has also revealed that what we thought was one species of fly is actually two. Early findings suggest the new species, *Prosoeca torquata* – which has a slightly shorter tongue than *P. peringueyi* – is an exclusive pollinator for some of these plants.

Between 2016 and 2018, Grenier spent four months of every year in the field, observing and capturing flies from almost 150 different populations. From a few dozen of these sites he sent fly samples to Theron. 'Based on my field observations of tongue length, I was already fairly convinced that *P. peringueyi* was two separate species,' recalls Grenier. But scientists aren't satisfied with hunches.

Theron performed a detailed study of 64 specimens from 13 sites. 'After doing the genetics we found two clear groupings,' says Theron. 'When we looked under the microscope, there were also clear morphological differences beyond tongue length.' The new species has a ring of white hairs behind its head ('Torquata' means collared in Latin) and a darker thorax than *P. peringueyi*. There are also, Theron adds, 'clear differences in the morphology



↓ LONG-TONGUED FLIES



Top left: *Prosoeca peringueyi* visiting *Zaluzianskya* sp.
Above: Enjoying the splendour of a field of daisies, outside Nieuwoudtville.
Left: A pair of *Prosoeca torquata* mating.



ONLY IN MZANSI

P. peringueyi is one of at least a dozen long-tongued species of the Nemestrinidae family that only occur in South Africa. In all other parts of the world, Nemestrinidae have short tongues. *Moegistorhynchus longirostris*, which occurs on the West Coast, has an eight centimetre-long tongue (five times longer than its body!), making it the longest-tongued fly in the world. Upwards of 100 flower species are exclusively pollinated by South Africa's nemestrinids.

burrow inside the locust, and gradually eat it from the inside. 'We think something similar is going on with *P. torquata* and *P. peringueyi*,' says Theron, 'but we can't say for sure.'

THE BIGGER PICTURE

The discovery of the new species does not come as a surprise to Professor Michael Kuhlmann of Kiel University in Germany, an entomologist who has studied Namaqualand's wild bees for more than 20 years. 'Namaqualand is a global hotspot for pollinator diversity, and there simply aren't enough scientists to study it,' says Kuhlmann. 'One of my biggest fears is that we will lose lots of species – and their specialised pollination relationships – before we even know that they exist!'

When it comes to conserving the endemic plants and insects of Namaqualand, 'the only answer is to conserve the habitat,' says Kuhlmann. Theron is in complete agreement, although she is prepared to stick her neck out and say that to conserve the flies and the flowers that depend on them, 'water use, land use, and especially pesticide use' are likely to be the most important factors.

'Namaqualand is a vast area with thousands of species,' continues Kuhlmann. 'This new fly is the "Lion King" or the "elephant" of Namaqualand insect species, and it's great that it gets picked up by the media. But there are also hundreds or thousands of others that don't get a mention. We need to use discoveries like this to showcase Namaqualand's incredible diversity before it's too late.'

'I wish more of the general public would fall in love with the smaller critters,' laments Theron, 'but it can be a difficult ask.'

Namaqualand's many incredible flowers might be an easier sell... **PM**

of the genitalia', a big clue for entomologists (and the rest of us!) that the two species are distinct.

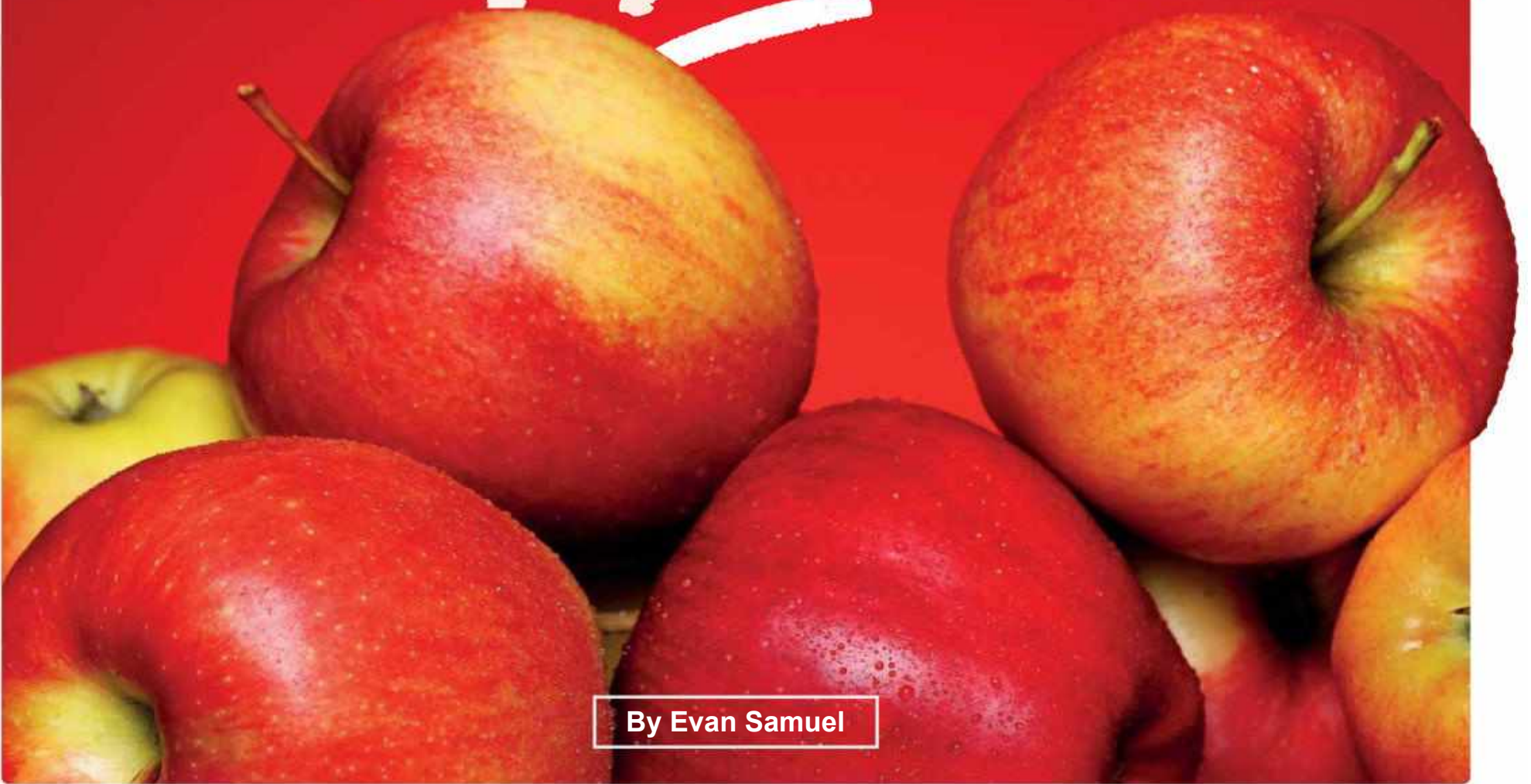
The discovery of *P. torquata* is a reminder of how little we know about the plant-pollinator relationships in Namaqualand. While the flies are promiscuous and will visit many different flower species, the plants are extremely loyal (not by choice) and can only be successfully pollinated by long-tongued flies – and sometimes by only one species of long-tongued fly.

The only way of really working out what's going on is to make detailed studies of each of these flower species. When, for example, Stellenbosch-based researcher Anton Pauw looked at a particular species of long-tubed pelargonium flower, he expected *P. peringueyi*

to be the primary pollinator, as its long tongue matches the flowers' tube length almost exactly. Once he'd crunched the numbers, however, it turned out that *P. torquata* was a much more important pollinator. Chances are, the Namaqualand is keeping many similar secrets.

When it comes to understanding the life cycle of the flies, the best we can do is to assume that they reproduce in a similar fashion to *Trichopsidea costata*, the only long-nosed Nemestrinidae whose life cycle has been studied in Southern Africa. *T. costata* lays its eggs on organic matter and when these hatch, the larvae climb on to the brown locust (the very same species that's currently leaving a trail of destruction across the Eastern, Western and Northern Cape),

How 'bout them apples?



By Evan Samuel

South Africa is known for its delicious fruit, but have you ever thought about what goes into getting those crisp, sweet apples from the orchards to our supermarkets? PM toured the Ceres Fruit Growers facility in Ceres to get the low-down.

The

FRUIT-GROWING SECTOR is a key player in South Africa's agricultural sphere. High-quality fresh fruit is always widely available locally, but did you know that vast quantities are also exported overseas, making it a crucial contributor to our GDP?

While things might always look rosy to the consumer, who buys apples at their local supermarket, the fruit industry is constantly facing challenges. To overcome these, role players are always innovating, striving for technical solutions to complex problems.



▲ The sorting and packing process is almost entirely automated.

ORIGINS

In 1652 the Dutch East India Company founded the Cape of Good Hope as a refreshment outpost for its passing ships. Deciduous fruit trees were planted to supply ships with fresh fruit. Ten years later, in April 1662, the first two ripe apples were picked at the Cape – these were *Witte Wijn appels*. Stone fruit and pears followed, and gradually small farmers started experimenting with other top fruit crops, and sold their produce to passing ships.

Since those small beginnings apple production has blossomed into an industry with more than 36 million trees covering some 25 000 ha. The total South African production is just more than one million tons, of which 460 000 tons are exported. The local market consumes 290 000 tons and a further 252 000 tons are processed as fruit juice and dried products.

Apples are primarily grown in the Western Cape on the farms surrounding Ceres, Wolseley, Elgin and Villiersdorp. The gross tonnage for these areas is 76 per cent of total South African production.

Ceres Fruit Growers (CFG) is a fruit producer, packing house and marketer owned by 39 farming groups. Tru-Cape Fruit Marketing, owned by CFG and Two-a-Day, markets 85 per cent of the volume of CFG's growers. To gain a better understanding of this industry, we were shown the technologies and solutions that have been adopted in a modern packing house. To keep things simple, we focused exclusively on apples.



GROWING AND PRODUCTION

The unique climate between the Skurweberg Mountains in the north and the Hex River mountain range to the south makes the Ceres district ideal for growing fruit. On average there are 300 days of sunshine a year, which helps produce particularly juicy, crisp and aromatic fruit.

The diverse altitudes and locations of the different farms help minimise potential losses due to crop failure, which are typically caused by drought, floods, hail and disease. The diverse locations also enable more varieties to be grown, and they widen the harvest date window, which ensures the capacity constraints of the packing facility aren't placed under undue stress.

LOGISTICS

Once the fruit is in 'full bloom', it's 155 to 165 days before the harvest commences in early January. This continues until the third week in May. With 29 different cultivars being packed, the different harvest dates help to smooth the demand on the pack house.

The packing lines have a daily capacity of 800 tons, however, at the harvesting peak the deliveries from the farms can top 3 000 tons per day. The excess is placed into controlled atmosphere storage and packed later in the year.

ENGINEERING

The engineering team at CFG is made up of 40 personnel. To get the low-down on the various processes, we spent time with Rahim Hassan, the engineering services manager, viewing the spotless plant rooms and efficient production lines.

The plant installed at CFG is a complex yet orderly facility comprising the following: 13 megavolt ampere (MVA) installed capacity, with a 10 MVA average running load with a corrected power factor of 0.99 (this represents 30 per cent of the power consumption in Ceres); 2.5 MW solar power installed; 19 transformers; 18 refrigeration compressors that circulate 22 tons of ammonia; 32 humidifiers; nine nitrogen generators; 30 CO₂ scrubbers; 152 storage rooms running at -0.5°C (of these, 134 run a nitrogen-rich environment); four fully automated and computer-controlled packing lines and 62 electric forklifts.

Eskom's load-shedding woes have necessitated the installation of seven diesel generators. These are all set to auto-start on weekdays, while on weekends they're manually started if and when they're needed, as the power demand is much lower.

Operating and maintaining this infrastructure, especially within South Africa's unique power-supply situation, presents a difficult set of challenges, which the engineering team is constantly overseeing.



PROCESS

Upon arrival from the orchard, a post-harvest drench treatment is done on certain cultivars. These are selected for their risk for harvest injuries, susceptibility to post-harvest decay, and their time in storage. This is done to minimise waste after storage by inhibiting the growth of ever-present post-harvest pathogens such as *Botrytis*, *penicillium*, and others. The fruit is treated with fludioxonil, a non-systemic fungicide, or pyrimethanil, a broad-spectrum fungicide.

Random samples of the fruit are then sent to CFG's laboratory and tested, to determine their readiness for packing, and to establish the maturity of the fruit before picking and upon arrival at the pack house. This work is carried out to ascertain how long fruit can be stored and if it meets the required maturity standard to be packed. Diameter, mass, colour (including background and foreground), firmness, total soluble solids, starch, seed colour and count, as well as titratable acidity are all measured or tested.

Using the laboratory findings, a decision is made to either store the fruit in a dynamic controlled atmosphere (DCA) at -0.5°C, store it in a controlled atmosphere (CA) at -0.5°C, or store it in regular atmosphere (RA) for immediate sorting, grading and packing.

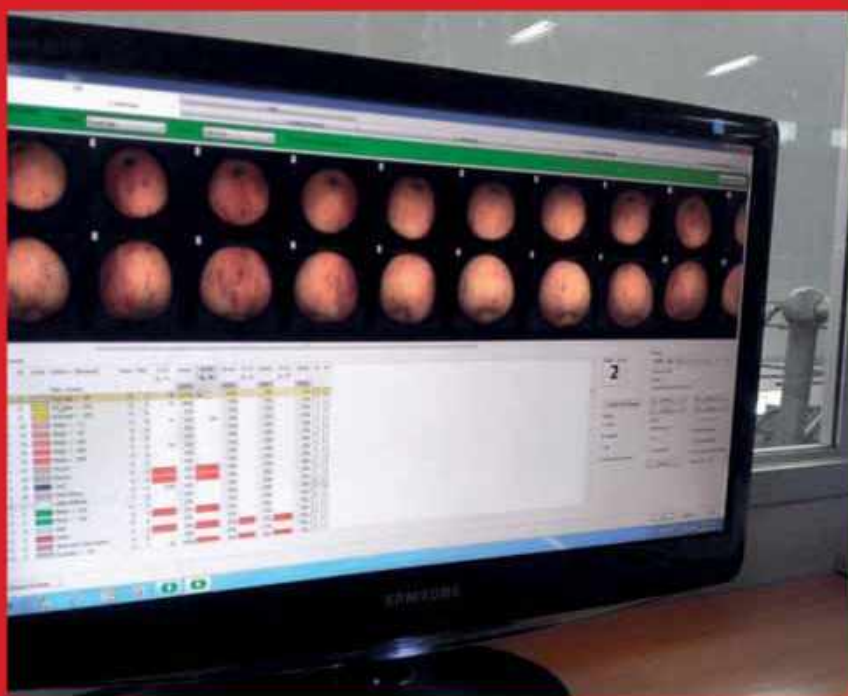
*This device
has 27
cameras
taking
3 600
photos per
second.*

- ◀ Random fruit samples are lab-tested, to find out their readiness for packing, and their level of maturity.
- ▼ Apples are floated out of their bins and on to conveyors, to protect them from damage.
- ▼ A computer sorts the apples by colour and size.
- ◀ Different grades are diverted to various packing lines, and placed in cartons.

SORTING AND PACKING

With all fruits, careful handling is imperative to avoid bruising. To this end, the apples are floated out of the bins and on to the conveyors. All conveyor transfer points are designed with the smallest possible drop to avoid bruising.

The apples then pass through an automatic computer-controlled colour and size sorter. This device has 27 cameras taking a total of 3 600 photos per second. It places the apples on to six graded rows. The different grades are diverted on to dedicated packing lines, labelled, placed into cartons with interlayer cushioning, palletised, and then sent to storage.



STORAGE

Perfect storage conditions are crucial for preserving the colour, crispness and flavour of apples. The parameters and constraints of cooling pome fruits is a highly complex subject – this is an abridged explanation of some of the essential factors associated with storing apples in a dynamic controlled atmosphere (DCA). (If you're interested in the detailed breakdown, visit hortgro.co.za.)

CFG has a total of 152 cold rooms, with enough space for 46 274 bins in a DCA environment and 132 259 bins in a CA environment (-0.5°C, but normal atmosphere). The product is held in the cold rooms until the planned dispatch date, at which point it is packed into refrigerated containers for export.

To keep apples for as long as possible, without them losing their nutritional properties, colour, taste and appearance, it's essential to create special conditions for reducing the fruit respiration intensity and rate. DCA is applied to create the required gaseous atmosphere. This has the following characteristics: The humidity in the chamber is set to 90 per cent and the temperature to -0.5°C. The natural air in the storage room is replaced with a different atmosphere, in which the oxygen content amounts to only five per cent, while the rest is mainly carbon dioxide and nitrogen. This is done to slow down the after-ripening process, minimise moisture loss and extend the storage life.

Specific equipment is used to create and maintain the required conditions. Large refrigeration compressors handle the heat load, while nitrogen generators are used to produce gaseous nitrogen. These operate on the basis of adsorption. Carbon dioxide scrubbers reduce the level of carbon dioxide that is released in the course of fruit respiration. The scrubber includes a tank with an adsorbing agent, that's used to reduce the CO₂ concentration in the air. An automatic control system simplifies the equipment control procedure – once the required parameters are set the system takes control. The system includes a gas concentration analyser and software for the nitrogen generator and scrubber control. Preserving the controlled climate is key, so sealed doors play an important role. They ensure complete gas-tightness.

It's imperative that the strictest safety protocols are observed at the plant, as exposure to the nitrogen-rich and oxygen-depleted atmosphere in the storage facility can result in death in mere minutes. Even inadvertently opening a door and being exposed to the escaping atmosphere can kill. As such, when working in or near this environment, stringent safety measures include the use of full coveralls and gloves, breathing apparatus, as well as a safety harness and line. As an added measure, line-of-sight standby responders are on duty.



▲ CFG has 152 cold rooms, with space for thousands of fruit bins. ► Nitrogen generators play a key role in creating the right storage conditions for the fruit. ◀ An automated computer system controls the storage atmosphere. ▼ Large compressors are integral to refrigeration.



AN APPLE A DAY...

A lot goes into the handling, packing and logistics of fruit, and the crew at Ceres Fruit Growers is setting the standard in South Africa. The next time you buy a delicious bag of crisp red apples, especially if it's out of season, take a moment to consider the science and engineering that goes into supplying consumers with the best possible fruit, and the dedication of the people involved in fruit storage and packing. **PM**

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WHAT'S FOR LUNCH?



Eating a nutritious lunch is the foundation of a productive afternoon. Prep these three delicious meals beforehand, to optimise the time away from your screen.



Recipe

01

CORN AND WHITE-BEAN FRITTERS, WITH TZATZIKI

What you'll need

FOR THE FRITTERS

- 1 tin cannellini beans, rinsed, drained and mashed
- $\frac{3}{4}$ cup frozen sweetcorn, cooked
- $\frac{1}{3}$ cup Cheddar, grated
- 1 tbsp parsley, chopped
- 1 egg, beaten
- 1 tbsp milk
- $\frac{1}{2}$ cup Nutty Wheat flour
- $1\frac{1}{2}$ tsp baking powder

FOR THE TZATZIKI

- $\frac{1}{2}$ cucumber, grated
- $\frac{3}{4}$ cup plain yoghurt
- 1 tbsp mint, finely chopped
- 2 tsp dill, finely chopped
- 1 tbsp olive oil
- 1 tbsp lemon juice

TO SERVE

- 4 handfuls almonds
- 4 baby marrows, cut into matchsticks
- 12 slices ham, rolled

Steps to success

FOR THE FRITTERS:

- 1** Line a baking tray, and preheat the oven to 200°C.
- 2** In a large bowl, mix the mashed beans, sweetcorn, cheese, parsley, egg and milk together. Season with salt and pepper.
- 3** In a separate bowl, mix the flour and baking powder together and fold it into the wet ingredients. Mix until a stiff batter forms.
- 4** Dollop the batter on to the prepared baking tray, leaving space between each fritter.
- 5** Shape the batter into circles and bake for 15–20 minutes, until golden brown and cooked through.

FOR THE TZATZIKI:

- 6** Mix all the ingredients together and refrigerate until needed.

FOR A TAKEAWAY LUNCH:

- 7** Place two to three fritters in a lunch box with the tzatziki and almonds in separate compartments. Fill up the lunch box with the baby-marrows sticks and ham roll-ups.

Prep time:

20 min

Cooking time:

20 min

Serves:

4

TIP

If you're short on time, store-bought tzatziki is a quick alternative.

ASIAN SLAW WITH BOILED EGG AND HOME-MADE CROUTONS

What you'll need

FOR THE SLAW

- 1¼ cup red cabbage, shredded
- 1¼ cup green cabbage, shredded
- ⅓ cup bean sprouts
- 3 carrots, cut into matchsticks
- 1 red pepper, thinly sliced
- 4 spring onions, thinly sliced
- 4 tbsp coriander, chopped

FOR THE DRESSING

- 5 tbsp olive oil
- 3 tbsp rice vinegar
- 3 tbsp soy sauce
- 2 tsp honey
- 1½ tsp ginger, finely chopped
- 1 chilli, thinly sliced

FOR THE CROUTONS

- 4 thick slices brown bread, cut into cubes
- 4 tbsp olive oil
- 2 tbsp sesame seeds

TO SERVE

- 4 eggs, boiled
- 4 handfuls wasabi peanuts

Steps to success

FOR THE SLAW

- 1 Toss all the slaw ingredients together in a bowl.

FOR THE DRESSING

- 2 Whisk the dressing ingredients together until combined.

FOR THE CROUTONS

- 3 Preheat the oven to 180°C. Brush the bread with olive oil and sprinkle with sesame seeds. Bake for 10–15 minutes, tossing, until golden brown and crispy.

FOR A TAKEAWAY LUNCH

- 4 Divide the slaw and eggs between four lunch boxes and place the dressing in a sealable container.
- 5 Divide the croutons and peanuts between separate compartments and mix together just before you're ready to eat.

Recipe

02

Prep time:

35 min

Cooking time:

15 min

Serves:

4

TIP

To save time on prep, buy ready-made dressing instead of making your own.

MINI MEATBALLS WITH BROWN RICE SALAD

Recipe
03

Prep time:

20 min

Cooking time:

25 min

Serves:

4

TIP

As an alternative to the brown rice, use wholewheat pasta, couscous or quinoa.

What you'll need

FOR THE MEATBALLS

- 500 g beef mince
- ½ green pepper, finely chopped
- 1 onion, finely chopped
- 2 garlic cloves, finely chopped
- 2 tsp dried mixed herbs
- 1 tsp paprika
- 3 tbsp tomato paste
- 1 egg
- ⅓ cup oats
- 2 tbsp olive oil

FOR THE BROWN RICE SALAD

- 2 cups cooked brown rice
- ½ cup olive oil
- 4 tbsp balsamic vinegar
- 4 tsp lemon juice
- 2 tsp mustard
- ½ red onion, finely chopped
- ½ cucumber, chopped
- 4 radishes, thinly sliced
- 2 feta wheels

TO SERVE

- 180 g tub red-pepper hummus
- ½ cup pumpkin seeds, toasted

Steps to success

FOR THE MEATBALLS

- 1** Preheat the oven to 180°C. Mix the mince, pepper, onion, garlic and spices in a bowl.
- 2** Add the tomato paste, egg and oats and mix until it comes together. Season generously.
- 3** Shape the mixture into small balls, arrange on a baking tray and drizzle with olive oil.
- 4** Bake for 20–25 minutes, turning occasionally until cooked through.

FOR THE BROWN RICE SALAD

- 5** Place the rice in a large bowl, and whisk the wet ingredients together and season.
- 6** Stir the dressing through the rice.
- 7** Add the remaining ingredients and toss.

FOR A TAKEAWAY LUNCH

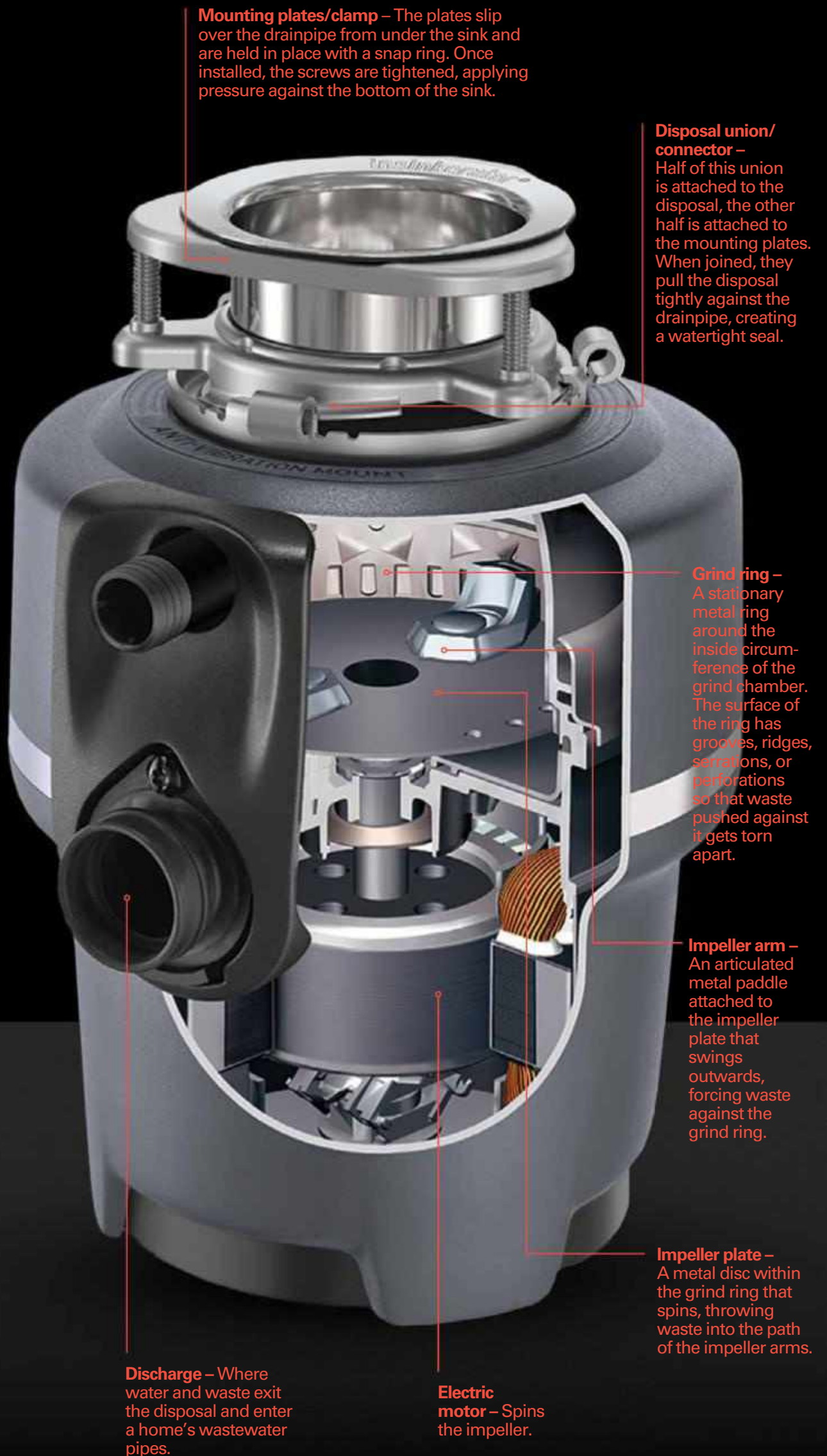
- 8** Place the brown rice salad in a lunch box with a few meatballs on top. Put the hummus and pumpkin seeds in separate containers. **PM**

POP MECH'S guide to garbage disposals

THE TERM 'GARBAGE disposal' is in fact a bit of a misnomer. They aren't too common in South Africa, but if you've ever had one, you already know that you can't run random trash through it. It's really designed to grind up and dispose of food waste – leftovers that would be otherwise compostable, with the exception of bones. What makes a good disposal, which features should you look for, and how much should you spend? We've put together this explainer to share what we've learnt through our years of testing disposals to help answer these questions about this sometimes overlooked (but extremely handy) appliance.

A LOOK AT THE GUTS

While there are some variations from manufacturer to manufacturer, these are the basic parts and functions of a garbage disposal unit.



Mounting plates/clamp – The plates slip over the drainpipe from under the sink and are held in place with a snap ring. Once installed, the screws are tightened, applying pressure against the bottom of the sink.

Disposal union/connector – Half of this union is attached to the disposal, the other half is attached to the mounting plates. When joined, they pull the disposal tightly against the drainpipe, creating a watertight seal.

Grind ring – A stationary metal ring around the inside circumference of the grind chamber. The surface of the ring has grooves, ridges, serrations, or perforations so that waste pushed against it gets torn apart.

Impeller arm – An articulated metal paddle attached to the impeller plate that swings outwards, forcing waste against the grind ring.

Impeller plate – A metal disc within the grind ring that spins, throwing waste into the path of the impeller arms.

Discharge – Where water and waste exit the disposal and enter a home's wastewater pipes.

Electric motor – Spins the impeller.

THINGS TO CONSIDER WHEN BUYING

Continuous vs batch feed ▶ The former kind of disposal can take food waste passing through the drain and into the grinding chamber continuously, as the name says. Their operation is controlled solely by a remote switch. Batch-feed disposals will operate only with the drain cover in place. You can't put additional waste in unless the drain cover is removed and the disposal is off. While these may be less convenient and slower, the safety advantages of not being able to reach in while the disposal is running are clear.

Power ▶ Disposals are typically available with 185–750 W ($\frac{1}{4}$ -, $\frac{1}{2}$ -, $\frac{3}{4}$ -, and 1-HP) motors. More power generally indicates more robust grinding. Some manufacturers suggest power that corresponds to the number of people in the family and how much action the disposal will see. Smaller families (one to three people) and infrequent use would need something in the lower range, and larger families that use a disposal more often should opt for something on the higher end. Regardless of family size, the

number is also worth keeping in mind because disposals with more power have stronger components and may last longer.

Noise ▶ Grinding noise and vibration are some of the biggest concerns people have with garbage disposals. The appliances usually connect to the sink with a heavy rubber gasket or union that helps reduce vibration. More expensive units may be enclosed in a cover filled with sound-deadening insulation.

Electrical connections ▶ New disposals may come pre-wired with a power cord and a plug, with a cord and a plug you have to wire, or with no cord at all – the latter two being options to replace an older, hardwired unit. The remote switch that controls the disposal will need to be within reach of the sink. If you're installing a disposal where there wasn't one previously, you'll need to run power to both that switch and an outlet installed in the sink cabinet for the disposal's plug. **PM**



PHOTOGRAPHY: INSINKERATOR (CUTAWAY), LAKOTA GAMBILL

GET RID OF THAT STINK IN THE SINK

All kinds of things can pass through a typical disposal, from scraps fresh from the dinner table to unidentifiable leftovers that have escaped detection for weeks – months? – in the back of the fridge. It should be no surprise, then,

if you occasionally smell a persistent, unpleasant odour emanating from the sink drain. There are numerous solutions for this problem, but here's the one we've found to be most reliable: equal parts baking soda and distilled vinegar.

With the water and the disposal off, take about half a cup of baking soda and dump it into the disposal. Then pour about a half a cup of vinegar in on top of it. Let the mixture sit for about five minutes, turn the

water on, then turn the disposal on for a few seconds, and turn everything off as you normally would.

Why it works: When vinegar (which contains acetic acid) and baking soda (also known as sodium bicarbonate) are combined, a reaction starts, creating carbonic acid – this reaction is what does the cleaning. Once the reaction stops, it leaves behind water containing sodium acetate, a type of salt.



For yard work and more, chainsaws are better when they're powered by batteries

FOR DECADES, PETROL-ENGINE POWER equipment was the only choice for garden work, followed by corded power tools at a distant second. Anything powered by a battery was either ineffective or an expensive novelty. The few successful versions of battery-powered outdoor equipment were limited to low-power applications, like grass shears. Of course, for every rule there's an exception: We reported on the highly effective GE Elec-Trak battery-powered tractor and Black & Decker's somewhat effective battery mowers in our April 1970 issue.

In many respects, petrol-engine equipment still rules the outdoors in terms of power and cost-effectiveness – at least for people with serious work to do. But a revolution in outdoor power is occurring. For many people doing garden work, cordless power tools are now the default choice. This has stood the status quo on its head.

Since chainsaws require so much power, given the strain that churning through wood puts on them, they were the last outdoor power tool that seemed practical to power with a battery. But even battery-powered chainsaws are now the better choice for garden maintenance. It took a lot of engineering to solve the hurdles to efficient battery power, which were 1) getting enough of a charge in the battery without making the tool much heavier,

and 2) eking enough power out of an electric motor. The pieces of design responsible for addressing those, respectively, and the success of cordless tools: lithium-ion batteries and brushless motors.

I remember the first time I witnessed the power that lithium-ion could deliver. I was attending the Milwaukee Electric Tool demonstration at the 2005 Builders Show in Orlando, Florida. Walking into the conference room, I couldn't believe what I was seeing. People were running a massive ship auger drill bit, lengthwise, into a gigantic pressure-treated beam without a shadow of hesitancy or stalling – incredibly impressive.

The key was that it was powered by a massive 28 V lithium-ion battery, of the same chemistry used in consumer laptops. We learned that the technology offered lightweight and a high-energy density, making it ideal for power-tool applications, so long as you could harness all that current without overheating and melting the battery or other circuits. Milwaukee solved that problem with a computer chip that allowed the battery, switch, and motor to communicate, metering current flow.

Other power-tool manufacturers quickly got on board, and then Makita took the next step when it offered the industry's first brushless-motor cordless tool in 2010 with its TD133D impact driver.

Brushless motors achieve their efficiency by eliminating the energy-robbing carbon brushes that transfer current from the stationary part of the motor to the spinning output shaft. Instead, they use small circuit boards and sensors to transfer current. The motor circuit sensors and computer chip also provide extremely precise speed control while monitoring electrical input. Since they are so electrically efficient, they are ideal for pairing with a battery.

The combination of the lithium-ion battery's lightweight charge density and the brushless motor's high torque-to-weight ratio means that cordless tool technology can challenge the petrol engine in many applications, even the most demanding of all: cutting wood.

Outdoor power equipment manufacturer Stihl was the first to cross the threshold. In 2010, it produced its 36 V chainsaw, the MSA 120-CB. That tool was the game changer, a mid-duty saw perfectly capable of quickly and quietly producing small batches of firewood or doing outdoor maintenance with ease. But what followed was even better. The MSA 220-CB has a bigger motor and more

INVEST IN A PAIR OF LIMB- SAVING CHAINSAW CHAPS

On the fence about whether you should buy a pair of chainsaw chaps? Consider that the most common wound chainsaws inflict is to the left leg (particularly the knee, below the knee, or the foot) and requires about 110 stitches to close. Chaps protect against such a gruesome injury with a unique mechanism. Once the saw pierces the outer fabric, the chain tears into the

synthetic fibres below, which so thoroughly entangle the chain and its sprocket that both are stopped dead in their tracks. Sure, the chaps are ruined, but your leg isn't. I've never cut into mine, but one time I came so close that the chain splattered a stripe of oil on the chaps as it flew by. When I look at that greasy stripe, I think the money I paid for those chaps was among the best I've spent.

torque and is an even faster cutter that comes much closer to petrol-engine performance.

But these cordless saws are more expensive than their equivalent petrol-engine power tool. And this is because their motor, battery, circuitry, and charger are more expensive to produce than a combustion engine. Also, their thin-kerf chain is specially engineered to produce less drag and to be as efficient as possible; it's more expensive to grind than the typical saw chain. And cordless saws are best suited to cutting sessions that run for a couple of hours. Our testing indicates that the sweet spot for these saws is in wood less than 30 cm in diameter and the saw itself equipped with a bar 35.5 cm long or shorter.

With those disclaimers out of the way, a cordless saw can do several things remarkably well. It will take care of most downed limbs, or even a small tree that has come down in a storm (say with a trunk 20–25 cm in diameter and six-to-nine metres tall). It will do work cleaning up riding and hiking trails and selective pruning in a small orchard or on trees out in your garden. Having an extra battery will help you do a pleasant and quiet morning's worth of firewood cutting, enough to fill a bakkie or small trailer.

So where does this leave you? If you cut several cords of firewood a year, stick with a petrol-engine saw. If you do maintenance woodcutting, garden clean-up, produce a little firewood for the stove, fireplace, or firepit, go cordless.



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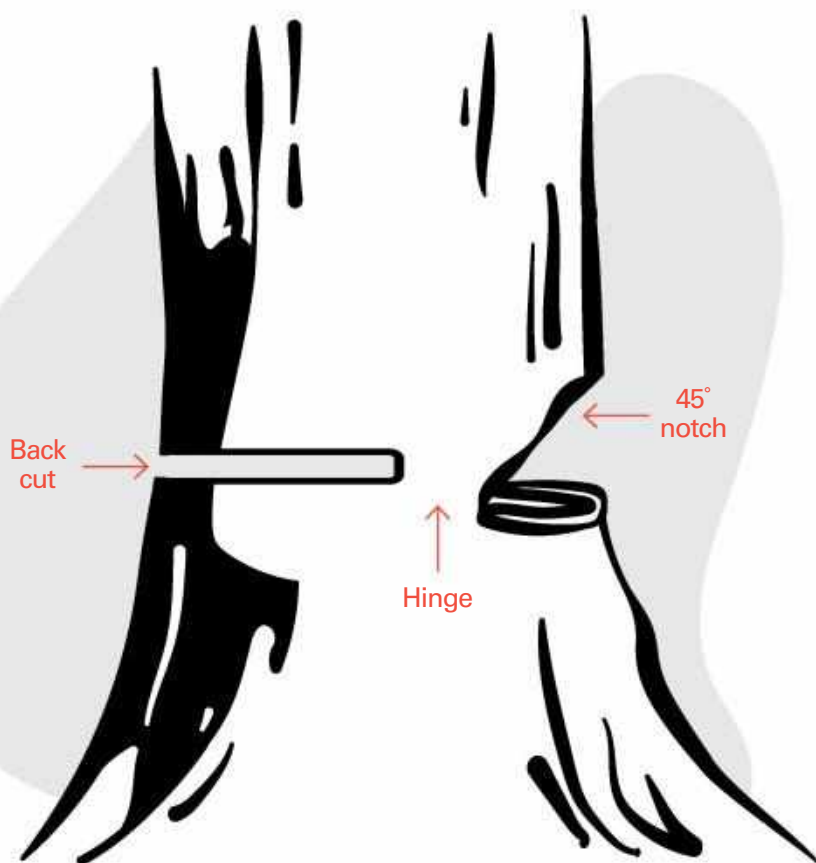
THE OPEN-FACE DIRECTIONAL FELLING NOTCH

When people first stopped felling trees with axes and turned to chainsaws, they kept using the same technique: basically, making a 45° notch on the side of the tree towards which they wanted it to fall, then making a level cut from the back of the tree. Called the back cut, this is 2.5–5 cm up from the point of the felling notch (see diagram). The wood that's left between the 45° felling notch and where the back cut ends is called the hinge, and it helps guide the tree safely to the earth.

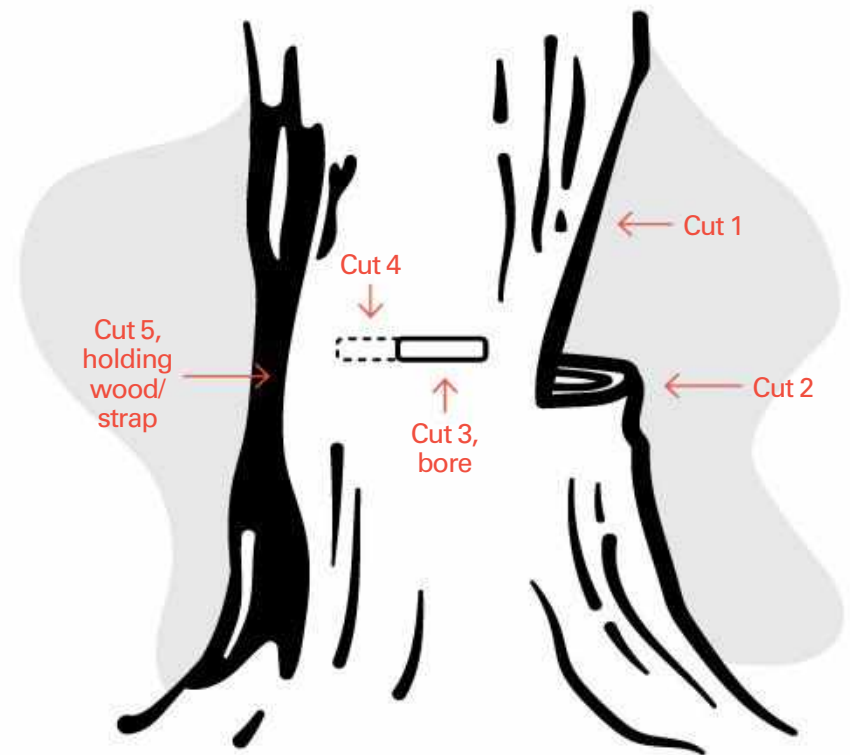
But this method can still be dangerous, with the potential for the butt of the tree (the part closest to the ground) to launch up backwards, injuring or even killing an unwary tree feller.

So a few decades ago, Swedish logger and chainsaw instructor Soren Eriksson pioneered and perfected a method that takes advantage of a chainsaw's unique ability. It's called the open-face directional felling notch. It's more complex, but it's also safer, and it gains that safety from giving the wood cutter far more control of how and when the tree falls.

TRADITIONAL 45° FELLING NOTCH



OPEN-FACE DIRECTIONAL FELLING NOTCH, 70°



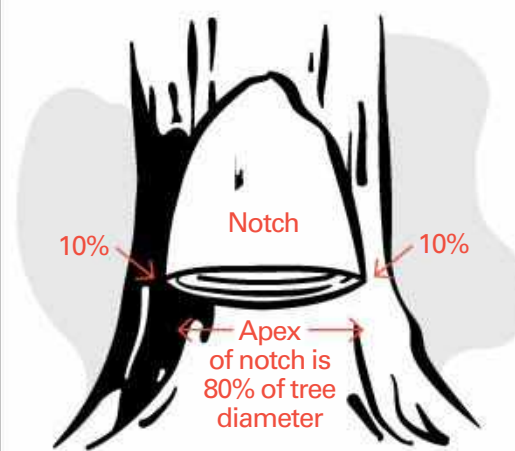
1. The initial step is a felling notch with an extremely shallow angle. The first downward sloping cut is about 70°.

2. Next comes the horizontal cut, which drops out the wedge of wood. This produces a felling notch that removes more sapwood from the tree than the traditional 45° method and makes it more likely that the falling tree will snap its hinge at a safe point in its fall.

4. The wood cutter then moves the chainsaw (and its bore cut) towards the back of the tree and stops, leaving several centimetres of wood on the back. This uncut wood is called 'the strap' or 'holding wood'. As its name implies, it holds the tree in position and affords the feller a chance to ensure everything is in order before the fall.

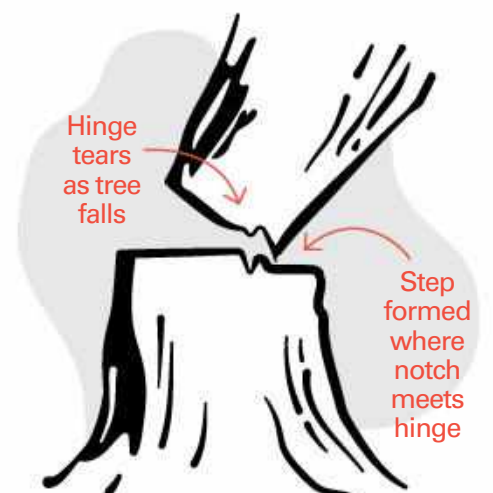
Withdrawing the chainsaw, the operator pounds wedges into the bore cut, one from each side of the tree. These apply pressure upward and in the direction the tree will fall.

ALTERNATE VIEW



3. The key difference is the bore cut, which goes in from one side of the tree's trunk and right out the other. Note two things about this bore cut. It's level with the ground and about 2.5–5 cm above the vertex (the point where cuts one and two meet) of the felling notch. And most importantly, it leaves the hinge wood intact. The hinge produced by the felling notch should have a width equal to 80 per cent of the tree's diameter when measured at chest height.

5. Finally, they cut the strap/holding wood. As the saw works in, the tree will begin to lean and makes the distinctive creaking sound that signals gravity is taking over. Stopping the saw and moving back quickly at a 45° angle, the feller lets the tree fall in the direction of the notch as its hinge snaps.



Testing the top battery saws

WHEN TESTING SAWS, WE LOOK FOR HOW WELL AND LONG they cut while mitigating vibration and stalling, taking into account any hesitancy and lack of trigger response. To gauge that performance and expose any of those potential weaknesses, we charged the saws' batteries and ran them through a truckload of hardwood logs. This involved cutting as many test discs – or 'cookies' – as we could on one charge. Also, if the saw had a low threshold for thermal cut-off to protect the battery and circuitry, that showed up because rapid repeat cuts through hardwood generate a lot of heat in the tool.

TOOL-FREE CHAIN TIGHTENING

DEWALT DCCS670X1

★★★★☆

Volts: 60 | Number of discs cut: 43

DeWalt fans will not be disappointed with this saw. It's a powerful cutter, and the cookie count doesn't convey how enthusiastically it goes

about its work, thanks to the great big motor and an equally massive battery. It's an easy saw to use, with excellent battery access and visibility. The tool-free chain tightening further improves our opinion of it. Our only dislike is the thumb-activated safety switch, which is too stiff.



CUTS THE LONGEST

HUSQVARNA 540i XP

★★★★★

Volts: 40 | Number of discs cut: 124

Take one look at the number of discs this saw produced. It indicates a powerful saw that has a high tolerance for hard work. What that number doesn't tell you is how quickly and

easily it got to that number – no stalling, vibration, or tiring us out. The 540i XP is equipped with a massive 9.36 Ah battery, and that certainly helped boost its number. On top of that battery girth, it's got a great motor and drivetrain and is formidable enough to compete with the Stihl. The 540i XP is ideal for cutting firewood, storm clean-up, and landscaping maintenance. **PM**



SLIM AND POWERFUL

STIHL MSA 220 C-B

★★★★★

Volts: 36 | Number of discs cut: 96

The Stihl is power tool excellence and one of the best we've ever used. To put that into perspective, consider that in the more than 30 collective years our test editors have been on this job, they've used saws designed to cut rock, concrete, steel, construction timber, hardwood timber, drywall, combined materials, plastics, and trees. That's a lot of cutting, sweat, and dirt. In terms of its power, productivity, safety, handling, quietness, and convenience, the Stihl is as good as any we have ever used. It's slim, powerful, and pivots nicely through the cut without stalling or vibrating.



STIHL

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Our tried-and-true sanding method

A POWER SANDER IS A SIMPLE TOOL THAT CAN smooth a piece of furniture you've proudly built, strip rust, deburr a sharp metal edge, or remove weathered paint. But the appliance isn't harmless, either. Use it incorrectly and the surface is liable to be worse than when you started. Fortunately, with a little direction and practice, you should have no problem using your sander properly. On these pages, we'll show you the fundamentals on how to get a glass-smooth surface, explain the nuances in levels of grit, and offer thoughts on the best power sanders we've tested that are worth your money.

Step by step Before you can begin, put on a dust mask, preferably one with a foam seal where it meets your face. And wear a covering like a work apron or an old shirt, something you don't mind getting covered in sawdust. Then follow these steps to get a clean, even surface with your sander.

1 / Select an appropriate disc. Choose the coarsest grit (or lowest number) that's suitable to begin the job. (Consult our grit guide on the next page for guidance if you're unsure.) If you start with too coarse a disc, it's liable to scratch the surface or remove too much. When in doubt, take a quick test run on scrap wood.

2 / Attach the disc to the sander. Both are hook-and-loop, so just align the holes on the disc with the holes in the sander's base and push the disc on. Once you've done that, plug in a vacuum hose to the sander's outlet or ensure the bag is empty. Most sanders can easily hook up to a vacuum if you prefer, either directly or with a separate adapter.

3 / Start the sander and bring it gently in contact with the wood. Move it slowly and steadily over the work surface, being sure to sand edge to edge without tipping the sander over those edges, which would round them off. Establish a pattern and sand that pattern in a clockwise direction and then anticlockwise. Repeat. You'll know you're done when the surface is evenly

abraded, with no unsanded corners or areas. Vacuum-clean the surface of whatever you're working on, in case any dust snuck out of the bag or vacuum hose. This is especially important, as is using the bag or a vacuum in the first place, so that the dust doesn't potentially damage what you are working on or grind down the disc faster. Then dump out the dust bag – though it's not a bad idea to save the dust in a Ziploc, as it can be handy later on to make DIY wood filler (sanding dust mixed with wood glue).

4 / Move to the next grit. Don't skip more than one grade as you move from coarse to smooth. For example, you can go from 100-grit to 150 (skipping 120), but don't go from 100 to 220. Use the same method as above in terms of movement and alternating clockwise and anticlockwise. When finished, vacuum the surface again, this time adding another step: Wipe it clean with a tack cloth (a sticky piece of fabric, sold in the paint aisle, used to pick up dust). Again, be sure to empty the dust bag.

5 / Proceed to final sanding with your finest grit, working over the surface as you did before. As a final quality-control check, vacuum and wipe down the workpiece and take a work light and shine it at various angles. This can reveal any swirl marks or under-sanded areas. At this point, you should have a smooth, evenly sanded surface.

6 / Clean up. The best thing you can do for the sander is to blow the dust out of it with compressed air or use a workshop vacuum and work over its exterior, especially the air vents. Vacuum the workbench and the floor. Finally, vacuum yourself. Take off your apron or shirt or peel off your overalls and leave them in the work area. Wipe your feet before you leave the workshop or, better still, take your shoes off and leave them there. In short, do everything you can to avoid transferring sanding dust into the house – it's unhealthy to breathe in, and you also run the risk of tracking in some sanding grit, which can scratch wood floors. **PM**

PHOTOGRAPHY: TREVOR RAAB



GRADES OF GRIT

Sanding grit is sized from coarse to fine, with lower numbers being more coarse than higher numbers. To illustrate grit coarseness and how it affects the surface you're working on, we applied two coats of semigloss blue enamel to a board, marked off 15 cm sections, and applied different grits (60, 80, 100, 120, 150, 220, and 320) to each from top to bottom, leaving the sander in contact for 15 seconds at each grit.



60: Great for paint stripping and removing marks left by planers or saws, but leaves a rough surface.

80: Same attributes as 60 grit, just doesn't work as quickly. Good for getting a smoother surface after you've finished with 60 grit.

100: Not an effective stripper but will nicely smooth out scratches from the previous, rougher grits.

120: Levels out brush marks and surface imperfections in paint. You can start with 120-grit on softwood and hardwood when the surface is already reasonably smooth and there are no machine marks to remove.

150: Use this for removing gloss from painted surfaces. It's gentler than 120, so it's particularly effective if you have to sand a surface around a carved area that you don't want to disturb or potentially mar.

220: A fine grit that's good for the final sanding of bare wood; also good at removing paint gloss.

320: An extremely fine grit, excellent for the last sanding for bare wood that will be finished with something like low-sheen oil finishes.



BUILD AN HEIRLOOM CUTLERY TRAY, FEATURING DOVETAILED JOINTS

In part six of our series on woodworking joints, we put into practice the dovetail joinery skills gained in the previous issue, and we learn how to make a cutlery tray.

/ BY TOBIAS LOCHNER; TECHNICAL: MATTHEUS ODENDAAL /

A **CUTLERY TRAY** is an essential braai-side accessory. The period style heirloom cutlery tray we chose for this project, made from classic black walnut, incorporates through-dovetail joinery. If you're late to the woodworking joint series, get your hands on the May/June issue, to learn the steps to making this traditional joint. The heirloom cutlery tray is a small yet versatile project that will challenge you and help to grow your skill set.

WHAT YOU'LL NEED

CUTTING LIST

Part	Quantity	Dimensions
End panels	2	200 mm × 110 mm × 12 mm
Side panels	2	296 mm × 100 mm × 12 mm
Centre panel	1	280 mm × 134 mm × 12 mm
Base panel	1	306 mm × 170 mm × 8 mm

CONSUMABLES

- » Template material (white hardboard or stiff artist's board)
- » Thin double-sided adhesive tape
- » 3M blue painter's tape
- » Adhesive
- » Finish of your choice

TOOL LIST

- » Marking knife
- » Blue painter's tape
- » 0.5 mm mechanical pencil
- » Black ballpoint pen
- » Mallet
- » Fret or coping saw
- » Fine tenon saw or Japanese dozuki saw
- » Bench chisels
- » Smoothing plane
- » Apron plane
- » Bevel gauge or dovetail guide
- » Try square
- » Combination square
- » Pair of dividers
- » Marking gauge
- » Rasps
- » Set of French curves
- » Small files
- » Low-angle spokeshave
- » Protractor
- » Router plane



WOOD FOR THE PROJECT

The folks at Rare Woods South Africa selected a beautiful black walnut board for our build. Thank you to owners Seamus and Brendan Harcourt-Wood for their ongoing sponsorship of all our wood-working projects.

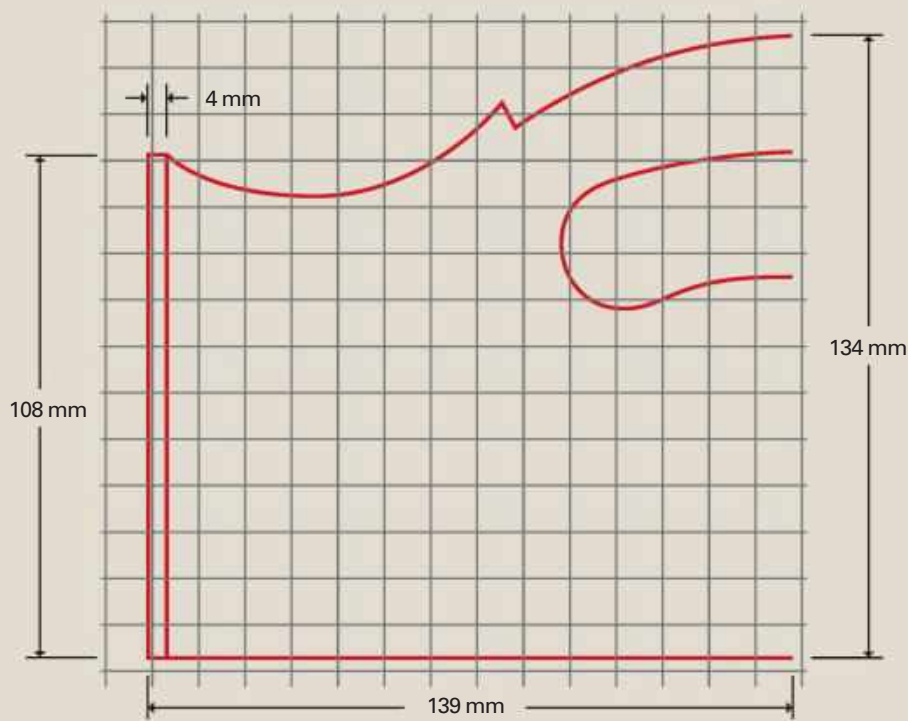
BLACK WALNUT (JUGLANS NIGRA)

Along with mahogany, maple and cherry, black walnut is a truly versatile cabinetmaking species, and a firm favourite of ours. Prized for its typically deep chocolate colour often highlighted by red or purple streaks and shades, it has an excellent strength-to-weight ratio, and is considered to have outstanding dimensional stability after drying.

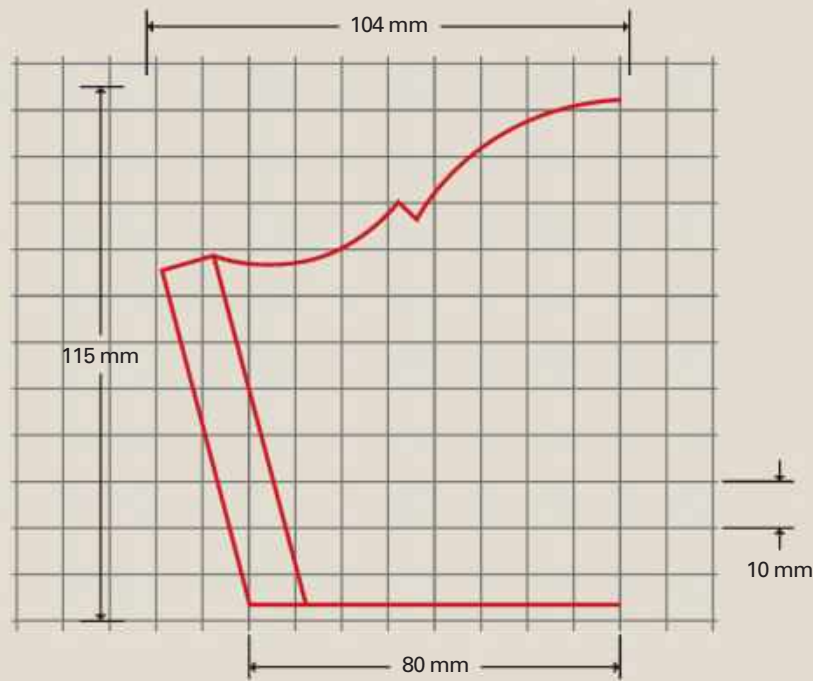
It carves and cuts beautifully, allows for crisp joints, is easy to work and takes adhesives and finishes very well. Black walnut has, over hundreds of years, been coveted as one of the classic furniture-making woods.



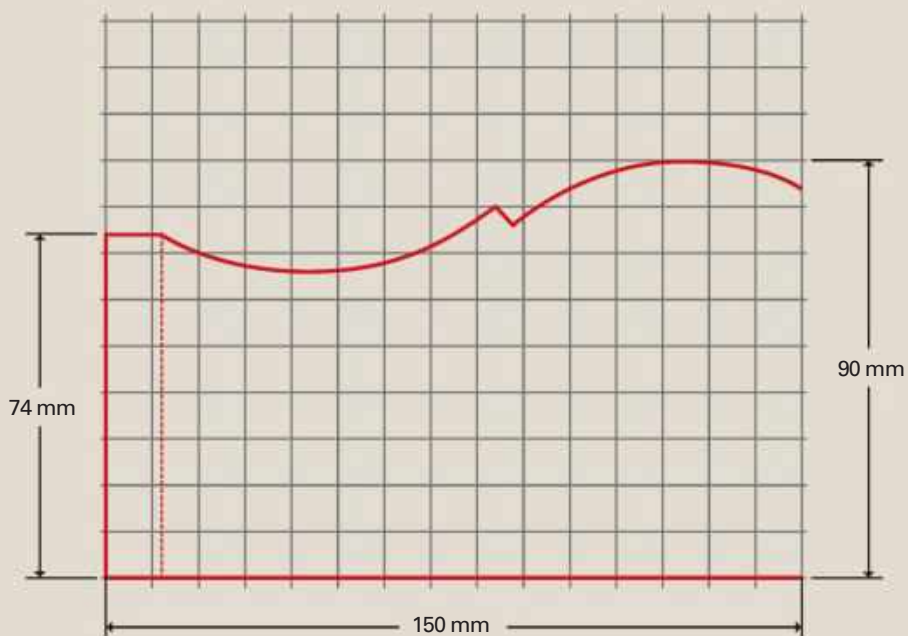
CENTRE PANEL PROFILE



END PANEL PROFILE



SIDE PANEL PROFILE



PROCESS

STEP 1: Four-square and plane all of the boards to size and thickness. Cross-check each board for squareness, and choose and clearly mark the show faces of each board. Set the boards off to the side.



STEP 2: To make the templates for the period profiles, take your template material and create two pieces for each profile, halved on a centre line. We used offcuts of white hardboard. Stick them together back-to-back with thin double-sided adhesive tape. This allows you to draw and cut out both halves of your templates by only marking half of the profile and cutting once. Cut out the template profiles with a coping saw. Once this is done and the profiles are cleaned up and sanded smooth, separate the two halves, fold them out along their baselines and tape them together at the centre to form the completed profile. Repeat this process for all three templates.

The profiles we chose are relatively simple and were in common use in the 18th and 19th centuries.



STEP 3: Starting with the tail boards (the end pieces), take the pair and tape them together with double-sided adhesive tape as you did when creating the templates. Make sure the show faces are on the outside and the inner faces are taped together. Also ensure the edges of the two boards are parallel and flush to each other all round. Clearly mark the centre line on both boards. From the centre line, lay out the rest of the boards. The ends of these boards taper at 15° outwards from the vertical.

Once you have the rectilinear layout complete, place the template on to the board packet, lining up on the baseline and centre line. Now draw the template profile on to your workpiece. The end boards remain taped together for cutting and shaping the profile, as well as for laying out and gang-cutting the tails of the joints. Cut out the profile fractionally proud of the template lines with your coping saw, and clean up with files, chisels, card scrapers and a little sandpaper where necessary.



↓ WOODWORKING

STEP 4: Repeat step 3 with the centre board and the side boards using the respective templates. The side boards should also be taped together with the show faces on the outsides of the packet. Cut out and clean up the centre board and side board profiles as you did with the end boards. Set them aside.



STEP 5: Lay out your dovetail 'tails' on the end boards. We chose to use a classic layout, putting two tails on each joint with a narrow pin between them. The tails are gang-cut, with the two end boards still taped together. We used a 1:8 ratio for the angle of the dovetails. (For directions on how to lay out the joint using the blue painter's tape method, refer to the article on creating dovetail joints in the May/June 2022 issue.) Lay out and scribe the joints. Cut the tail walls using your dozuki or tenon saw. As always, be careful not to overshoot your baselines.

Remove the bulk of the waste between the tails with a coping or fret saw, and the waste areas above and below the tails with a tenon saw. Once this is complete, pare to the baselines with a very sharp chisel. Check with a small try square as you go to make sure the base line surfaces are at exactly 90° to the faces of the components throughout their surface areas.

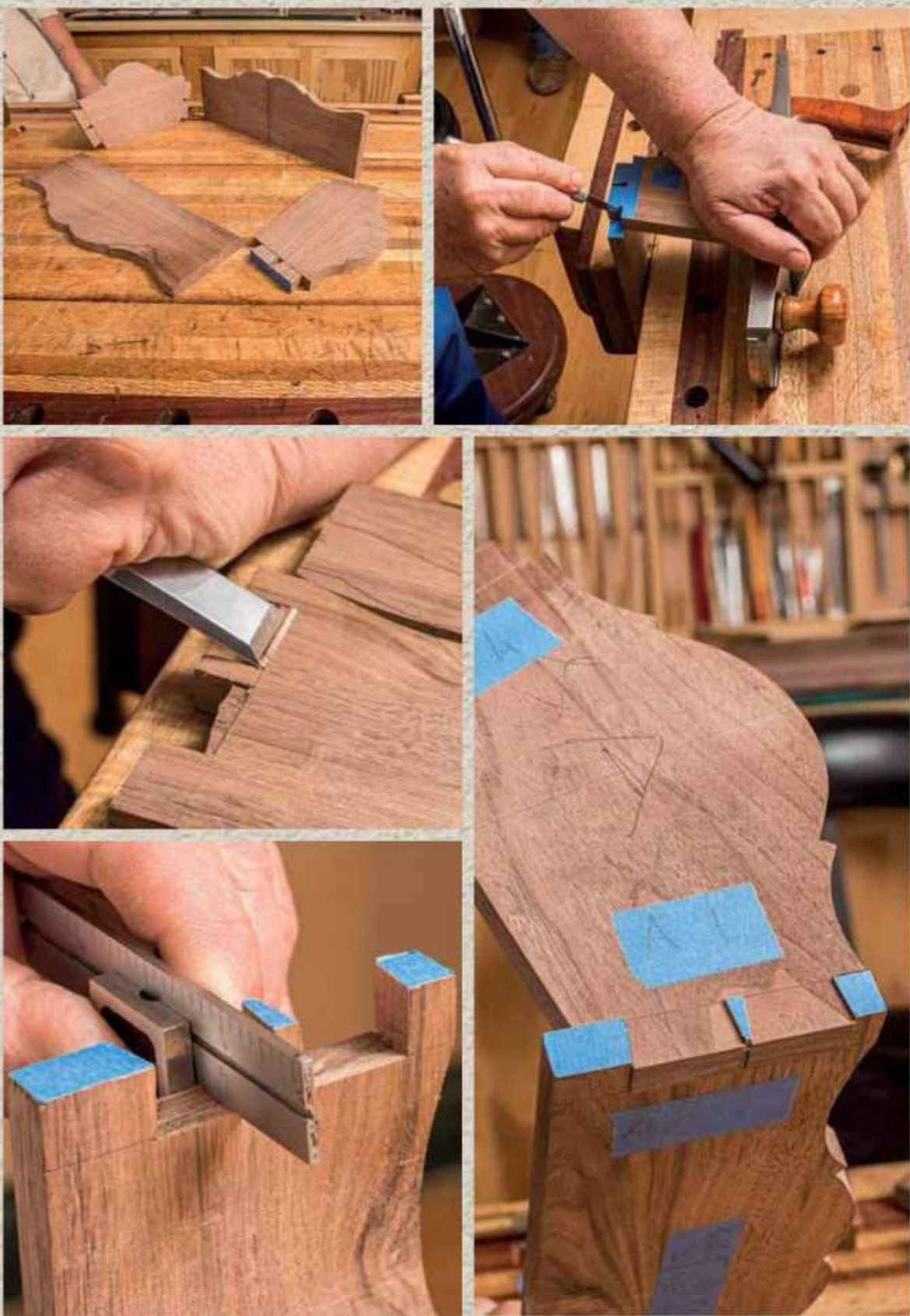
Separate the pair of end boards and do a final check and clean-up of all the joint surfaces, making sure the baselines are at 90° to the faces of the boards.



STEP 6: Separate the two tail boards from each other and remove any residue of the double-sided tape adhesive. Take a pin board (side panel), lay blue painter's tape on the front, rear and end of the pin area and clamp it in the vice. Use a hand plane to set the edge of the pin board exactly parallel and above the bench surface, as per the images. Move the hand plane backwards and rest the tail board inner face on both the pin board edge and the hand plane. Position the tailboard in the correct position and scribe your pins using your tail board as the joint template.

Set the tail board aside. With the pin board still in the vice, scribe the rest of the pin board baseline. Remove the blue tape from the areas of the pins that are to be cut out.

Saw out the pin walls down to the baseline, making sure to cut on the waste sides of the blue tape, and then remove the waste between the pins with your coping or fret saw. Carefully pare the sockets down to the baseline with a sharp chisel, always checking with a small try square as you go. Now you can test fit your first set of dovetails. Do not force the components together. Light tapping with a mallet should be all you require. Proceed to complete the other three joints as you did the first.



STEP 7: With all of the dovetail joints successfully completed, disassemble the components. Take the two end boards and clamp them in the vice with their inner faces together, then mark out the centre line and shoulder lines for the centre board dados on both boards.

Separate the two end boards and complete the layout of the dados with your marking knife. Cut the walls of the dados with a tenon saw or dozuki and remove the waste with a router plane.

On the centre board, scribe the shoulders on both ends and remove the waste. At this stage, the sliding tenons should still be longer than required. These will only be trimmed to fit once the entire assembly is finally glued and cured.

↓ WOODWORKING

STEP 8: Glue up all four dovetail joints, clamp, check for squareness and set aside to cure. It's wise to pre-finish the interior faces as it'll be more difficult to do so when the assembly is glued up. The same applies to your centre board.



STEP 9: Take your centre board and test it in the dados. Trim the tenons to an exact fit and if necessary, the shoulders as well. Once the centre board fits properly, glue it in position.



STEP 10: With the assembly fully cured, turn it upside down and clamp the handle area of the centre board in the vice. Plane the bottom of the entire assembly flush and true. Check as you go by testing the base on a flat surface.

**WHICHEVER
PRODUCT YOU
CHOOSE, IT'S
ALWAYS GOOD
PRACTICE TO
PRE-FINISH
COMPONENTS
WHEREVER
POSSIBLE.**



STEP 11: For the base of your tray, you'll require a 6–8 mm-thick finely planed board slightly larger than the base of the tray. Place your tray on the board and lay out the dimensions of the base board allowing for a 6 mm overhang all round. Cut and plane the base board square and round over the edges with a hand plane or with a tiny round-over bit in your router.

Once this board is finished, place the tray assembly on to it and set all four corners to an equal overhang all round. Temporarily tape the base board in place with two small pieces of thin double-sided tape, turn the tray over and clamp the handle area of the centre board in the vice.

Mark out all the screw-hole positions on the base board. With an awl, make a tiny hole for each screw position. Mark one corner of the tray and the corresponding corner of the base board to enable you to reassemble the components correctly. Drill all of the screw holes and then counter sink them so the screw heads will be about 0.5 mm below the surface.



STEP 12: Apply finish to the base board. When dry, attach the base board to the tray assembly. Osmo Wood Wax Finish Clear Extra Thin 1101 was applied as the finish for our project. Whichever product you choose, it's always good practice to pre-finish components wherever possible. We pre-finished the inner surfaces of our components. As a final step, we added two thin coats of paste wax to the exterior of the tray, and buffed it to a satin sheen.



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Rare Woods South Africa is *the* place to seek out the best-quality wood species for your woodworking projects. Simply log on to the website, rarewoods.co.za, to view their entire range. Alternatively, call the Cape Town office on 021 535 2004, or the Knysna team on 044 382 6575. **PM**

IN THE NEXT ISSUE:

We begin the final project build of our joinery series, a piece that will include all of the joints featured in our previous articles. You can expect to see lap joints, mortise and tenons, and dovetails.

↓ HOW TO BE GOOD AT WHAT YOU DO

/ Carl Elsener, Jr, 63, CEO of Victorinox, Schwyz, Switzerland /

Watch the complete MADE HERE
video series on YouTube:
youtube.com/popmechshow



MY GREAT-GRAND-father founded Victorinox in 1884. He chose his mother's name, Victoria, for the company, adding 'inox', the stainless steel from which our knives are made, after its invention. In 1897, we patented the little red knife, the *Schweizer Offiziers- und Sportmesser*, which American soldiers shortened to 'Swiss Army Knife'.

Victorinox produces 45 000 Swiss Army Knives per day, with 100 per cent recycled steel. The approximately 500 tons of grinding sludge that's generated during manufacturing is recycled at the steel plant; the water in the sludge is absorbed; and the steel particles are pressed into briquettes.

It's fantastic to hear people share their adventures with their little red knife, like Canadian astronaut Chris Hadfield. In his book, *An Astronaut's Guide to Life on Earth*, he describes breaking into the Mir space station. Russian astronauts had sealed the docking module hatch shut with tight straps – but Hadfield had a Swiss Army Knife and simply cut his way in. He wrote, 'Never leave the planet without one.' **PM**



HOW IT'S DONE

“ The knife blades are stamped from a 3 mm steel strip, then placed in a container with abrasive ceramic stones, which round and refine the blades' edges. After embossing Victorinox's seal of authenticity on the tang, we place the blades in an oven heated to 1 050°C. This hardens the material and strengthens the structure of the steel. Finally, we grind the blade for its final sharpening. – Urs Wyss, senior product marketing manager

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FIGURES

- » 90 kW battery
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 - » 294 kW; 696 Nm
 - » 8-year/160 000 km battery warranty
- Priced from**
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WE'RE AT A significant point in the evolution of the automobile.

We're in the middle of the transition phase, moving from the dominion of the internal combustion engine over to battery – or electric – power. In many ways, it's uncomfortable; those of us who've only really ever known internal combustion engines are having to come to terms with new technology. And this technology is changing quickly, ever advancing and improving. In ten years' time, electric cars will be very different to the ones we're driving now. Motoring is changing.

Jaguar is a brand that's made notable progress in this realm, with their all-electric I-Pace. My week spent with this vehicle was eye-opening, and not only because of the test-car's highly conspicuous iridescent-green promotional body wrap that turned heads wherever I went.

I can say that 'range anxiety' is a real thing when driving electric cars. With the I-Pace, though, it's mitigated by the fact that it can do around 400 km on a full charge. The manufacturer claims a battery range 'of up to 470 km', but in real-world driving scenarios it'll be hard to achieve that.

The driving experience is thrilling – acceleration is mind-bogglingly quick; we're talking 0–100 km/h in around 4.5

seconds. But keep in mind that aggressive driving has a significant effect on battery range. Steering and handling are precise, allowing you to handle the two-ton-plus vehicle nimbly and comfortably. Naturally, the car is whisper quiet, so much so in fact that Jaguar added what I can only describe as a UFO-like tone when reversing, likely to inform pedestrians of your presence. Silent and swift, the I-Pace launches off the mark when you drop the accelerator, forcing you back into your seat (my passenger may or may not have had their sunglasses fly backwards off the top of their head...).

Notwithstanding the crazy body wrap, this is a handsome car in anyone's language. Its

bold, wide stance on 20-inch wheels lays claim to the road, and its raked bonnet and windscreen profile implies little to no aerodynamic drag. It's mid-sized in the SUV sector, and certainly not overly spacious inside, but occupants enjoy a high degree of comfort, with all of the bells and whistles you'd expect from a futuristic contender such as this. Surfaces, finishes and upholstery exude premium quality, and ergonomic enhancements abound. The Meridian surround sound system delivers exemplary audio, which is particularly enjoyable in the near-silent cabin. Seats up front are electrically adjustable, of course, and you can even narrow the sides of the backrests, to better



support your torso during fast cornering. The centre console, with its bridge-like structure, has a cordless charging pad for your phone underneath; the set-up makes it awkward to physically grab your phone while driving, which is a good thing. It would also be unnecessary anyway, since Android Auto and Apple CarPlay are included.

Mounted on the console pillar, which swoops futuristically up to the dash, are several tactile buttons and toggles for the different drive modes, traction control and drive-height settings. And I must add – in many instances I still enjoy buttons over touchscreen menus... They're so much less-distracting, and in my opinion, safer.

The grille, up front, is essentially for show – it serves no role in cooling the heat-generating engine, because there isn't one. Under the bonnet is a small compartment for stowing the vehicle's charging cables. Speaking of which – plugged into a conventional domestic socket at home, charging time from empty, according to Jaguar, will take 'from 48 hours, or up to 8 km of

range from 60 minutes'. Slow – yes, very. Alternatively, an installed 7 kW AC home charger – something I presume many owners would opt for – will charge the battery overnight 'from 13 hours, or 35 km of range per 60 minutes'. In this instance, if you're plugging in each evening after work, and not driving from Joburg to Cape Town, you'll likely never have to worry about the charge status.

The I-Pace launches off the mark when you drop the accelerator, forcing you back into your seat.

If you find a 50 kW rapid DC charging station, on the other hand, you'll achieve 62 km of range from 15 minutes; a 100 kW DC rapid charging point will deliver 127 km from 15 minutes. The warranty on the battery is up to eight years, or 160 000 km – whichever comes first.

Even with the cost of electricity (when it's actually flowing through our cables) escalating, running and servicing costs of the I-Pace versus petrol or diesel vehicles will be reduced. That said, this is an extremely expensive vehicle to purchase, so buying it will be more about its zero-emissions status and future-proofing our planet than the cost savings on your daily commute. – *Mark Samuel*

Toyota

Corolla Cross 1.8 Hybrid



FIGURES

- » 1.8 L petrol, 53 kW electric motor
 - » CVT
 - » 3-year/100 000 km warranty
 - » 6 services/90 000 km service plan
 - » Petrol: 72 kW; 142 Nm
 - » Electric: 53 kW; 163 Nm
- Priced from R425 400**
toyota.co.za

GLOBALLY, IT'S ONE of the most widely known car model names. Hear the word 'Toyota' in South Africa, and you'll probably think 'Corolla' ... or Hilux, of course, or both.

I've had a love-dislike relationship with Corolla for decades. Past generations have been perfectly adequate for the motoring needs of most, but they've also been dull.

That's all been turned on its head with the introduction of the Corolla Cross, and we're particularly excited about the hybrid version that PM had on test. It integrates the efficiency and low-emissions rating of an electric powertrain with an economical 1.8-litre petrol engine, housed in an attractive crossover-SUV package. And

you never have to worry about plugging it in to charge – the closed-loop system automatically recharges the battery via regenerative braking, or by the petrol engine.

While the propulsion tech is forward-thinking, the cabin's interior, in my opinion, is relatively unsophisticated. But that's not a bad thing – I like simple. Everything you need is present, especially if you opt for a range-topping XR model, which includes adaptive cruise control, blind-spot monitoring,

lane trace assist, and a pre-collision warning system.

It took a moment for me to adjust my driving style to optimally suit the vehicle's hybrid character. Nurse the throttle gently, and the car will remain on battery power, at least initially. Floor it and the petrol engine kicks in immediately, the revs soar, and you get a mild surprise. But once I was used to it, driving around the city was efficient and zippy, and on the open road it cruised along comfortably and capably.

The closed-loop system automatically recharges the battery.

Toyota claims a combined fuel index of 4.3 L/100 km. I achieved 4.9 L/100 km, without trying too hard, which is pretty darn good.

And what does 'cross' really mean? Well, the body shape hints at enhanced capabilities – this may well be true, but the ground clearance at 161 mm is average at best. Still, the taller seating position means better visibility for passengers (think cruising the Kruger Park), and black plastic body panels will fend off scuffs. The roof rails too are neat inclusions, that accommodate racks more easily.

This is a light, responsive and well-mannered (mostly urban) crossover that will carry out its duty diligently on the daily work commute, school run, or family holiday. – *Mark Samuel*

FIGURES

- » 2.0 L bi-turbo diesel
- » 10-speed automatic
- » 4-year/130 000 km warranty
- » Service plan optional
- » 157 kW; 500 Nm

Priced from
R877 300
ford.co.za

Ford

Everest 2.0 BiT LTD 4WD



THERE IS AN entirely new Everest hitting the showrooms soon, that's true. But that's not to say we should just discard what's come before. The current Everest is not to be overlooked – it's a highly capable large SUV, especially in the form of the 2.0-litre bi-turbo diesel LTD edition.

Two litre!? I hear you say! Yes, this twin-turbo engine, mated to a 10-speed automatic transmission, delivers a hefty 500 Nm of torque, and 157 kW. During our week with the vehicle we cruised on the highways and the back-ways up to the Cape's Cederberg Mountains, and loaded with four adults and their gear, the vehicle performed exactly as I wanted it to... Open-road

cruising is easy, overtaking is effortless, and gravel roads (and worse) are swallowed up without breaking a sweat.

Included in this model is a hands-free power tailgate, parking sensors at the front and rear, as well as a reverse camera. Yes, the dimensions of the vehicle are sizeable, so these features certainly come in handy.

On the driving aid front there's adaptive cruise control, as well

as forward- and distance alert, and collision mitigation.

It might be an SUV that's often seen around shopping malls and the kids' sports field on a Saturday, but don't be fooled. With its 4x4 low-range, ground clearance of 225 mm, wading depth of 800 mm, and approach-, breakover- and departure angles of 29.5°, 21.5° and 25° respectively, the Everest will take you well beyond where the

tarred road ends, into the depths of Southern Africa if you like.

If you have a large family, you'll appreciate the third row of seats, though legroom back there is limited. So too is the boot space, with those seats set up, but fold them down and the stowage space is cavernous.

I won't lie and say I'm not frothing to get behind the wheel of Ford's new interpretation of Everest, but this version has served us loyally for years, and a track record like that counts for a lot. And, in spite of the vehicle's bulk, the fuel economy figure I achieved of 8.6 L/100 km was decent, something that's important to factor in with every vehicle purchase these days.

– *Mark Samuel* **PM**

The Everest will take you well beyond where the tarred road ends, into the depths of Southern Africa.

↓ SEND US YOUR HINT AND SCORE!

Clever tips and lifehacks

THROW IN THE DOWEL

I needed to put a concentric 19 mm 'button' on the end of a 12 mm dowel to help my daughter to make marimba sticks. And so my project began...

The jig: Using a Forstner bit in a drill press, I drilled a 19 mm hole in a 25 mm piece of board, to the depth of the button required. Then, using the same centre, I drilled all the way through the board with a smaller bit (size not critical) to enable the removal of the button once drilled. This formed a 'round rebate'.

The process: The 19 mm dowel stock was cut off square on the mitre saw, then inserted into the 19 mm hole in the board and pressed down to the stop in the round rebate. The dowel was then marked level with the board surface and withdrawn. The centre was marked on the cut end from four sides at right angles and dimpled with an awl. Then the button was cut off square on the mitre saw (on the waste side!) and placed firmly back into the round rebate in the board, dimpled side up. A 12 mm Forstner bit was then used with a depth stop, centred on the dimple, to drill a stopped recess. The button was then knocked out of the board from the underside, using a suitable short piece of dowel.

I repeated the process until the required number of concentric buttons was cut. They were then glued on to the ends of the 12 mm dowel sticks and rounded over using a disc sander. Wool was then tightly wound around the buttoned head in a special pattern to form the firm surface with which to strike the marimba.

Russell Dixon-Paver



WIN

WIN WITH MASTER LOCK

Write to us with your tip and you could win a prize from Master Lock. This issue's top contribution has won:

Master Lock Mini Safe:

Set your own combination and keep your keys safe, without having to carry them with you. Solid zinc body withstands hammering and sawing.



Master Lock Tower Combination Lock:

Set your own combination on this sturdy padlock featuring a 37 mm-wide zinc body.



Master Lock Excell Disc Padlock:

The Tough-Cut octagonal boron-carbide shackle is 50 per cent harder than normal hardened steel.



Master Lock Keyed Locking Cable:

The 1.8 m-long self-coiling braided-steel cable is designed for maximum strength. The vinyl coating prevents scratches and protects the cable.



Master Lock M1 Excell Padlock:

The boron-alloy body is 50 per cent stronger than standard padlocks, and the octagonal boron-carbide shackle provides maximum cut resistance.



Send your tips to

popularmechanics@ramsaymedia.co.za
with the subject line: 'Do It Your Way'.
Regrettably, only South African residents are eligible for the prize. Prizes not claimed within 60 days will be forfeited.

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